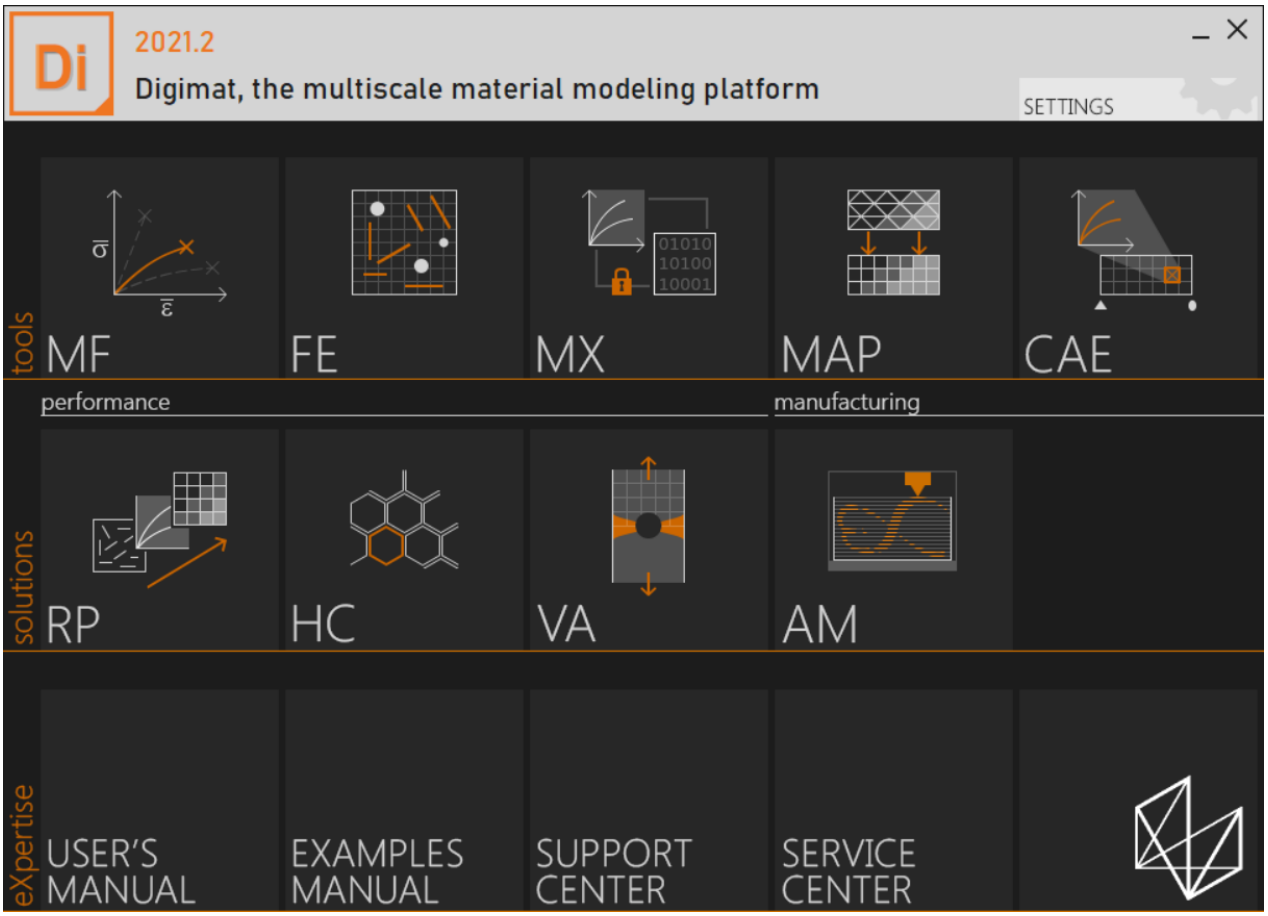
INSTALLATION

Release 2021.2 – February 2021



For material suppliers and end-users who suffer from long and costly development cycles, e-Xstream engineering offers Digimat, The nonlinear multi-scale material & structure modeling platform, an innovative and efficient software suite to accurately predict the nonlinear behavior of composite materials and structures used across the industries.

Contents

Part I

Installation of Digimat software

Installation I.1

Digimat licensing

I.1.1 License server installation

Introduction

Digimat licensing is based on the MSC license manager. It enables the following types of licensing:

- seat-based
- MSC One

Masterkey license system is not supported for Digimat products.

For supported platforms, see the `msc_licensing_helium_doc_user.pdf` user's guide in section Operating System Requirements section. This guide is available on MSC Download Center (MSC licensing page).

Installation of the licensing system

In order to set-up Digimat licensing, the executable `msc_licensing_helium_windows64_a.exe.exe` (for Windows platforms) or `msc_licensing_helium_linux64_a.bin` available at MSC Download Center (MSC licensing page) needs to be run from the installation medium and the installation steps followed. This setup allows to

- install `MSC` FlexLM daemon, `lmgrd` license component and license management tools;
- start `lmgrd` service.

For a step-by-step standard installation of the MSC license server via the provided installer, please refer to the `msc_licensing_helium_doc_user.pdf` user guide.

It is recommended to use the MSC Daemon only with `lmgrd` component provided by MSC license installation.

For further details, please consult the `msc_licensing_helium_doc_user.pdf` user's guide.

Starting MSC license server under Windows

Under Windows, `lmgrd` component is started at the end of the installation procedure. `lmgrd` is installed as a Windows service name `MSC_Licensing_Helium`. Windows services are restarted automatically after a reboot.

Notice that it is *required to be logged as administrator* in order to install a Windows service.

Detailed procedure to define and start license server is described in `msc_licensing_helium_doc_user.pdf` user's guide.

Starting MSC license server under Linux

Under Linux, `lmgrd` component is started at the end of the installation procedure but this starting process will be active only till the next reboot of the Linux machine. Each time the Linux machine is rebooted, the `lmgrd` component must be restarted manually.

Detailed procedure to define and start license server is described in `msc_licensing_helium_doc_user.pdf` user's guide.

Check license server installation

Ensuring that the license server is running can be achieved by looking at the log file of the license server. Path of log file can be found by using `lmtools.exe` utility in "Config service" toggle (see figure I.1.1. If the server did start successfully, you should see something similar to script below. If the server is running and you still have issue to start the products, check the firewall configuration of your license server, and open the right ports.

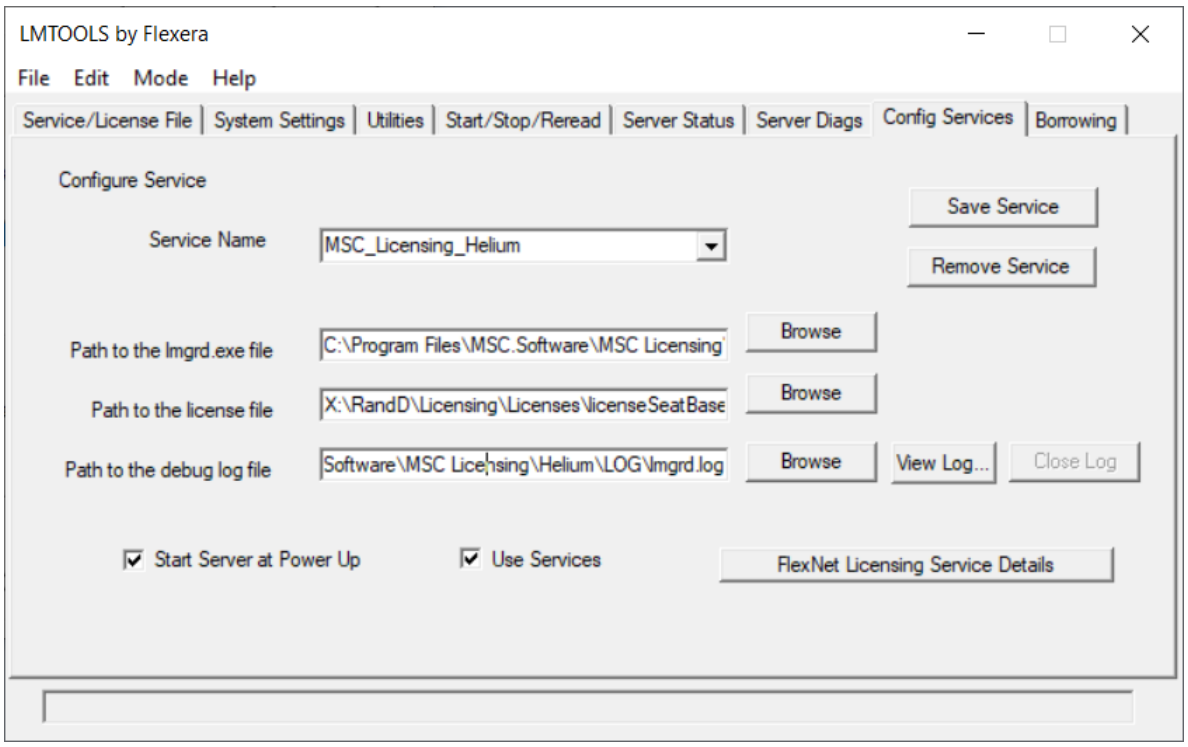


Figure I.1.1: Get path to license log file

```
9:42:53 (lmgrd) -----------------------------------------------
9:42:53 (lmgrd)   Please Note:
9:42:53 (lmgrd)
9:42:53 (lmgrd)   This log is intended for debug purposes only.
9:42:53 (lmgrd)   In order to capture accurate license
9:42:53 (lmgrd)   usage data into an organized repository,
9:42:53 (lmgrd)   please enable report logging. Use Flexera's
9:42:53 (lmgrd)   software license administration  solution,
9:42:53 (lmgrd)   FlexNet Manager, to  readily gain visibility
9:42:53 (lmgrd)   into license usage data and to create
9:42:53 (lmgrd)   insightful reports on critical information like
9:42:53 (lmgrd)   license availability and usage. FlexNet Manager
9:42:53 (lmgrd)   can be fully automated to run these reports on
9:42:53 (lmgrd)   schedule and can be used to track license
9:42:53 (lmgrd)   servers and usage across a heterogeneous
9:42:53 (lmgrd)   network of servers including Windows NT, Linux
9:42:53 (lmgrd)   and UNIX.
9:42:53 (lmgrd)
9:42:53 (lmgrd) -----------------------------------------------
```

```
9:42:53 (lmgrd)
9:42:53 (lmgrd)
9:42:53 (lmgrd) Server's System Date and Time: Fri Oct 11 2019 09:42:53 Romance Daylight Time
9:42:53 (lmgrd) pid 12356
9:42:53 (lmgrd) SLOG: Summary LOG statistics is enabled.
9:42:54 (lmgrd) Done rereading
9:42:54 (lmgrd) FlexNet Licensing (v11.16.3.0 build 246844 x64_n6) started on PPJ-PC2015 (IBM PC) (10/11/2019)
9:42:54 (lmgrd) Copyright (c) 1988-2019 Flexera. All Rights Reserved.
9:42:54 (lmgrd) World Wide Web:  http://www.flexerasoftware.com
9:42:54 (lmgrd) License file(s): C:\MSC.Software\Digimat\licenseHelium.dat
9:42:54 (lmgrd) lmgrd tcp-port 27500
9:42:54 (lmgrd) (@lmgrd-SLOG@) ===============================================
9:42:54 (lmgrd) (@lmgrd-SLOG@) === LMGRD ===
9:42:54 (lmgrd) (@lmgrd-SLOG@) Start-Date: Fri Oct 11 2019 09:42:54 Romance Daylight Time
9:42:54 (lmgrd) (@lmgrd-SLOG@) PID: 12356
9:42:54 (lmgrd) (@lmgrd-SLOG@) LMGRD Version: v11.16.3.0 build 246844 x64_n6 ( build 246844 (ipv6))
9:42:54 (lmgrd) (@lmgrd-SLOG@)
9:42:54 (lmgrd) (@lmgrd-SLOG@) === Network Info ===
9:42:54 (lmgrd) (@lmgrd-SLOG@) Listening port: 27500
9:42:54 (lmgrd) (@lmgrd-SLOG@)
9:42:54 (lmgrd) (@lmgrd-SLOG@) === Startup Info ===
9:42:54 (lmgrd) (@lmgrd-SLOG@) Is LS run as a service: Yes
9:42:54 (lmgrd) (@lmgrd-SLOG@) Server Configuration: Single Server
9:42:54 (lmgrd) (@lmgrd-SLOG@) Command-line options used at LS startup: -c C:\MSC.Software\Digimat\licenseHelium.dat
                               -l C:\MSC.Software\MSC Licensing\Helium\LOG\lmgrd.log -z -s local
9:42:54 (lmgrd) (@lmgrd-SLOG@) License file(s) used:  C:\MSC.Software\Digimat\licenseHelium.dat
9:42:54 (lmgrd) (@lmgrd-SLOG@) ===============================================
9:42:54 (lmgrd) SLOG: FNPLS-INTERNAL-VL1-4096
9:42:54 (lmgrd) Starting vendor daemons ...
9:42:54 (lmgrd) License server manager (lmgrd) startup failed:
9:42:54 (lmgrd) File not found, C:\Program Files\MSC.Software\MSC Licensing\Helium
9:42:54 (lmgrd) Started MSC (pid 14200)
9:42:54 (MSC) FlexNet Licensing version v11.16.3.0 build 246844 x64_n6
9:42:54 (MSC) Loading feature details 3
9:42:54 (MSC) Loading feature details 3
9:42:54 (MSC) SLOG: Summary LOG statistics is enabled.
9:42:54 (MSC) SLOG: FNPLS-INTERNAL-CKPT1
9:42:54 (MSC) SLOG: VM Status: 255
9:42:54 (MSC) SLOG: FNPLS-INTERNAL-CKPT5
9:42:54 (MSC) SLOG: TPM Status: 0
9:42:54 (MSC) SLOG: FNPLS-INTERNAL-CKPT6
9:42:54 (MSC) Server started on PPJ-PC2015 for:        EX_DIGIMAT_MF
9:42:54 (MSC) EX_DIGIMAT_FE_MODELER EX_DIGIMAT_FE_SOLVER EX_DIGIMAT_VA_GUI
9:42:54 (MSC) EX_DIGIMAT_VA_SOLVER EX_DIGIMAT_MX        EX_DIGIMAT_MX+
9:42:54 (MSC) EX_DIGIMAT_MAP        EX_DIGIMAT_RP_GUI EX_DIGIMAT_CAE_STRUCTURAL
9:42:54 (MSC) EX_DIGIMAT_CAE_MOLDING EX_DIGIMAT_RP_MOLDEX3D EX_DIGIMAT_HC
9:42:54 (MSC) EX_DIGIMAT_AM_SLS_GUI EX_DIGIMAT_AM_STANDARD_SOLVER EX_DIGIMAT_AM_FFF_GUI
9:42:54 (MSC) EX_DIGIMAT_AM_GUI EX_DIGIMAT_AM_ADVANCED_SOLVER EX_DIGIMAT_CAE_FATIGUE
9:42:54 (MSC) EX_DIGIMAT_CAE_DRAPING EX_DIGIMAT_CAE_CASTING EX_DIGIMAT_CAE_CT
9:42:54 (MSC) EX_DIGIMAT_CAE_ADDITIVE EX_DIGIMAT_CAE_TOKEN EX_DIGIMAT_FE_SOLVER_TOKEN
9:42:54 (MSC) EX_DIGIMAT_CAE_LINEAR
9:42:54 (MSC) EXTERNAL FILTERS are OFF
9:42:54 (lmgrd) MSC using TCP-port 19980
9:42:54 (MSC) Initialization
9:42:54 (MSC) (@MSC-INFO@) === Date ===
9:42:54 (MSC) (@MSC-INFO@) 2019-10-11
9:42:54 (MSC) (@MSC-INFO@)
9:42:54 (MSC) (@MSC-INFO@) === Component Versions ===
9:42:54 (MSC) (@MSC-INFO@) MSC created executables:
9:42:54 (MSC) (@MSC-INFO@)   1) MSC.exe vendor daemon (msc.exe):
9:42:54 (MSC) (@MSC-INFO@)        Flexera internal version =  11.16.3.0 x64_n6
9:42:54 (MSC) (@MSC-INFO@)        MSC internal version     =  Helium (Build 659671)
9:42:54 (MSC) (@MSC-INFO@)   2) summarizer: Helium (Build 659671) x64_n6
9:42:54 (MSC) (@MSC-INFO@)   3) uploader:   Helium (Build 659671) x64_n6
9:42:54 (MSC) (@MSC-INFO@) Flexera created executables:
9:42:54 (MSC) (@MSC-INFO@)   1) lmgrd.exe:   11.16.3.0 x64_n6
9:42:54 (MSC) (@MSC-INFO@)   2) lmtools.exe: 11.16.3.0 x64_n6
9:42:54 (MSC) (@MSC-INFO@)   3) lmutil.exe:  11.16.3.0 x64_n6
9:42:54 (MSC) (@MSC-INFO@)
9:42:54 (MSC) (@MSC-INFO@) === Usage Reporting Tool Status ===
9:42:54 (MSC) (@MSC-INFO@) Usage Reporting Activated:      yes
9:42:54 (MSC) (@MSC-INFO@) Summarizer Activated:           yes
9:42:54 (MSC) (@MSC-INFO@) Uploader Activated:             no
9:42:54 (MSC) (@MSC-INFO@) Usage Reporting Tool Log File:  C:\MSC.Software\MSC Licensing\Helium\LOG/mscusage.mpl
9:42:54 (MSC) (@MSC-INFO@)
9:42:54 (MSC) (@MSC-INFO@) === License File Information === (Actual details pending)
9:42:54 (MSC) (@MSC-INFO@) MSC License File Reference: 6XJD
9:42:54 (MSC) (@MSC-INFO@)     6XJD: Maint Date=2019-02-21; End Date=2019-12-31:
9:42:54 (MSC) (@MSC-INFO@)
9:42:54 (MSC) (@MSC-INFO@) === Token Pool Information === (Actual details pending)
9:42:54 (MSC) (@MSC-INFO@) MSC One Tokens: Base = 1000
9:42:54 (MSC) (@MSC-INFO@)
9:42:54 (MSC) SLOG: Statistics Log Frequency is 240 minute(s).
9:42:54 (MSC) SLOG: TS update poll interval is 600 seconds.
9:42:54 (MSC) SLOG: Activation borrow reclaim percentage is 0.
9:42:54 (MSC) (@MSC-SLOG@) ===============================================
9:42:54 (MSC) (@MSC-SLOG@) === Vendor Daemon ===
9:42:54 (MSC) (@MSC-SLOG@) Vendor daemon: MSC
9:42:54 (MSC) (@MSC-SLOG@) Start-Date: Fri Oct 11 2019 09:42:54 Romance Daylight Time
9:42:54 (MSC) (@MSC-SLOG@) PID: 14200
9:42:54 (MSC) (@MSC-SLOG@) VD Version: v11.16.3.0 build 246844 x64_n6 ( build 246844 (ipv6))
9:42:54 (MSC) (@MSC-SLOG@)
9:42:54 (MSC) (@MSC-SLOG@) === Startup/Restart Info ===
9:42:54 (MSC) (@MSC-SLOG@) Options file used: None
9:42:54 (MSC) (@MSC-SLOG@) Is vendor daemon a CVD: No
9:42:54 (MSC) (@MSC-SLOG@) Is FlexNet Licensing Service installed and compatible: No
```

```
9:42:54 (MSC) (@MSC-SLOG@) FlexNet Licensing Service Version: -NA-
9:42:54 (MSC) (@MSC-SLOG@) Is TS accessed: No
9:42:54 (MSC) (@MSC-SLOG@) TS access time: -NA-
9:42:54 (MSC) (@MSC-SLOG@) Number of VD restarts since LS startup: 0
9:42:54 (MSC) (@MSC-SLOG@)
9:42:54 (MSC) (@MSC-SLOG@) === Network Info ===
9:42:54 (MSC) (@MSC-SLOG@) Listening port: 19980
9:42:54 (MSC) (@MSC-SLOG@) Daemon select timeout (in seconds): 1
9:42:54 (MSC) (@MSC-SLOG@)
9:42:54 (MSC) (@MSC-SLOG@) === Host Info ===
9:42:54 (MSC) (@MSC-SLOG@) Host used in license file: PPJ-PC2015
9:42:54 (MSC) (@MSC-SLOG@) HostID node-locked in license file: 9890969f897a
9:42:54 (MSC) (@MSC-SLOG@) HostID of the License Server: "9890969f897a 0a002700000f"
9:42:54 (MSC) (@MSC-SLOG@) Running on Hypervisor: None (Physical)
9:42:54 (MSC) (@MSC-SLOG@) ================================================
9:42:54 (MSC) Loading feature details 3
9:42:54 (MSC) Usage records are being written to C:\MSC.Software\MSC Licensing\Helium\LOG/mscusage_2019-10-11.ddu
```

I.1.2 Client license configuration

Configuration of the licensing system

During Digimat installation, a valid MSC license file path is requested (see I.2.7). Given value defines `MSC_LICENSE_FILE` global environment variable. Most classical values are:

```
port@host
```

where

- `host` refers to the IP address or the host name of the computer on which runs the license server.
- `port` is the port to be used to establish the connection between the application and the license server (default port is 27500).

Multiple license servers can be defined with different `@host` references separated by ':' under Linux and ';' under Windows, for example:

```
MSC_LICENSE_FILE = 27500@WorkStation1:27500@192.168.1.10
```

If no `MSC_LICENSE_FILE` environment variable is defined, it is not possible to run any Digimat products.

MSC One licensing system

Digimat also support MSC One licensing system. MSC One licensing is such that it allows most MSC products to use a shared pool of license tokens.

All Digimat capabilities are working in the same way as with the traditional licensing system explained in the previous section, except that :

- Encryption feature `EX_DIGIMAT_MX+` in Digimat-MX is not available.
- The fiber orientation estimator embedded in Digimat-RP is not available.
- Crystal plasticity functionalities in Digimat-FE is not available.

Installation of MSC One license system is identical to ones of seat-based license systems (please refer to section I.1.1).

Licensing location check

The licensing location defined by `MSC_LICENSE_FILE` can be directly checked by using the "License" option of the Digimat platform (see Figure I.1.2). Clicking on "Query status" will give a status of license server defined in `MSC_LICENSE_FILE` (number of available/used licenses...).

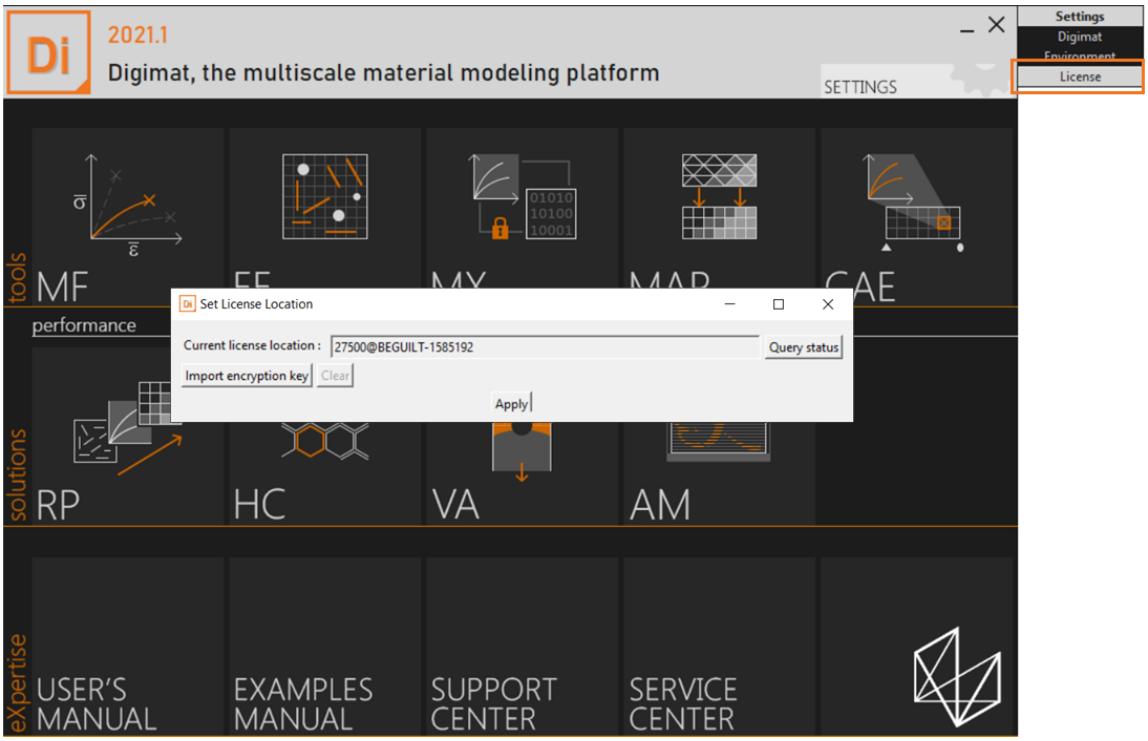


Figure I.1.2: Checking the licensing location via the Digimat GUI.

Installation I.2

Digimat software

I.2.1 Introduction

The following sections are intended to give a quick and general overview over the single steps of the Digimat installation. A general overview over the installation procedure is followed by a typical example of a local Digimat installation on a Windows computer. For detailed procedures please refer to the dedicated chapters.

It is highly recommended to follow the described procedures as given in the overview step by step to receive a stable installation of Digimat software!

Files for testing Digimat 2021.2 installation are available in Digimat documentation.

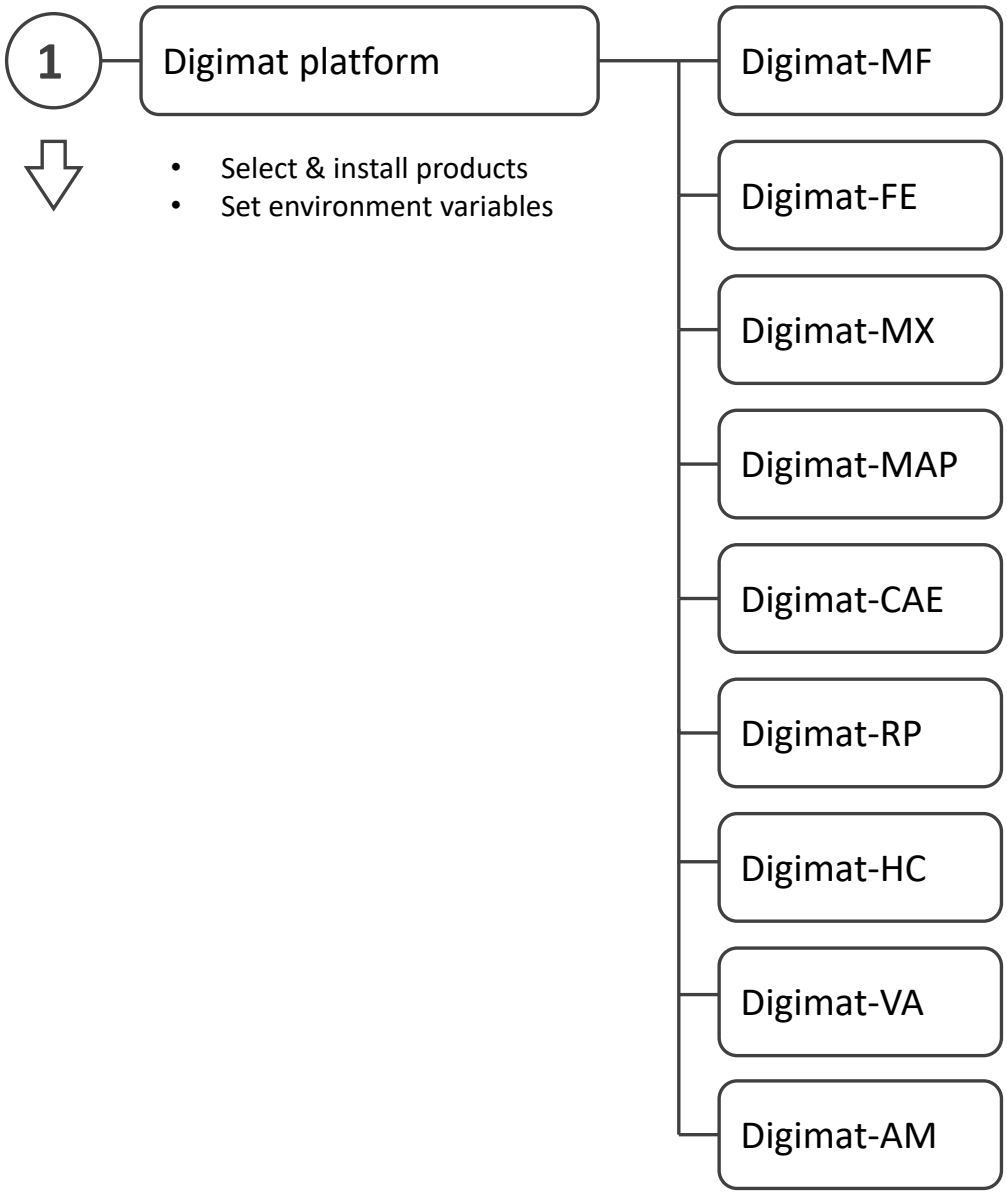


Figure I.2.1: General overview over steps required to receive a stable installation of Digimat software.

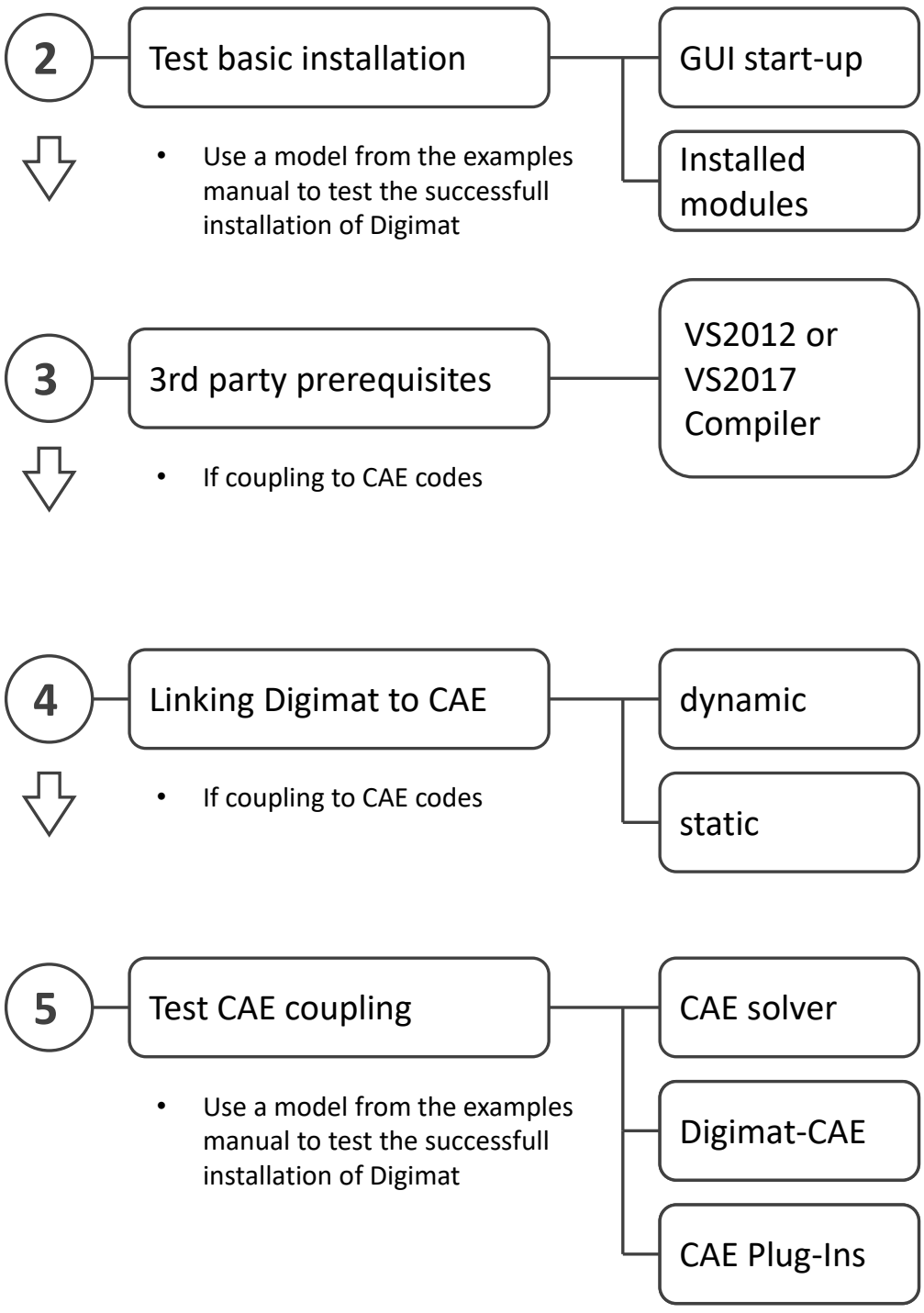


Figure I.2.2: General overview over steps required to receive a stable installation of Digimat software.

I.2.2 Local installation of Digimat on a Windows machine

This section demonstrates the most straightforward way to create a **FULL standard installation of the Digimat software on a Windows machine**.

Step-by-step: Digimat software

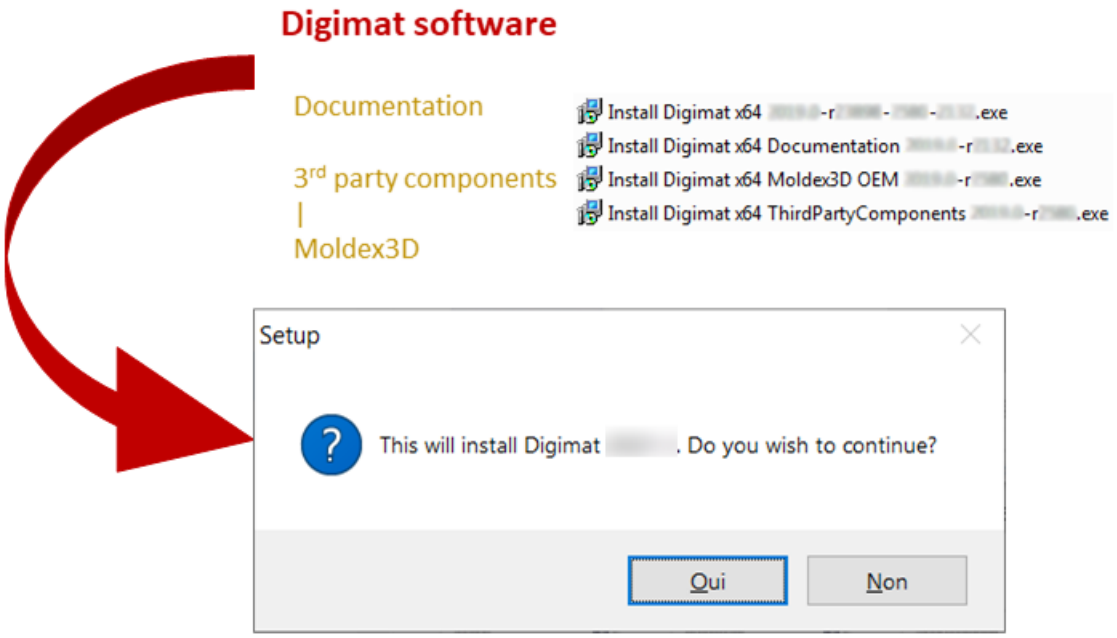


Figure I.2.3: Archive from MSC Download Center (https://mscsoftware.subscribenet.com/) contains 3 or 4 executable files according to download of standard installation or installation including Digimat-RP/Moldex3D: main installer, third-Party installer, documentation installer, Digimat-RP/Moldex3D installer (optional).

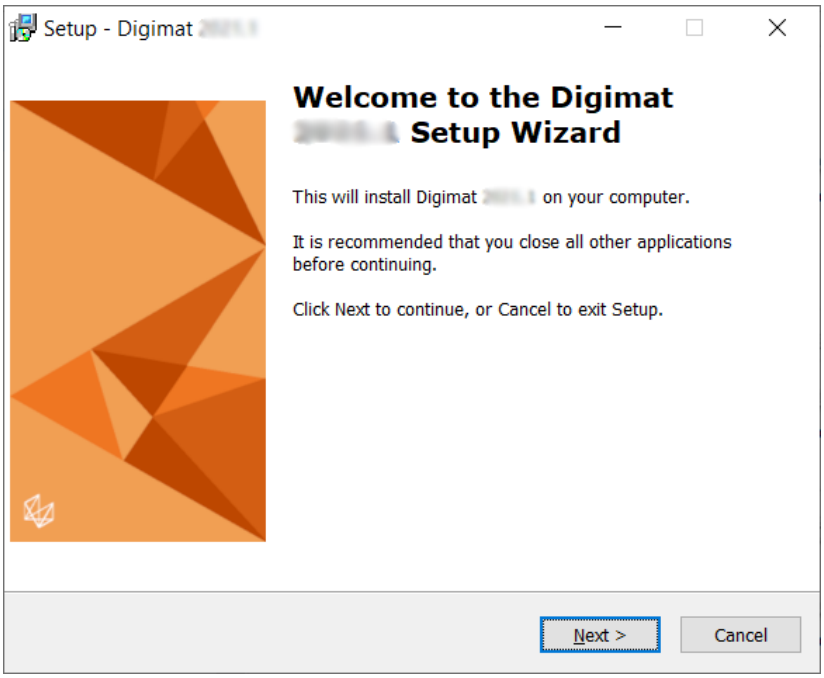


Figure I.2.4: Opening prompt of the Digimat installer. Follow the given instructions step-by-step.

Digimat

Digimat 2020 Feature Pack 1 – July 2020

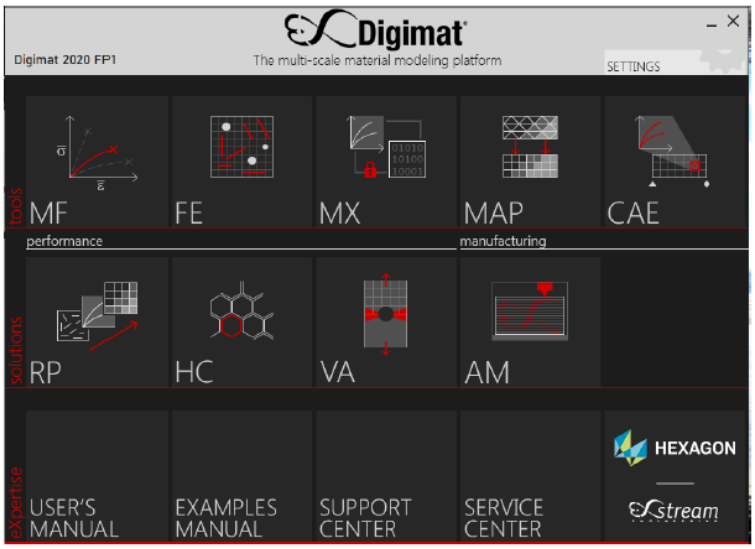


Figure I.2.5: Upon execution of the Digimat installer, the release notes will be shown in a separate PDF viewer.

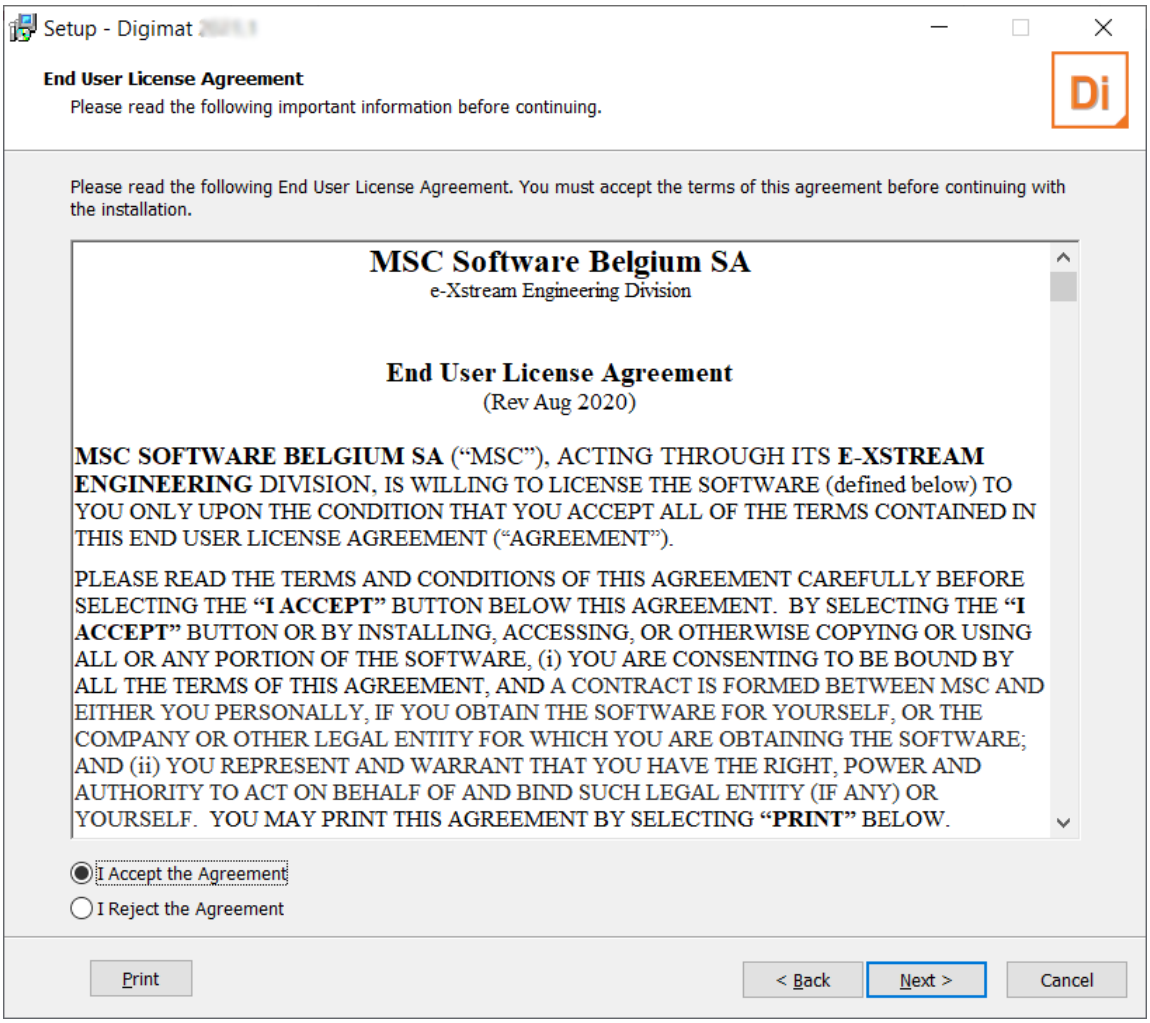


Figure I.2.6: Please read carefully the software license agreement. It must be agreed to before being able to continue with the installation procedure.

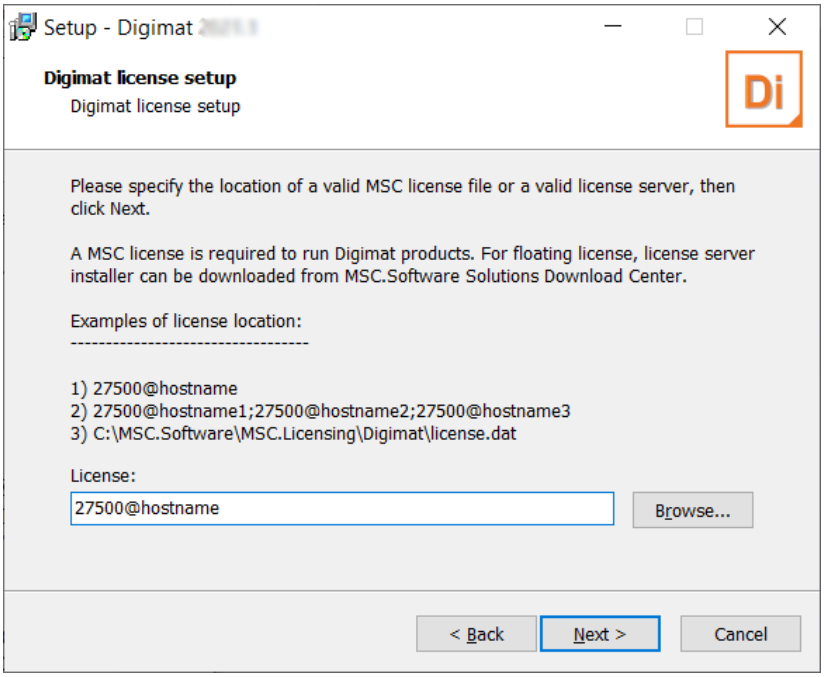


Figure I.2.7: The IP address for communication with the MSC license service has to be given, preceded by the `@`. If needed, user can also specify explicitly the port used by the license server, e.g., `27500@hostname`. Port specification should only be used if it is explicitely specified in the license server.

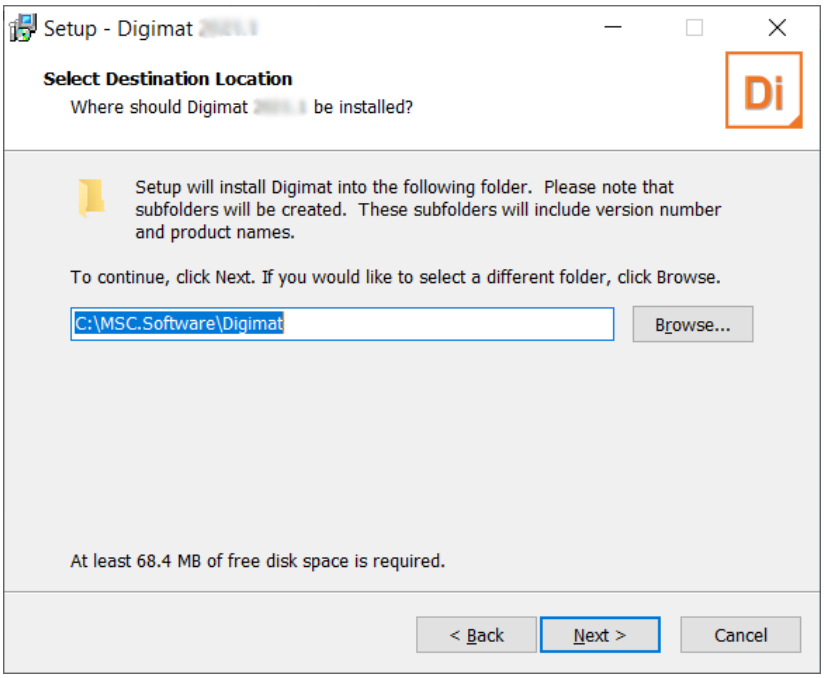


Figure I.2.8: The destination folder for the Digimat installation has to be given. A 2021.2 directory will be automatically created.

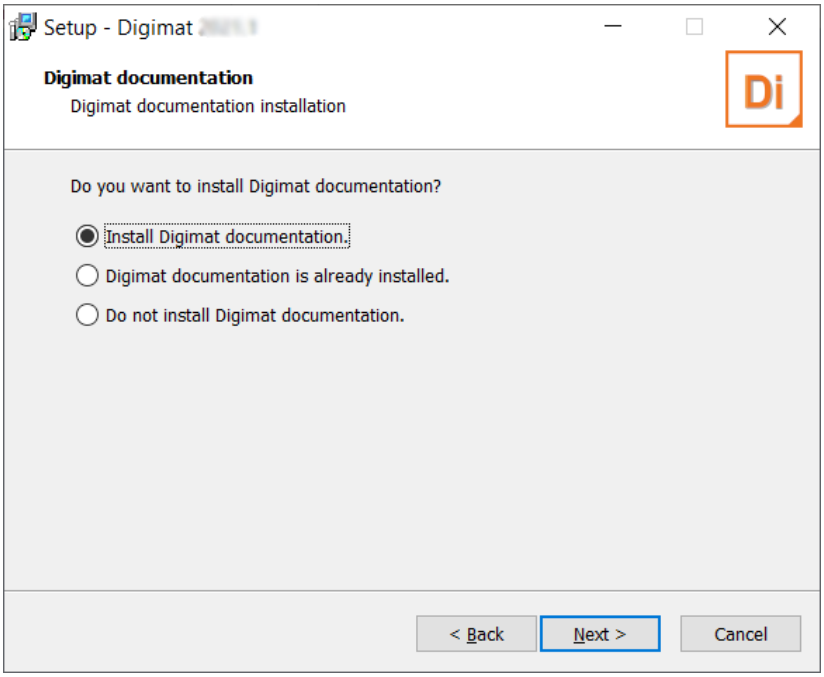


Figure I.2.9: Choice of installing Digimat documentation. If user chooses to not Digimat documentation, it is still possible to install Digimat documentation step after complete Digimat installation.

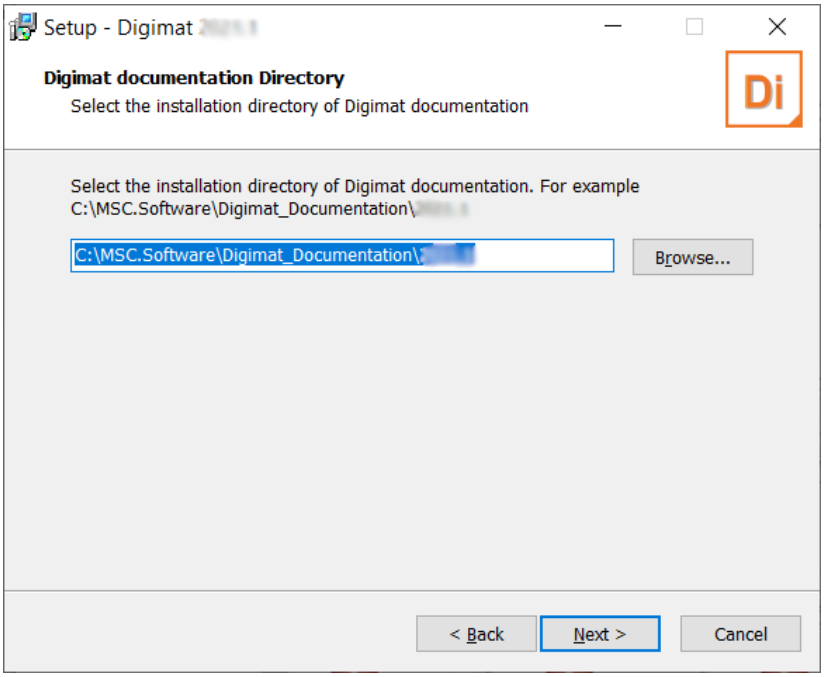


Figure I.2.10: If the option "Digimat documentation is already installed" is selected, user has to point to the Digimat documentation directory. So the settings of Digimat will be automatically updated to point to this documentation. Note that user cannot point to a Digimat documentation prior to Digimat 2016.0.

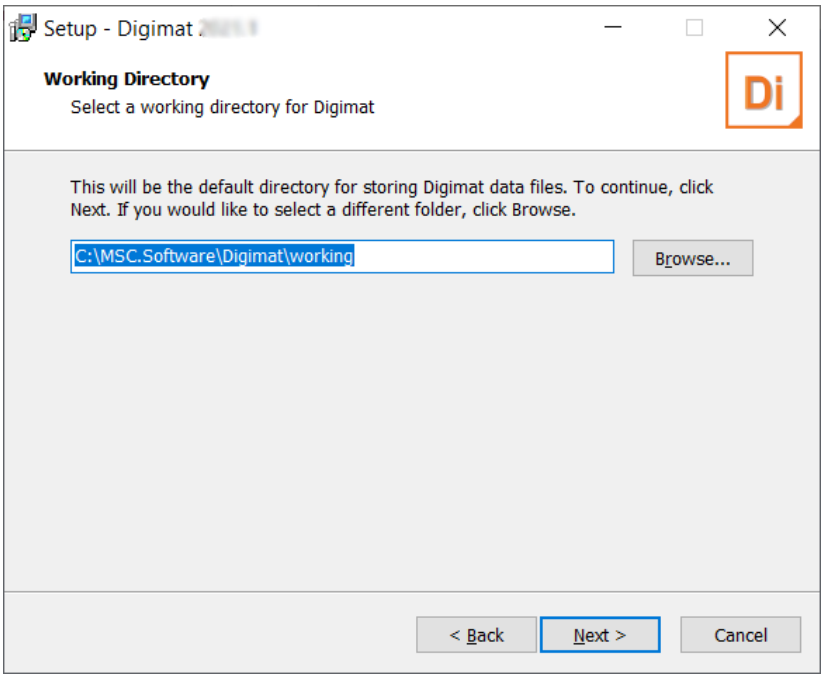


Figure I.2.11: The destination folder for the Digimat working directory has to be given. This directory can be located anywhere on the computer and shared also between different versions of Digimat. Note that, if Digimat-HC component is selected, working directory cannot contain spaces.

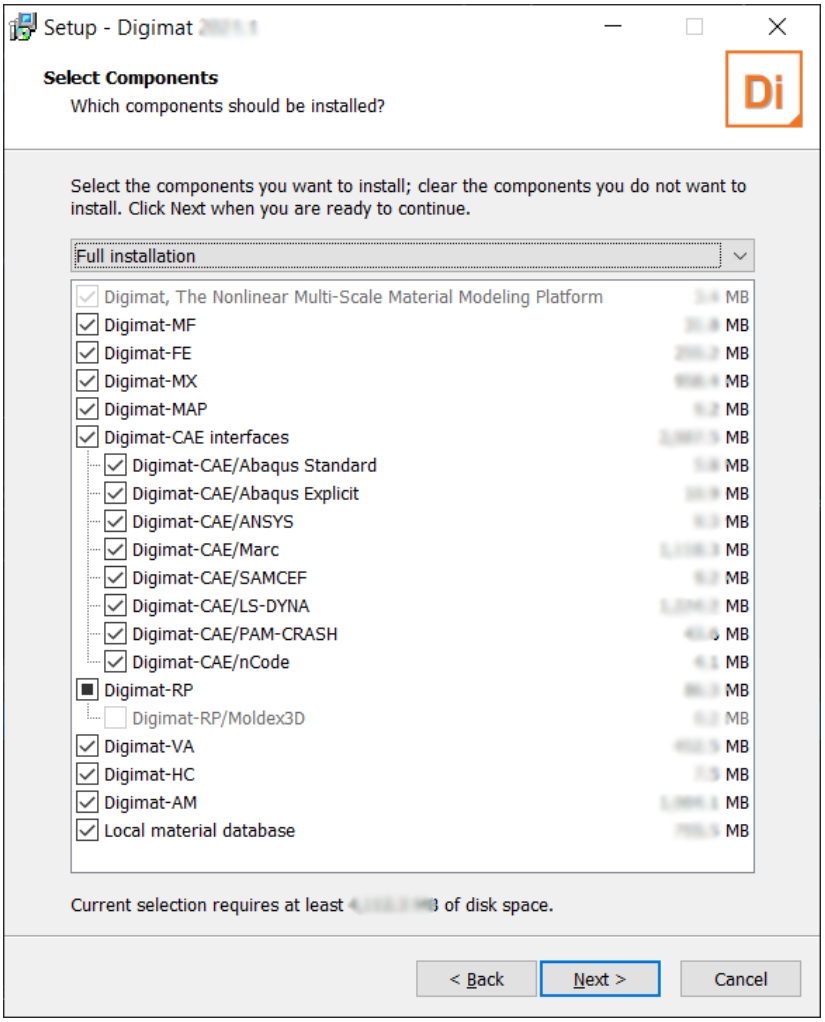


Figure I.2.12: The required Digimat modules can be chosen individually to save disk space for the installation. In the default case as used here all modules will be installed. If Moldex3D installer has been downloaded, it will be installed by default, unless the sub-component "Moldex3D integrated into Digimat-RP " is unchecked. When intending to use Digimat-MX Remote database, Local database component must be unchecked.

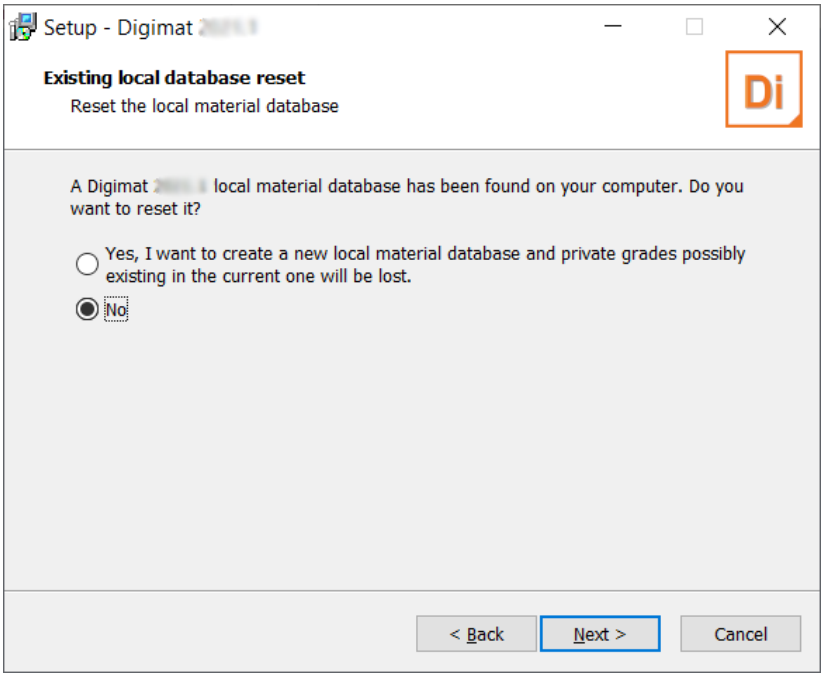


Figure I.2.13: The local material database can be reset if a Beta version of Digimat 2021.2 has been previously installed (cf. Section I.2.4).

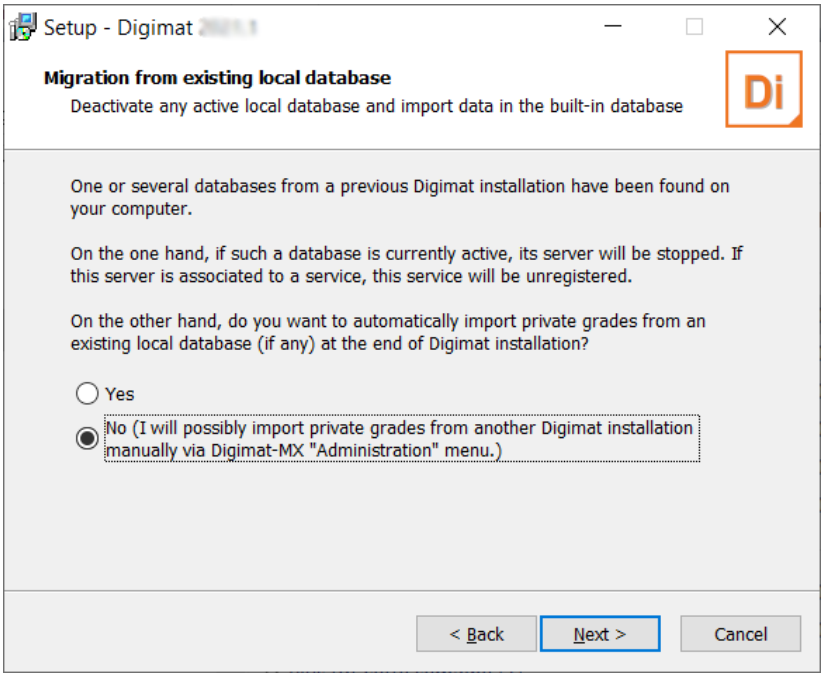


Figure I.2.14: To be fully operational, the new built-in local database may require the migration of an existing local database at the end of Digimat installation (cf. Section I.2.4 and Figure I.2.26).

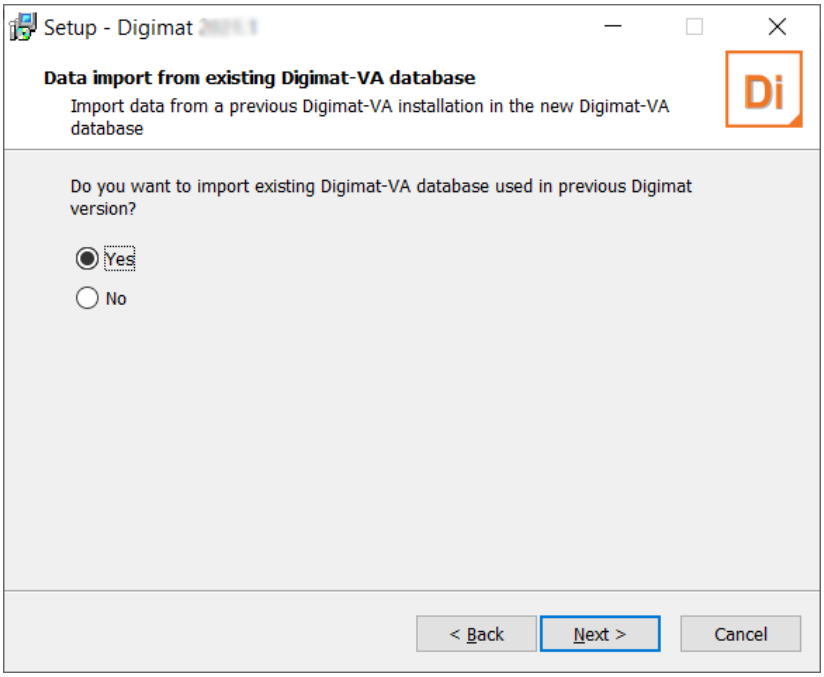


Figure I.2.15: If Digimat-VA component is selected and if a previous version of Digimat-VA database is found, this database can be imported in database 2021.2.

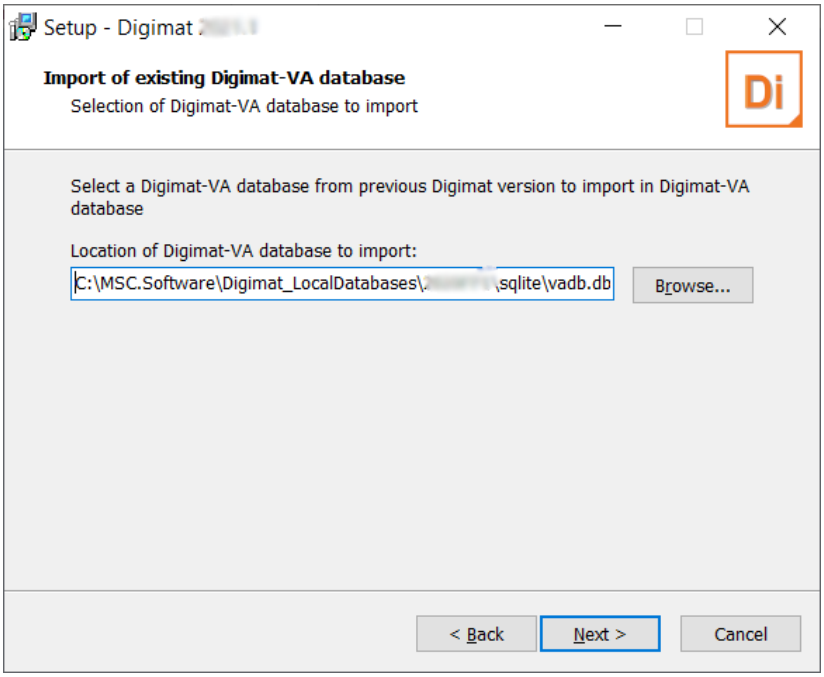


Figure I.2.16: If user wants to import a previous version of Digimat-VA database, the path to this Digimat-VA database must be given.

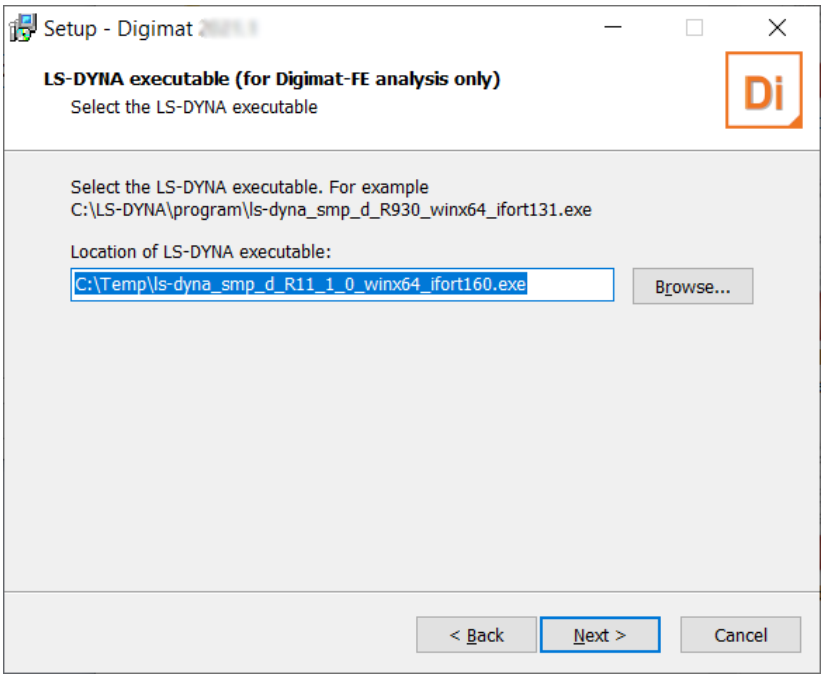


Figure I.2.17: If Digimat-FE component is selected, path of an existing LS-DYNA executable is requested to allow running Digimat-FE computation using LS-DYNA implicit. If not using LS-DYNA FEA solver the step can be skipped and the input field left blank. If needed this path can be specified in a later step via Digimat settings as explained in section I.2.6.

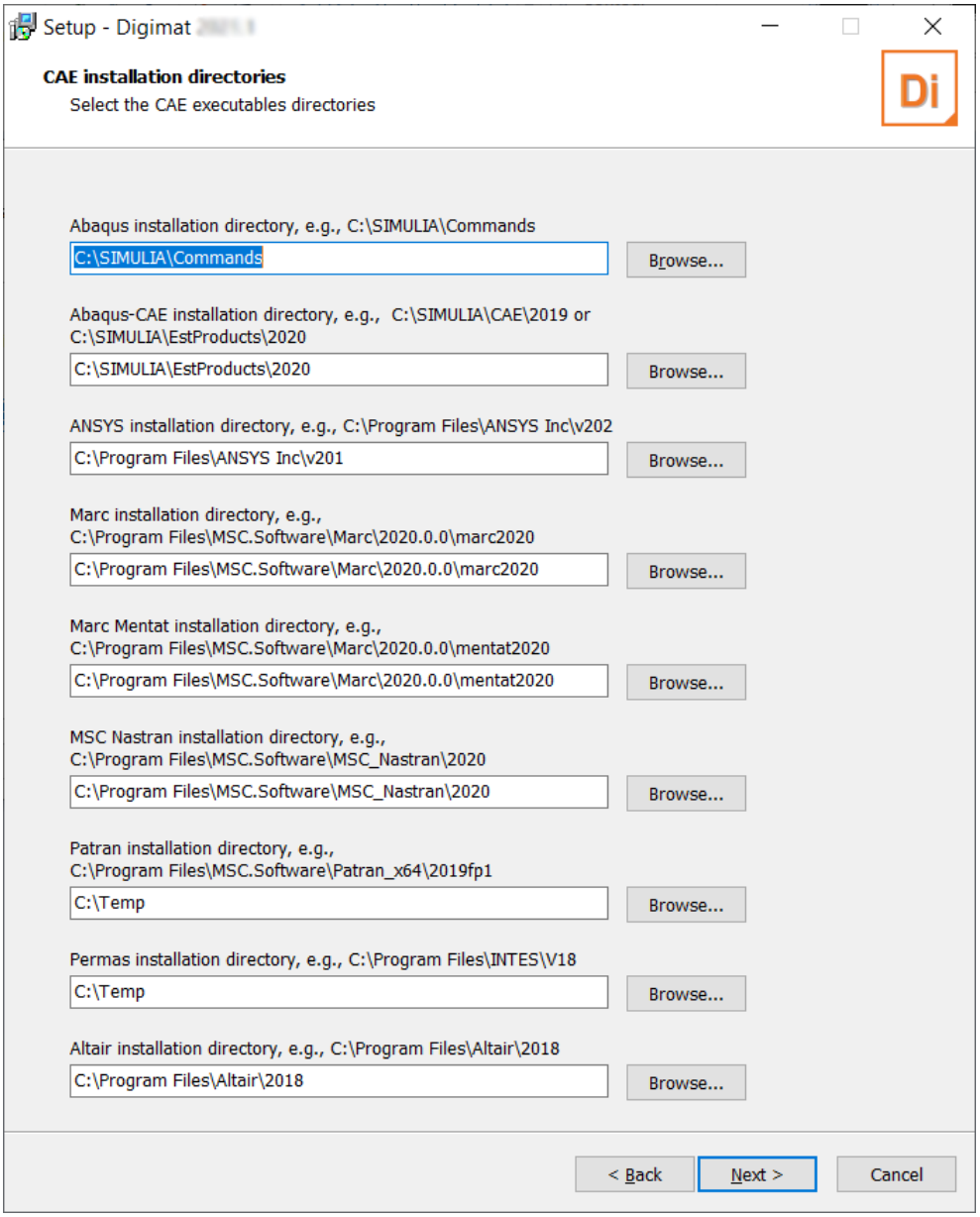


Figure I.2.18: If Digimat-CAE, Digimat-RP or Digimat-FE components are selected, paths to existing CAE installations are requested. If not using this FEA solver the step can be skipped and the input field left blank. If needed this path can be specified in a later step via Digimat settings as explained in section I.2.6.

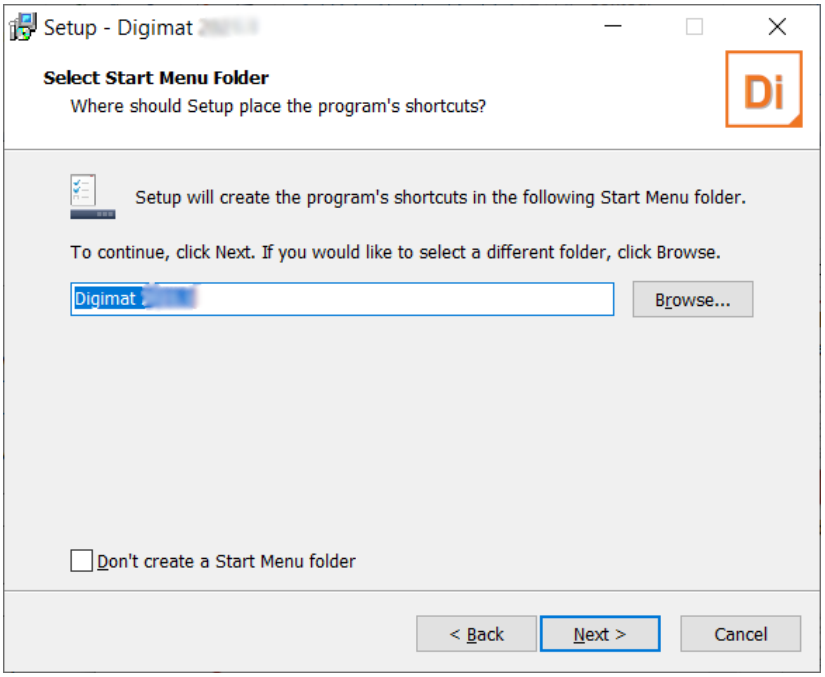


Figure I.2.19: An individual name for the Digimat shortcut can be specified.

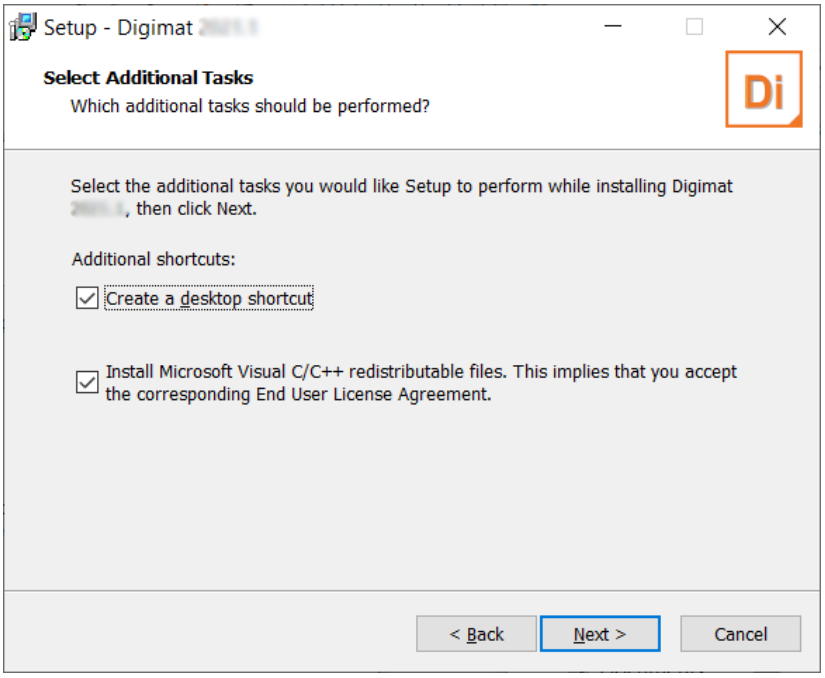


Figure I.2.20: A desktop icon can be created. User can also choose to install Visual 2010, 2012, 2015 and 2017 C/C++ redistributable files together with Digimat. These files are required to run Digimat computations. In this case, Visual C/C++ redistributable files will be installed.

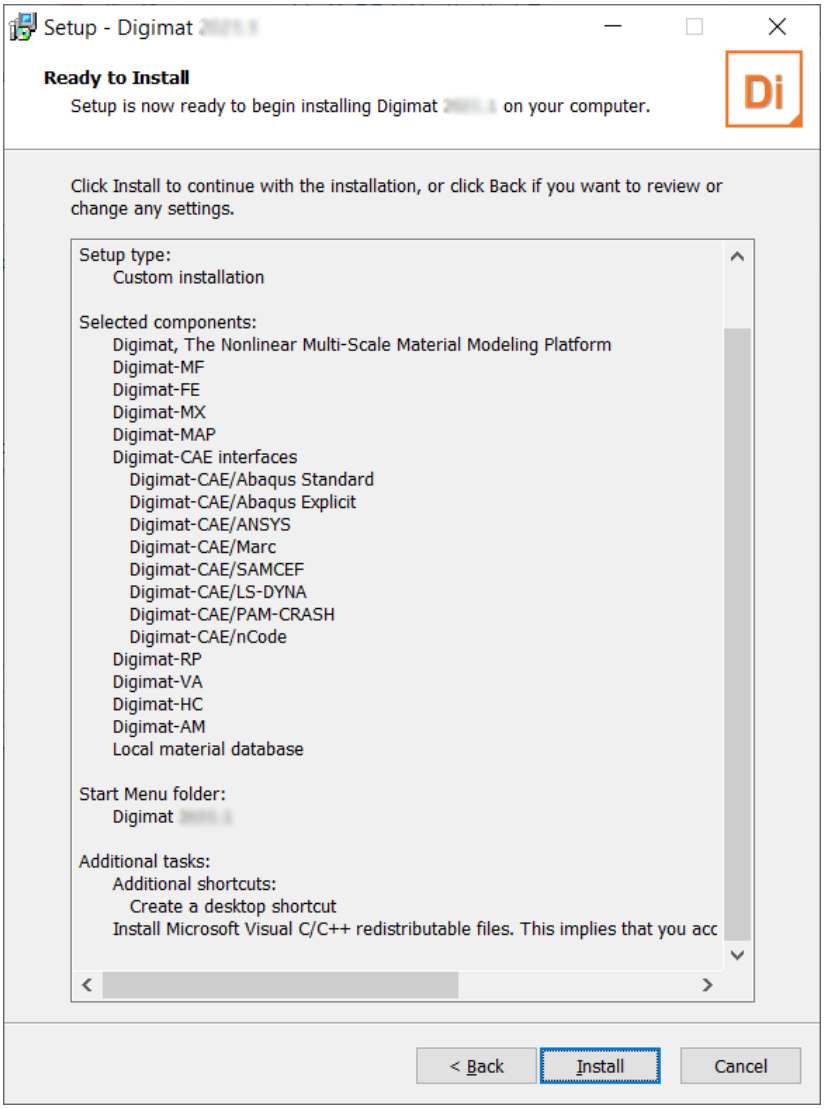


Figure I.2.21: A summary of the installation details is given and can be checked. Proceeding with the "Install" button will start the installation of Digimat.

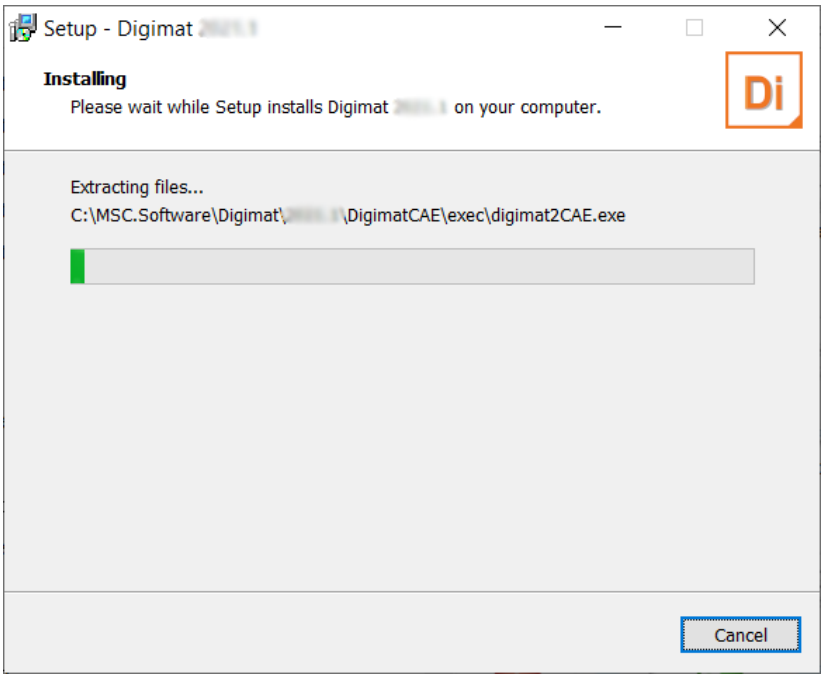


Figure I.2.22: The installation of the Digimat core software is executed.

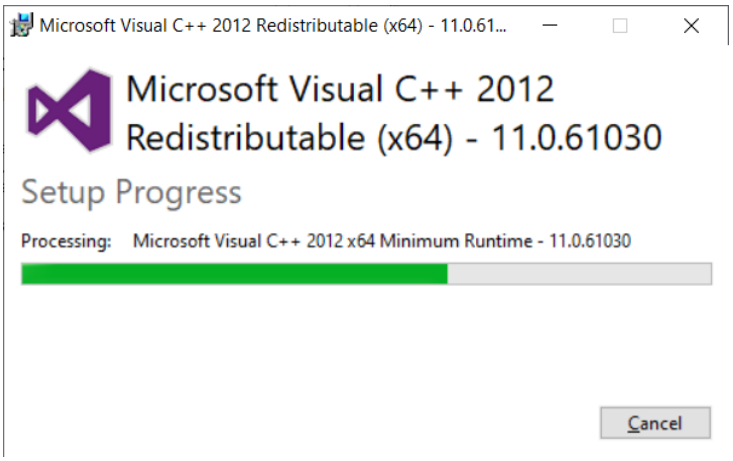


Figure I.2.23: The installation of the Microsoft Visual C++ 2012 redistributables is executed.

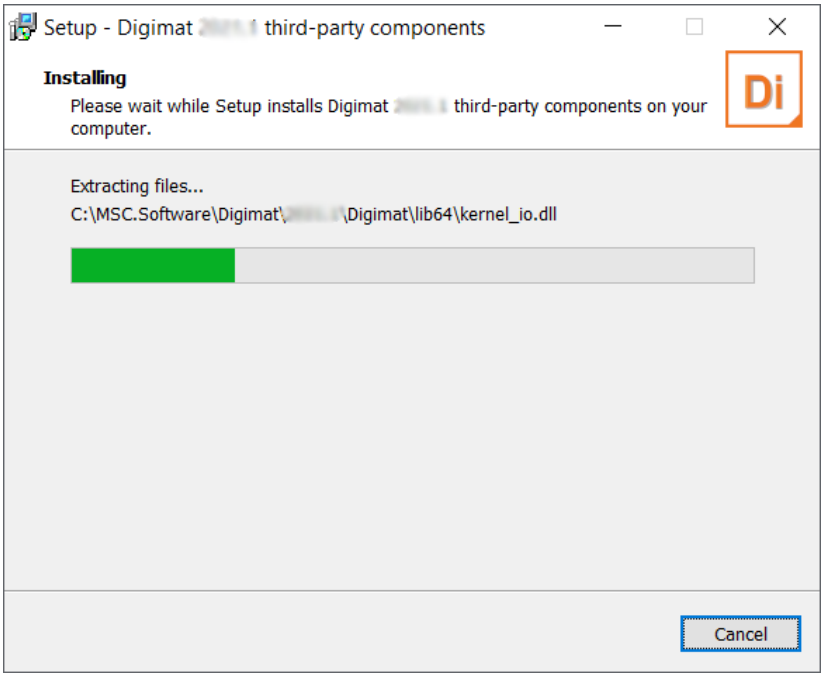


Figure I.2.24: Third party products are installed. Third party components must be installed in order to be able to run the Digimat software.

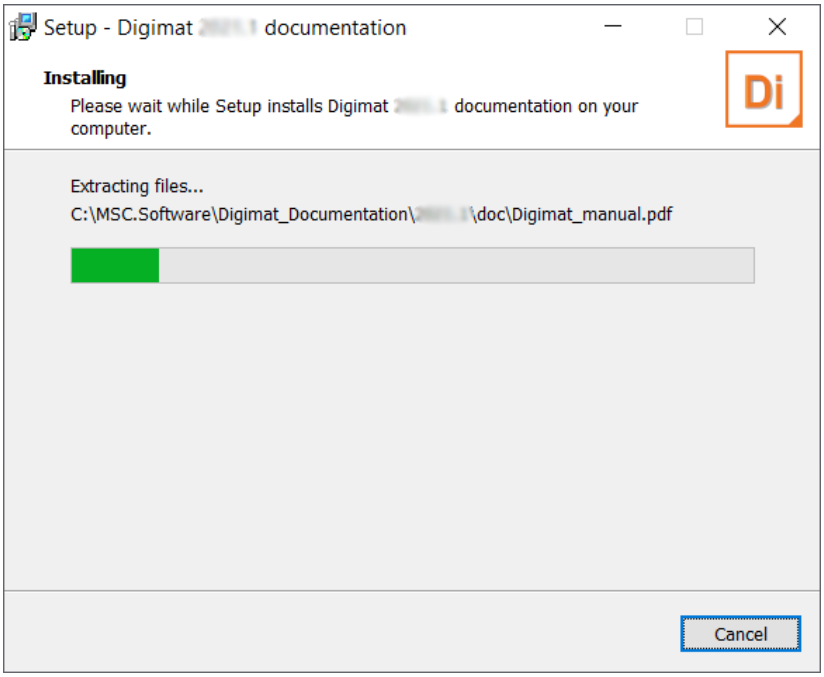


Figure I.2.25: As a last step, the Digimat documentation is installed (if chosen).

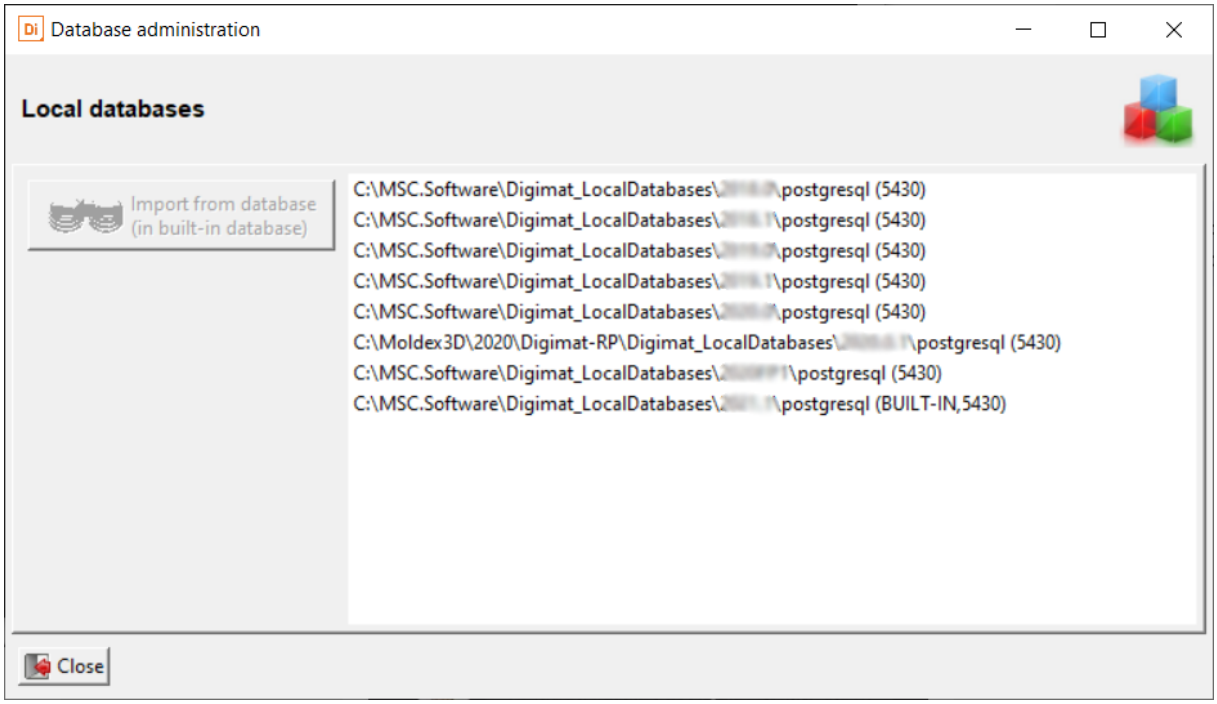


Figure I.2.26: If the migration of a previous local database in the new local database is required (cf. Figure I.2.14), the directory of this database must be selected prior to the actual database import (cf. Section **??**).

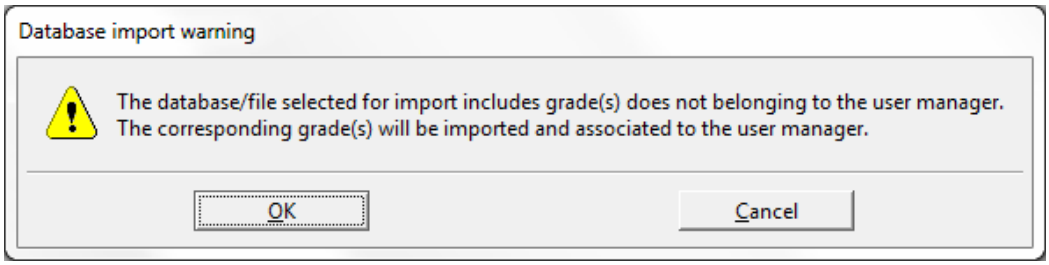


Figure I.2.27: During database import from previous Digimat version, data belonging to different users are addressed specifically.

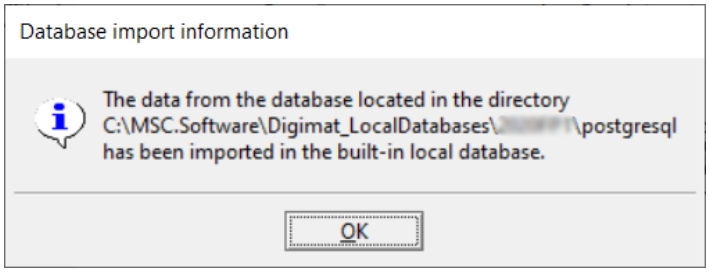


Figure I.2.28: Successful database import from previous Digimat version.

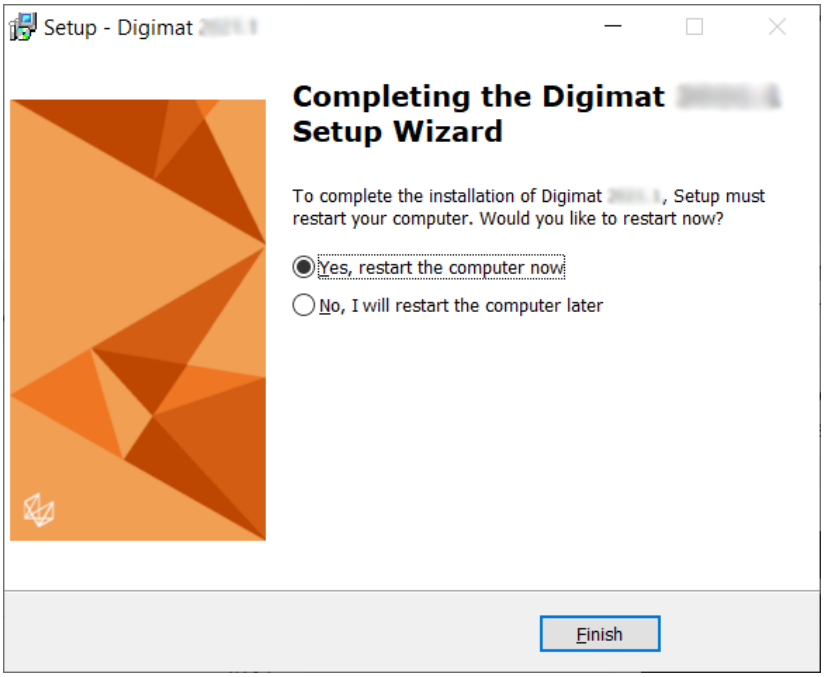


Figure I.2.29: Upon finalization of the installation the user can choose to reboot the computer immediately. **To ensure safely a fully functional installation of Digimat, the reboot of the machine is mandatory!**

Encryption key management

The encryption keys needed to decrypt the material files are not managed via the license file. The keys are handled by the Digimat platform and written in the Digimat configuration file.

Here is the procedure to be performed prior to being able to decrypt any material files :

- The encryption keys are delivered by e-Xstream engineering within files named `key_number.priv`. If not already received please contact your Digimat support. You will have at least two encryption keys to handle, one to decrypt material files that were encrypted for you only, and one to decrypt material files that can be decrypted by everyone.
- Go to the Digimat platform to have access to the license management functionalities (see Figure I.1.2). There you will have access to a button named **Import encryption key**. Click on the button, select your .priv file, click **OK** and then click the **Apply** button. Perform this procedure as many time you have received different encryption key files.

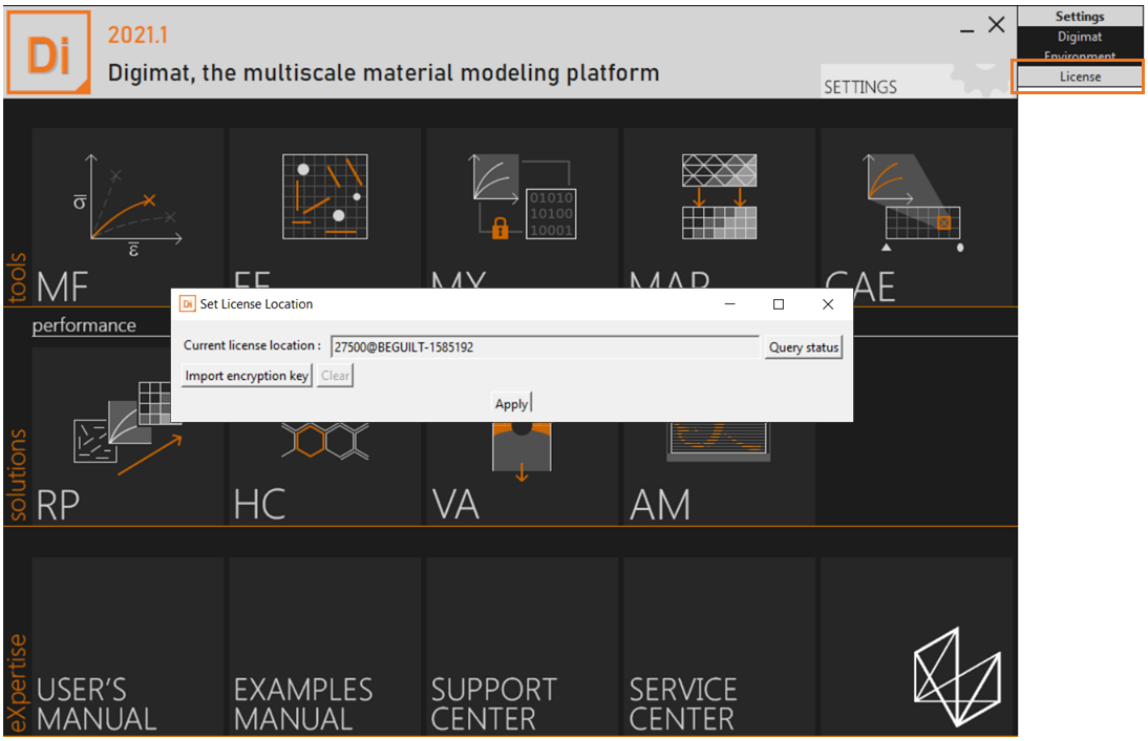


Figure I.2.30: Import private encryption key using Digimat platform.

Installation of Intel-MPI 2018 hydra service for fiber orientation estimation

When installing Digimat-RP/Moldex3D for fiber orientation estimation, Intel-MPI 2018 hydra service is automatically installed to allow parallel computation for fiber orientation estimation. The executables associated to the service are located in directory "`C:\Program Files\Intel MPI 2018`". It appears in Windows task manager with the name "`impi_hydra`" (see Figure I.2.31), corresponding to the executable named "`hydra_service.exe`". Only one instance of this service with "`impi_hydra`" name can run on a computer. So, if another instance of the service is running with "`impi_hydra`" name when installing Digimat, this instance will be replaced by the one installed by Digimat-RP/Moldex3D.

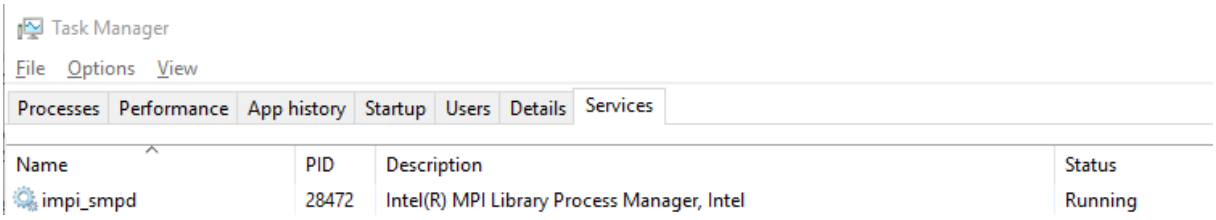


Figure I.2.31: Intel-MPI 2018 hydra service in task manager.

Remark: Intel-MPI 2018 hydra service is not uninstalled when uninstalling Digimat.

To remove an existing Intel-MPI hydra service:

- Open a Command prompt as an administrator.
- Find the directory of Intel-MPI hydra service to be removed. This directory can be found by clicking on properties of the existing service (e.g., "`C:\Program Files\Intel MPI 2018`"), see Figures I.2.32 and I.2.33. The name of the executable associated to the service ("`hydra_service.exe`") can also be found in the properties of the service. Type in the command prompt:
  - `cd "C:\Program Files\Intel MPI 2018"`
  - `hydra_service.exe -stop`
  - `hydra_service.exe -remove`

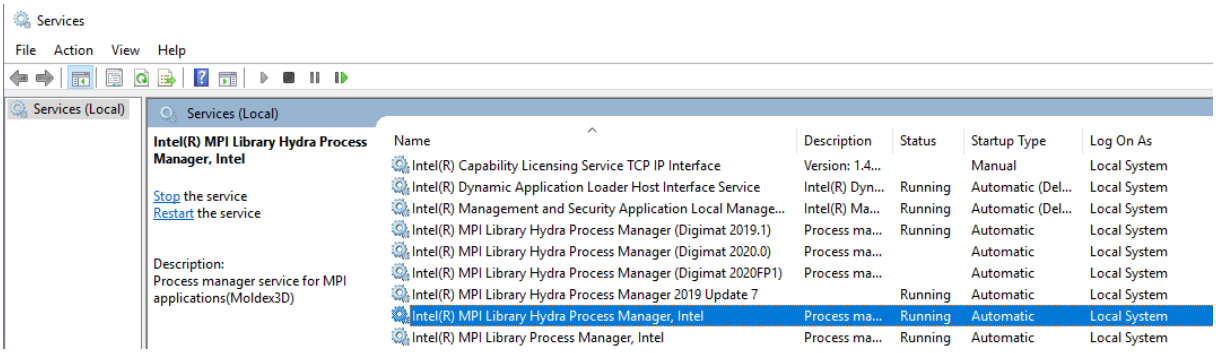


Figure I.2.32: Intel-MPI hydra service.

To re-install a new Intel-MPI hydra service:

- Open a Command prompt as an administrator.
- Go to directory of Intel-MPI hydra service to be installed.
- Type `hydra_service.exe -install`.

In case of conflicts with another Intel-MPI hydra service, please contact digimat.support@mscsoftware.com.

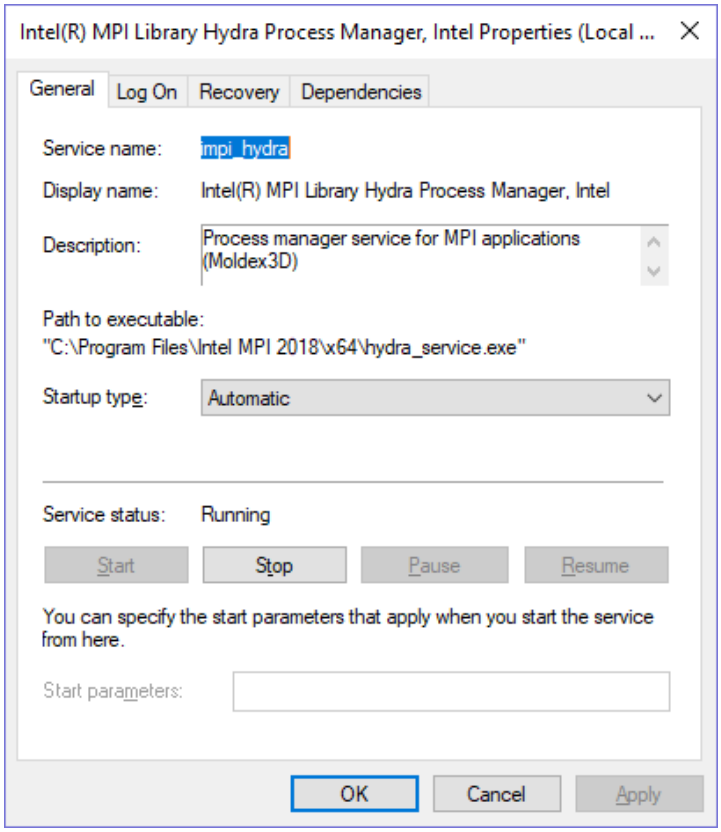


Figure I.2.33: Intel-MPI hydra service installation directory.

I.2.3 Installation of Digimat on a network Windows machine

This section explains extra operations to be able to use Digimat with network installation.

First operation consists in installing Digimat on network machine following procedure described in section I.2.2.

Digimat configuration on server machine

After having installed Digimat on server machine, it is needed to adapt path defined in `DIGIMAT_Settings.ini` file, so that they point now to shared location. For example, suppose that Digimat is installed on server machine in directory:

```
C:\MSC.Software\Digimat\2021.2
```

and suppose that shared location on client machine is:

```
\\AppShare\MSC.Software\Digimat\2021.2
```

Then, `DIGIMAT_Settings.ini` file is located in directory:

```
C:\MSC.Software\Digimat\2021.2\Digimat\exec
```

This file must be edited in 3 steps:

- Path to Digimat executables must be changed to point to shared path. For example, key

  ```
  DIGIMATMF_Directory=C:\MSC.Software\Digimat\2021.2\DigimatMF\exec
  ```

  must be changed into:

  ```
  DIGIMATMF_Directory=\\AppShare\MSC.Software\Digimat\2021.2\DigimatMF\exec
  ```

- Path to working directory must point to a local directory, e.g. `C:\temp`: key

  ```
  Working_Directory=C:\MSC.Software\Digimat\working
  ```

  must be changed into:

  ```
  C:\temp
  ```

- Finally, path to CAE codes must also be adapted if needed.

In same directory as `DIGIMAT_Settings.ini` file, a Python script (`installDigimatNetwork.py`) is provided. Running this python script will automatically adapt path to Digimat executables and to Digimat working directories. This file is used in the following way:

- Open the script in a text editor
- Adapt the path for initial and new Digimat installation path and for new Digimat working directory:

  ```
  instdir = 'C:\\MSC.Software\\Digimat'
  new_instdir = '\\\\AppShare\\MSC.Software\\Digimat'
  new_workdir = 'C:\\temp'
  ```

- Run Python script like:

  ```
  python.exe installDigimatNetwork.py
  ```

- `DIGIMAT_Settings.ini` file is now adapted with new path to Digimat executables. Backup of initial `DIGIMAT_Settings.ini` file (with `_old` suffix) is also created.

For full explanation about content of `DIGIMAT_Settings.ini` file, please see section I.2.6.

Digimat configuration on client machine

In order to make Digimat fully functional on client machine, three environment variables must be defined on each client machine:

- `MSC_LICENSE_FILE` pointing to MSC license server.
- `DIGIMAT_BIN_20212` pointing to `DIGIMAT_Settings.ini` file of shared installation, for example:
  `\\AppShare\MSC.Software\Digimat\2021.2\Digimat\exec`
- `DIGIMAT_FONT_CACHE` pointing to a local directory accessible in writing mode by the user, typically
  `C:\temp\fonts`
  This directory will contain the files related to the font cache specific to the client machine, which will be automatically created the first time they are needed. This creation operation may take up to several minutes but will happen only once, provided that the font cache directory is not modified or deleted. Next usage will then be smoother.

Reverse engineering on client machine

The reserve engineering can be very slow in case of network installation where the Digimat executables are called through the local network. To solve this problem, all the libraries and executables are copied on the local computer, on which Digimat will be run, in a folder located in Digimat-MX working directory.

To activate this particular installation, it is necessary to modify the Digimat setting `DIGIMATMX_Local_Installation` to true. This can be done through Digimat platform setting (see Figure I.2.34). Apply this setting modification will create, at the first execution of Digimat-MX, a new folder named bin in the Digimat-MX working directory and copy all the needed files.

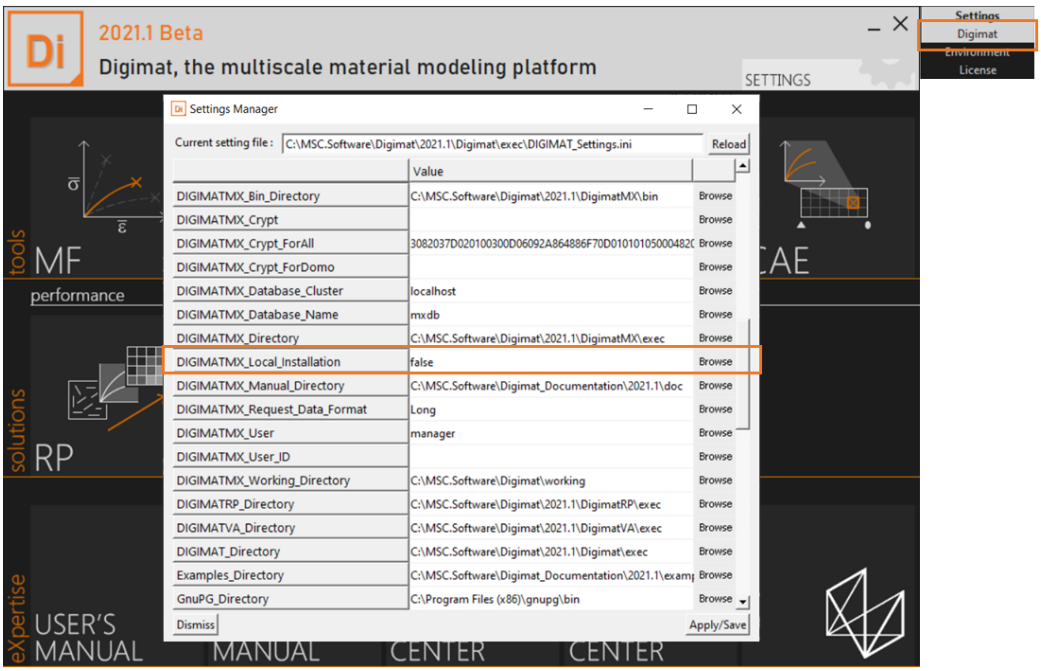


Figure I.2.34: Digimat-MX local installation setting.

I.2.4 Installation of Digimat-MX database

This section explains the steps to install Digimat-MX remote database.

Database installation

Material data can be easily accessed from databases in several Digimat modules, Digimat-MX in particular. Hence such a database must be created to enable material data access in 2 different ways.

- **Local database**: The database is physically located on the disk of the (only) computer used to connect to it. Such configuration is relevant when a single user needs material data acess.
- **Remote database**: The database is physically located on a computer server to which several Digimat-MX installations installed on distant computers can connect. Such configuration is relevant when several users need to share material data.

Local database installation

A **local database** is exclusively created *during* the Digimat installation process in a directory besides Digimat installation directory (e.g., `C:\MSC.Software\Digimat_LocalDatabases\XXXX.X\postgresql`). As the new – so-called built-in – local database is likely intended to become the default one, together with the new Digimat installation, its creation deactivates – but does not modify – any database created with an earlier Digimat version on which a server is running. Such an active database may exist especially with Digimat 2016.0 and earlier versions, which enabled advanced local databases administration similar to remote databases administration. Hence, stopping any running server and unregistering any active service prior to Digimat installation would prevent from any inconvenience, e.g., abrupt disconnection.

The built-in local database creation involves 3 possible actions.

- Select the component "Local material database" (cf. Figure I.2.12; selected by default).
- Request to reset a previous database of the same Digimat version if such a database exists (cf. Figure I.2.13; not requested by default). In such a case, the existing database is deleted before creating the new one (cf. Section **??**).
- Request to migrate a previous database of an earlier Digimat version if such a database exists (cf. Figure I.2.14; not requested by default). In such a case, the private grades of the existing database are imported at the end of Digimat installation via Digimat-MX local databases administration window (cf. Section **??** and Figure I.2.26).

Remote database installation

A **remote database** can be created *after* Digimat installation, via Digimat-MX remote database administration (cf. Section **??** and Section **??**). Such a database is usefully associated to a Windows service. In addition, its creation requires to stop the postgresql server of all remote databases currently running.

The creation of a remote database may even constitute the only purpose of Digimat installation, i.e., on a computer server. In such a case, any server (resp. service) running on a remote database of an earlier Digimat

version already existing on the computer server must be stopped (resp. unregistered) with the corresponding Digimat-MX version prior to the uninstallation of the earlier version and the installation of the new version.

Install successively Digimat and the remote database as follows.

- Install Digimat and select only the Digimat-MX component (cf. Figure I.2.12). In particular, do not select the component "Local material database".
- Open Digimat-MX and do not connect to any database.
- Open the remote databases administration window via the menu "Administration" / "Remote databases" / "Databases".
- Select "New" / "Create". (Define a service if appropriate.)
- Choose the new database and select "Server" / "Start" or "Service->Start".
- Close Digimat-MX.

To continue working with a remote database of an earlier Digimat version already existing on the computer server, upgrade it as follows (cf. Section **??**).

- Open Digimat-MX and do not connect to any database.
- Open the remote databases administration window via the menu "Administration" / "Remote databases" / "Databases".
- Choose the existing database to upgrade and select "Server" / "Upgrade".
- Choose the upgraded database and select "Server" / "Start" or "Service" / "Create" and "Service->Start".
- Close Digimat-MX.

I.2.5 Installation of Digimat on a linux machine

This section demonstrates the most straightforward way to create an **installation of the Digimat software on a Linux machine**.

It supposes that a Digimat license server has already been installed (see section I.1.1).

- Step 1 : Unzip installer in a temporary directory (see Figure I.2.35):
  `unzip Digimat2021.2-rNNNNN-MMMM-OOOO-Linux64bit.zip`
- Step 2 : Execute Digimat installation script: `./DigimatInstall` (see Figure I.2.36)
- Step 3 : If accept license agreement, type 1 (see Figure I.2.37)
- Step 4 : If accept the general conditions, type 1 (see Figure I.2.38)
- Step 5 : Select Digimat installation directory (see Figure I.2.39)
- Step 6 : Digimat installation in progress (see Figure I.2.40)
- Step 7 : Introduce Digimat license adress (see Figure I.2.41)
- Step 8 : End of Digimat installation (see Figure I.2.42)

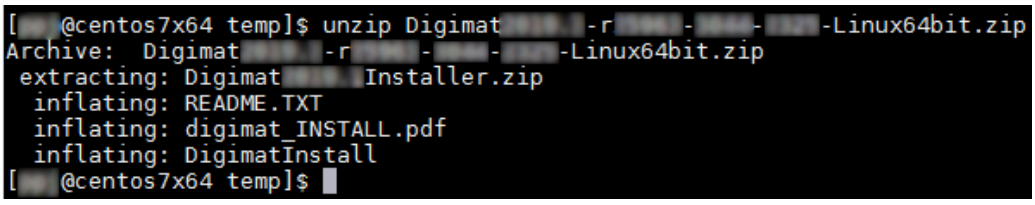


Figure I.2.35: Unzip installation file.

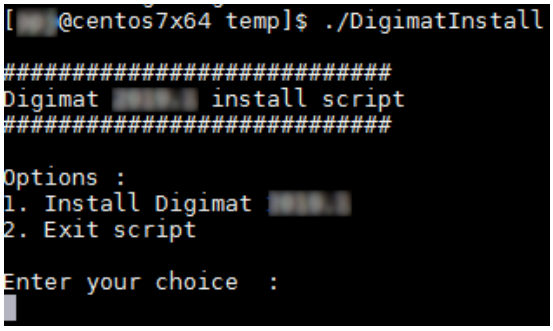


Figure I.2.36: Execute installation script.

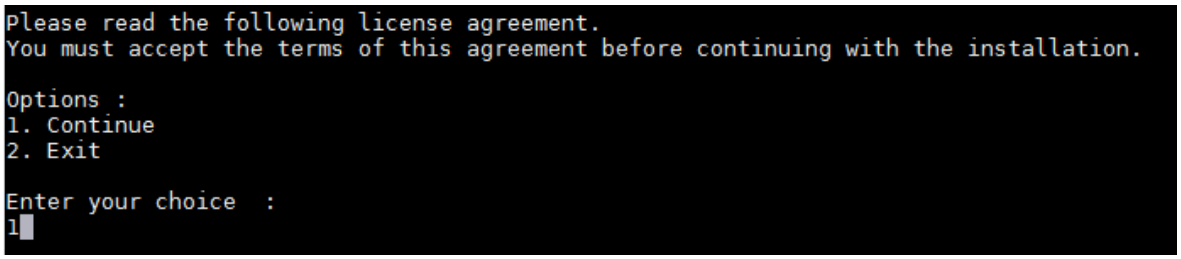


Figure I.2.37: License agreement.

```
14.8    All notices will be in writing.  Notices permitted or required under this Agre
ement shall be delivered
personally (including courier service), by certified or registered mail, return receip
t requested, or by confirmed
facsimile transmission.  Notices shall be effective upon receipt.  If notice is sent t
o MSC, it shall be directed
to the attention of the Legal Department.
14.9    Customer acknowledges and agrees that any and all consulting services performe
d or to be performed by MSC
for Customer are independent of Customer's purchase and use of the Software licenses.
Customer further agrees that
payment for Software licensed hereunder is in no way dependent or in any other way ass
ociated with the
commencement, completion or delivery of consulting services.
14.10   The English language version of this Agreement is legally binding in case of a
ny inconsistencies between
the English version and any translations.


Contacts:

http://www.e-Xstream.com
info@e-Xstream.com

--------------------------------------------------------------------------


Do you accept the agreement ?
Options :
1. Yes (Continue)
2. No (Exit)

1
```

Figure I.2.38: General conditions.

```
Digimat [redacted] installation requires [redacted] of disk space

Write permissions are required in target installation directory

Enter target installation directory (example : /msc). A directory /Digimat/[redacted] will
 be automatically created :
```

Figure I.2.39: Select Digimat installation directory.

```
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/SCA/libMXP_22_0.so
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libDeFeaPSRelated.so
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libicudata.so
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libicudata.so.60
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libicui18n.so
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libicui18n.so.60
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libicuio.so
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libicuio.so.60
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libicuuc.so
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libicuuc.so.60
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libJavaSCAModule.so
  inflating: /home/[redacted] /Digimat/[redacted] /Digimat/lib/xfg/xfg/libkernel_io.so
```

Figure I.2.40: Digimat installation progress.

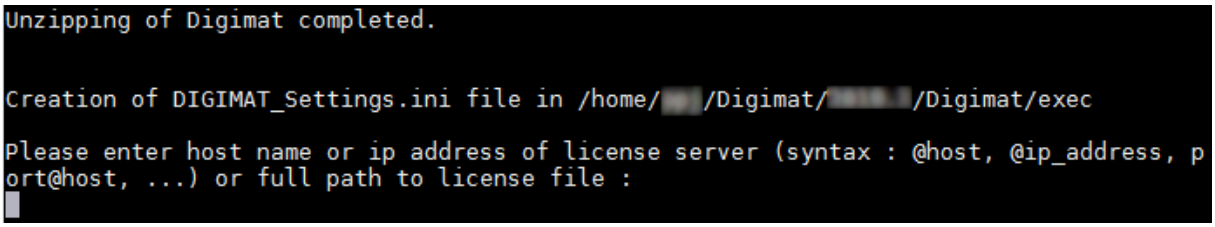


Figure I.2.41: License server adress.

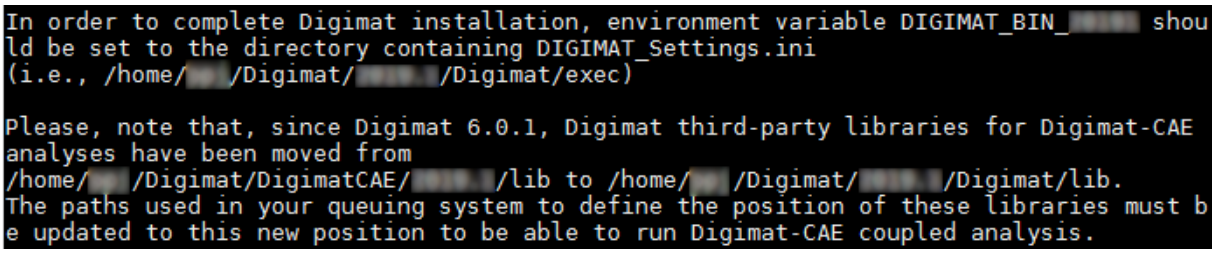


Figure I.2.42: End of Digimat installation.

I.2.6 Digimat settings

MSC_LICENSE_FILE environment variable

Under Windows platform, MSC_LICENSE_FILE environment variable is defined at Digimat installation as global environment variable. This environment variable is used to define path to the license server(s). If an initial value exists, Digimat installation will propose this value.

If MSC_LICENSE_FILE is not defined as environment variable, no Digimat product can run.

The licensing location defined by MSC_LICENSE_FILE can be directly checked by using the "License" option of the Digimat platform (see Figure I.2.43). Clicking on "Query status" will give a status of license server defined in MSC_LICENSE_FILE (number of available/used licenses...).

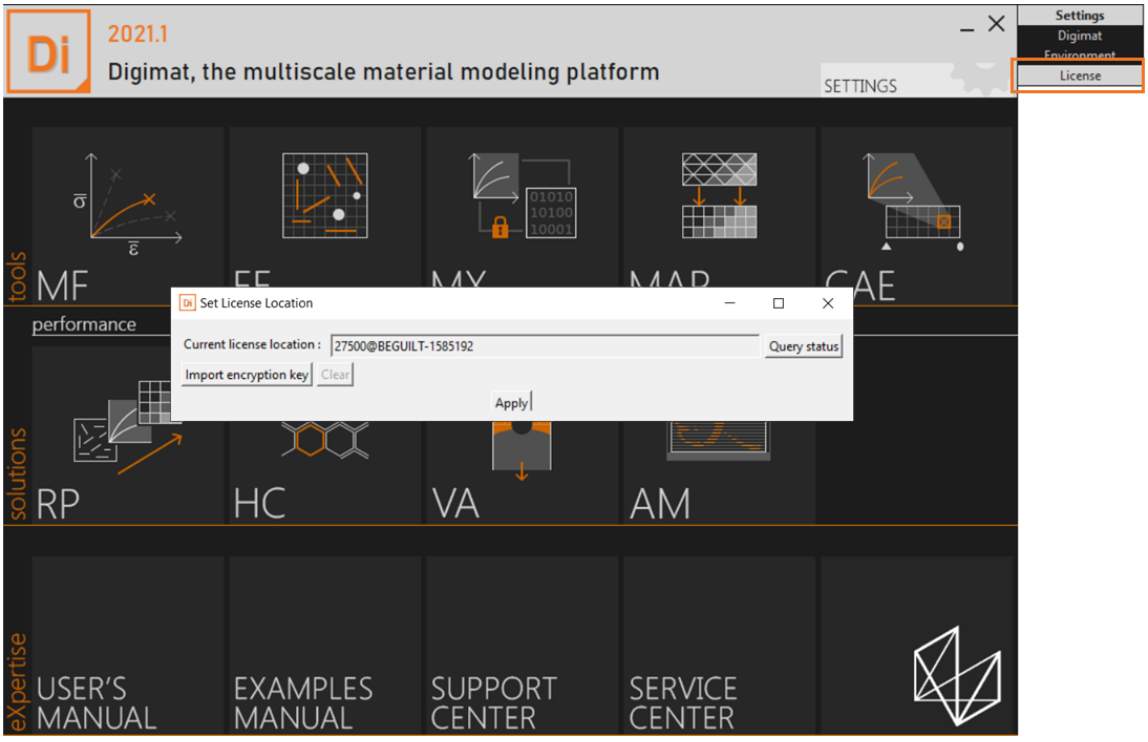


Figure I.2.43: Checking the licensing location via the Digimat platform.

DIGIMAT_BIN_20212 environment variable

Under Windows platform, DIGIMAT_BIN_20212 environment variable is defined at Digimat installation as a global environment variable. This environment variable is used to define directory of DIGIMAT_Settings.ini file (see section I.2.6). After installation, DIGIMAT_BIN_20212 points initially to directory:

```
DIGIMAT_INSTALL_DIR\Digimat\exec
```

with DIGIMAT_INSTALL_DIR is the Digimat 2021.2 installation directory, e.g.,

C:\MSC.Software\Digimat\2021.2

If this value is not defined, it will be defined by Digimat product launching scripts (Digimat platform, Digimat-MF GUI ...). Global environment variable always override the one defined in Digimat product launching scripts.

Value of DIGIMAT_BIN_20212 can be checked from the setting of Digimat platform and then changed to point to another DIGIMAT_Settings.ini file (see Figure I.2.44). This change can be done only in admnistrator mode.

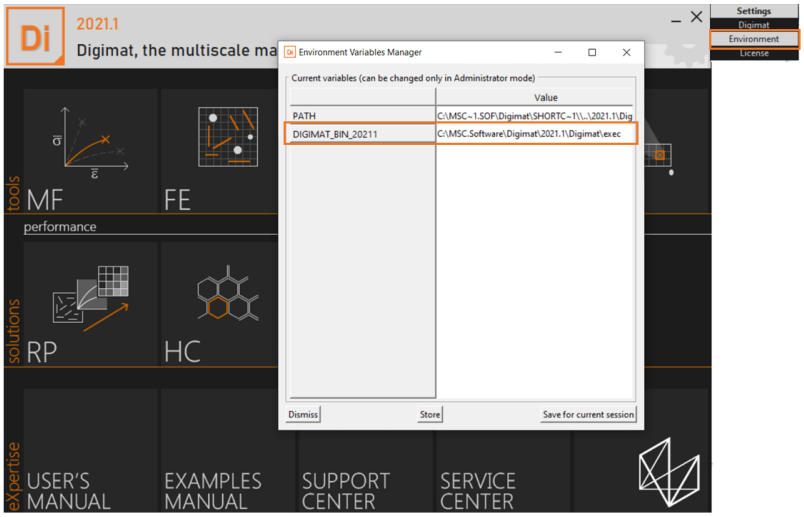


Figure I.2.44: Definition of Digimat environment variables

Remark: When using Digimat-CAE plugins (Abaqus, ANSYS and Marc Mentat), it is mandatory to define the global DIGIMAT_BIN_20212 environment variable as pointing to a valid directory containing DIGIMAT_Settings.ini file, e.g.,

C:\MSC.Software\Digimat\2021.2\Digimat\exec

Under Linux platform, the DIGIMAT_BIN_20212 environment variable must always be set manually to point on a valid DIGIMAT_Settings.ini file.

During Digimat installation, path to the shortcuts folder, containing the file that launches the Digimat platform is added to the system environment variable PATH.

Additional environment variables for network installations of Digimat

See section I.2.3 to get all information relative to network installation settings.

The DIGIMAT_Settings.ini file

Digimat settings are set by the **DIGIMAT_Settings.ini** file which contains a list of key-values. This file is read by Digimat each time the platform is launched to let them become the current settings. The entire Digimat installation can be parameterized by these settings.

Digimat looks in the following directories for the `DIGIMAT_Settings.ini` file:

1. in the current working directory, i.e., the directory in which the computation is run;
2. in the directory pointed to by the environment variable `DIGIMAT_BIN_20212` .

Note that Digimat will use the first `DIGIMAT_Settings.ini` file that it finds! Since it first looks in the current working directory, it allows using a local settings file, and if none is defined, it is not problematic as long as it can find the global settings file defined in the folder where the `DIGIMAT_BIN_20212` variable is pointing to.

The `DIGIMAT_Settings.ini` file can be modified from the platform settings menu (see Figure I.2.45) or directly via a text editor.

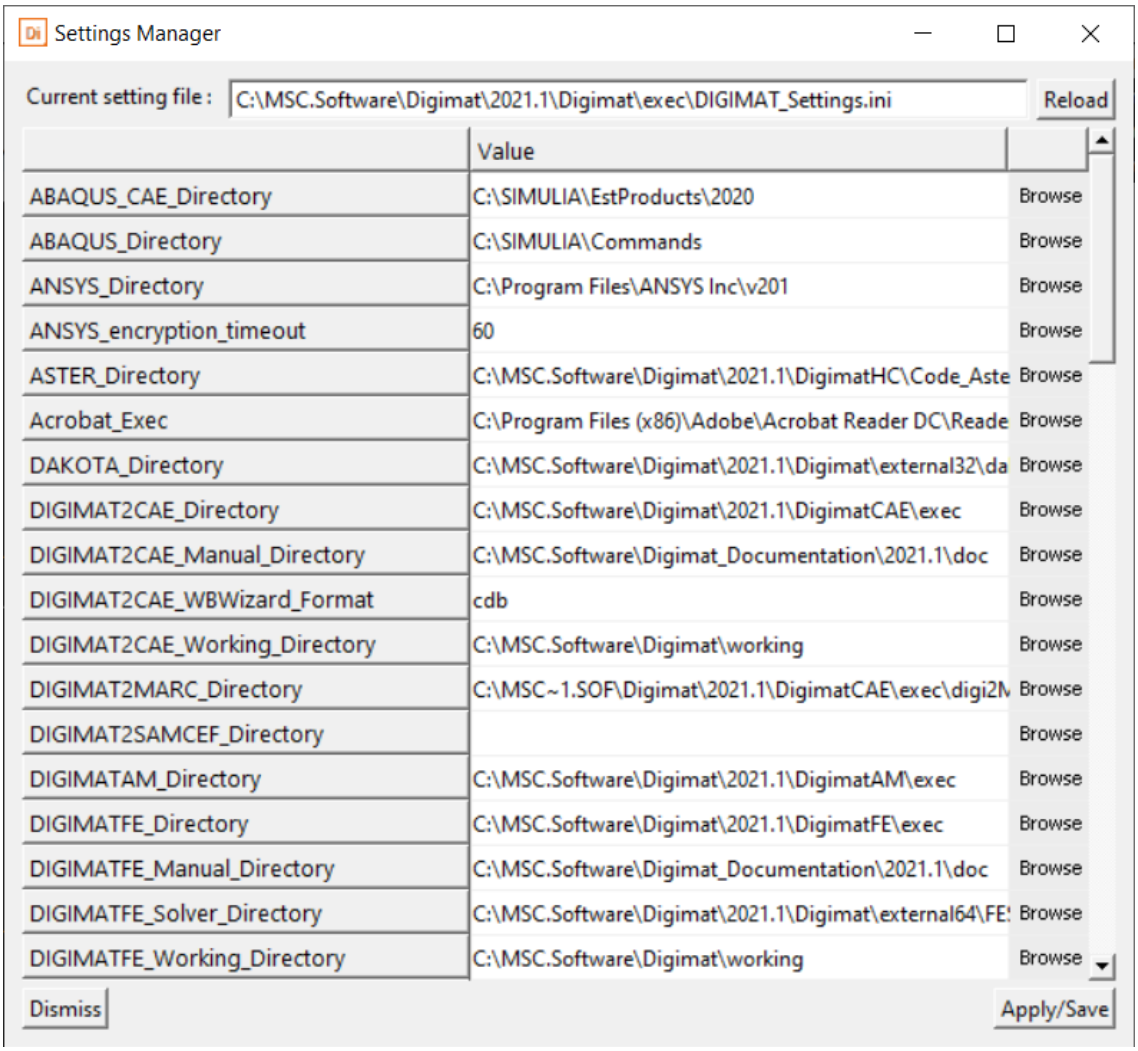


Figure I.2.45: Definition of Digimat settings.

Structure of the `DIGIMAT_Settings.ini` file

The `DIGIMAT_Settings.ini` file is made of sections delimited by a line '`[SectionKeyWord]`', each section containing a list of lines '`key = value`'.

For the current version, this file is made of a unique section which is identified by the `[Default]` tag as a header to the file content. The list of keys that can be used is the following:

- ABAQUS_CAE_Directory: path to the Abaqus CAE directory.
- ABAQUS_Directory: path to the Abaqus root directory.
- ANSYS_Directory: path to the ANSYS root directory.
- ANSYS_encryption_timeout: relates to the encryption of material properties when using Macro solution in Digimat-RP for ANSYS. Number of seconds between the beginning of the ANSYS-service startup process, and its forced termination by Digimat. This entry is generated during Digimat installation, with a default value of 60. It should be defined according to the ANSYS licence timeout settings.
- ASTER_Directory: path to the ASTER binaries.
- Acrobat_Exec: path to Adobe Reader executable, including its name.
- DAKOTA_Directory: path to Dakota binaries.
- DIGIMAT2CAE_Directory: path to the Digimat-CAE binaries.
- DIGIMAT2CAE_Manual_Directory: path to the Digimat-CAE documentation. It is used by Digimat when opening the documentation (general or context help page) from the GUI.
- DIGIMAT2CAE_WBWizard_Format: Deprecated setting
- DIGIMAT2CAE_Working_Directory: path to the working directory used by Digimat-CAE.
- DIGIMAT2MARC_Directory: path to the directory containing Digimat-CAE/Marc executable (see Section I.4.4).
- DIGIMAT2SAMCEF_Directory: path to the directory containing Digimat-CAE/Samcef executable (see Section I.4.6).
- DIGIMATAM_Directory: path to the Digimat-AM binaries.
- DIGIMATFE_Directory: path to the Digimat-FE binaries.
- DIGIMATFE_Manual_Directory: path to the Digimat-FE documentation. It is used by Digimat when opening the documentation (general or context help page) from the GUI.
- DIGIMATFE_Solver_Directory: path to Digimat-FE solver directory.
- DIGIMATFE_Working_Directory: path to the working directory used by Digimat-FE.
- DIGIMATHC_Directory: path to the Digimat-HC binaries.
- DIGIMATHC_Manual_Directory: path to the Digimat-HC documentation. It is used by Digimat when opening the documentation (general or context help page) from the GUI.
- DIGIMATHC_Working_Directory: path to the working directory used by Digimat-HC.
- DIGIMATMF_Directory: path to the Digimat-MF binaries.
- DIGIMATMF_Manual_Directory: path to the Digimat-MF documentation. It is used by Digimat when opening the documentation (general or context help page) from the GUI.
- DIGIMATMF_Output_Precision: Number of significant number for Digimat-MF outputs
- DIGIMATMF_Working_Directory: path to the working directory used by Digimat-MF.
- DIGIMATMX_Bin_Directory: path to PostgreSQL binaries.
- DIGIMATMX_Crypt
- DIGIMATMX_Crypt_ForAll: Decryption key allowing to use all public encrypted materials
- DIGIMATMX_Crypt_ForDomo
- DIGIMATMX_Database_Cluster: list of the locations (**localhost** and **server** IP addresses) of servers on which a successful connection has been made. The first listed value is the location of the server on which the last successful connection occurred and it is the default value used by Digimat-MX. If no successful connection ever occurred, **localhost** is the only value.
- DIGIMATMX_DataBase_Name: Digimat-MX default database to be opened. The default value is mxdb.
- DIGIMATMX_Directory: path to the Digimat-MX binaries.
- DIGIMATMX_Local_Installation: true of false (see section I.2.3).
- DIGIMATMX_Manual_Directory: path to the Digimat-MX documentation. It is used by Digimat when opening the documentation (general or context help page) from the GUI.
- DIGIMATMX_Request_Data_Format: length of the content of the email which is automatically created when requesting data to a material supplier from Digimat-MX. The two possible values are **Long** (which is the default) and **Short** (which is usually required when using Lotus Notes as e-mail client).
- DIGIMATMX_User: Digimat-MX user name.
- DIGIMATMX_User_ID
- DIGIMATMX_Working_Directory: path to the working directory used by Digimat-MX.
- DIGIMATRP_Directory: path to the Digimat-RP binaries.
- DIGIMATVA_Directory: path to the Digimat-VA binaries.
- DIGIMATVA_MODELER_EXTENDED_INTERFACES: must be set to true to allow use of external solver in Digimat-VA.

- DIGIMAT_Directory: path to the working directory used by the Digimat platform.
- Examples_Directory: path to the Digimat examples directory used by Digimat when opening the documentation (general or context help page) from the GUI.
- GnuPG_Directory: path to GnuPG directory. Needed to encrypt material properties when using Macro solution in Digimat-RP for LS-DYNA.
- HYPERWORKS_Directory: path to the HyperWorks root directory.
- LS-Dyna_SMP_Exec: path to LS-DYNA executable used by Digimat-FE.
- LSDYNA_Directory: path to the directory containing Digimat-CAE/LS-DYNA executable (see Section I.4.7).
- LSPREPOST_Directory: path to the LS-PrePost root directory.
- LSTC_PGPKEY: Full path and name of key file needed to encrypt material properties when using Macro solution in Digimat-RP for LS-DYNA. Default location value is Digimat working directory and default name is lstc_pgpkey.asc. This entry is generated during Digimat installation. The way to generate this key is explained in section I.4.7.
- LocalDatabase_Directory: path to the built-in local database.
- LocalDatabase_SQLite_Directory: path to the Digimat-VA database.
- log_output: path to the location where Digimat will output its log messages. This is one of the keys a user could most probably be brought to change. The different choices are:
  - Default: the Digimat messages will be output to the default location which means, for example:
    - in the .log file of the analysis/job if using Digimat-MF or a Digimat-CAE interface;
    - the dos screen when using the interface to ANSYS, ...
  - Any valid path to a file, including its name. The log messages will be output to the indicated file.
- MAP_Directory: path to the Digimat-MAP binaries.
- MAP_Manual_Directory: path to the Digimat-MAP documentation. It is
- MAP_Working_Directory: path to the working directory used by Digimat-MAP.
- MARC_Directory: path to the Marc root directory.
- MENTAT_Directory: path to the Marc Mentat root directory.
- MSCNASTRAN_Directory: path to the MSC Nastran root directory.
- Manual_Directory: path to the Digimat documentation.
- Number_of_processors: Number of processors of computer where Digimat is installed.
- OPTISTRUCT_Directory: path to the OptiStruct root directory.
- PAMCRASH_Directory: path to the PAM-CRASH root directory.
- PATRAN_Directory: path to the Patran root directory.
- PCMPI_Directory: path to Platform-MPI directory.
- PERMAS_Directory: path to the PERMAS root directory.
- POSTGRESQL_PORT: Port for access to remote database.
- RADIOSS_Directory: Deprecated.
- SAMCEF_Directory: path to the Samcef root directory.
- Specific_features: list of opened specific features (see section **??**).
- VISUALVIEWER_Directory: path to the Visual-Viewer root directory.
- WISETEX_Directory: path to Wisetex binaries.
- Working_Directory: path to the working directory used by Digimat.

All these parameters can be set from the Digimat platform settings manager (see Figure I.2.45).

An example of a valid DIGIMAT_Settings.ini file is:

```
[Default]
DIGIMAT_Directory=C:\MSC.Software\Digimat\2021.2\Digimat\exec
Acrobat_Exec=C:\Program Files (x86)\Adobe\Acrobat Reader DC\Reader\AcroRd32.exe
Number_of_processors=16
Working_Directory=C:\MSC.Software\Digimat\working
log_output=Default
WISETEX_Directory=C:\MSC.Software\Digimat\2021.2\Digimat\external32\wisetex
DIGIMATMF_Directory=C:\MSC.Software\Digimat\2021.2\DigimatMF\exec
DIGIMATMF_Working_Directory=C:\MSC.Software\Digimat\working
DIGIMATFE_Directory=C:\MSC.Software\Digimat\2021.2\DigimatFE\exec
DIGIMATFE_Working_Directory=C:\MSC.Software\Digimat\working
```

```
DIGIMATFE_Solver_Directory=C:\MSC.Software\Digimat\2021.2\Digimat\external64\FESolver
LS-Dyna_SMP_Exec=C:\LSDYNA\ls-dyna_smp_d_R930_winx64_ifort131.exe
MAP_Directory=C:\MSC.Software\Digimat\2021.2\DigimatMAP\exec
MAP_Working_Directory=C:\MSC.Software\Digimat\working
DIGIMATHC_Directory=C:\MSC.Software\Digimat\2021.2\DigimatHC\exec
DIGIMATHC_Working_Directory=C:\MSC.Software\Digimat\working
ASTER_Directory=C:\MSC.Software\Digimat\2021.2\DigimatHC\Code_Aster81
DIGIMATRP_Directory=C:\MSC.Software\Digimat\2021.2\DigimatRP\exec
DIGIMATVA_Directory=C:\MSC.Software\Digimat\2021.2\DigimatVA\exec
DIGIMATAM_Directory=C:\MSC.Software\Digimat\2021.2\DigimatAM\exec
DIGIMATVA_Working_Directory=C:\MSC.Software\Digimat\working
DIGIMAT2CAE_Directory=C:\MSC.Software\Digimat\2021.2\DigimatCAE\exec
DIGIMAT2CAE_Working_Directory=C:\MSC.Software\Digimat\working
DIGIMAT2CAE_WBWizard_Format=cdb
MARC_Directory=C:\Program Files\MSC.Software\Marc\2020.0.0\marc2020.0
MSC_LICENSE_FILE=27500@localhost
ABAQUS_Directory=C:\SIMULIA\Commands
ANSYS_Directory=C:\Program Files\ANSYS Inc\v202
MENTAT_Directory=C:\Program Files\MSC.Software\Marc\2020.0.0\mentat2020.0
MSCNASTRAN_Directory=C:\MSC.Software\MSC_Nastran\20190
PATRAN_Directory=C:\MSC.Software\Patran_x64\20190
ALTAIR_Directory=C:\Program Files\Altair\2018
PERMAS_Directory=C:\Program Files\INTES\V17
DIGIMATMX_Directory=C:\MSC.Software\Digimat\2021.2\DigimatMX\exec
DIGIMATMX_Bin_Directory=C:\MSC.Software\Digimat\2021.2\DigimatMX\bin
DIGIMATMX_Working_Directory=C:\MSC.Software\Digimat\working
DIGIMATMX_DataBase_Name=mxdb
DIGIMATMX_Database_Cluster=localhost
DIGIMATMX_User=manager
DIGIMATMX_Local_Installation=false
DIGIMATMX_Request_Data_Format=Long
LocalDatabase_Directory=C:\MSC.Software\Digimat_LocalDatabases\2021.2\postgresql
LocalDatabase_SQLite_Directory=C:\MSC.Software\Digimat_LocalDatabases\2021.2\sqlite
DAKOTA_Directory=C:\MSC.Software\Digimat\2021.2\Digimat\external32\dakota
DIGIMATMX_Crypt_ForAll=3082037D020100300D06092A864886F70D01010105000482...
GnuPG_Directory=C:\Program Files (x86)\gnupg\bin
LSTC_PGPKEY=C:\MSC.Software\Digimat\working\lstc_pgpkey.asc
Manual_Directory=C:\MSC.Software\Digimat_Documentation\2021.2\doc
Examples_Directory=C:\MSC.Software\Digimat_Documentation\2021.2\examples
DIGIMATMF_Manual_Directory=C:\MSC.Software\Digimat_Documentation\2021.2\doc
DIGIMATFE_Manual_Directory=C:\MSC.Software\Digimat_Documentation\2021.2\doc
MAP_Manual_Directory=C:\MSC.Software\Digimat_Documentation\2021.2\doc
DIGIMATHC_Manual_Directory=C:\MSC.Software\Digimat_Documentation\2021.2\doc
DIGIMAT2CAE_Manual_Directory=C:\MSC.Software\Digimat_Documentation\2021.2\doc
DIGIMATMX_Manual_Directory=C:\MSC.Software\Digimat_Documentation\2021.2\doc
```

Remarks

- The listing order of the keywords does not matter.
- Trailing or leading white spaces, tabulations, or quotations marks (') are removed from the values.
- The initial keyword [Default] must be defined.
- A path including directories with long names can be written in short notation, e.g., `C:\Progra~1\Digimat`.

Installation I.3

Digimat documentation

Since Digimat 2016.0, it is possible to install Digimat documentation before, after or automatically during Digimat software installation. It is also possible to use existing Digimat documentation when installing Digimat software (see figure I.2.10). When installing Digimat documentation separately from main Digimat software, the following step by step procedure must be followed.

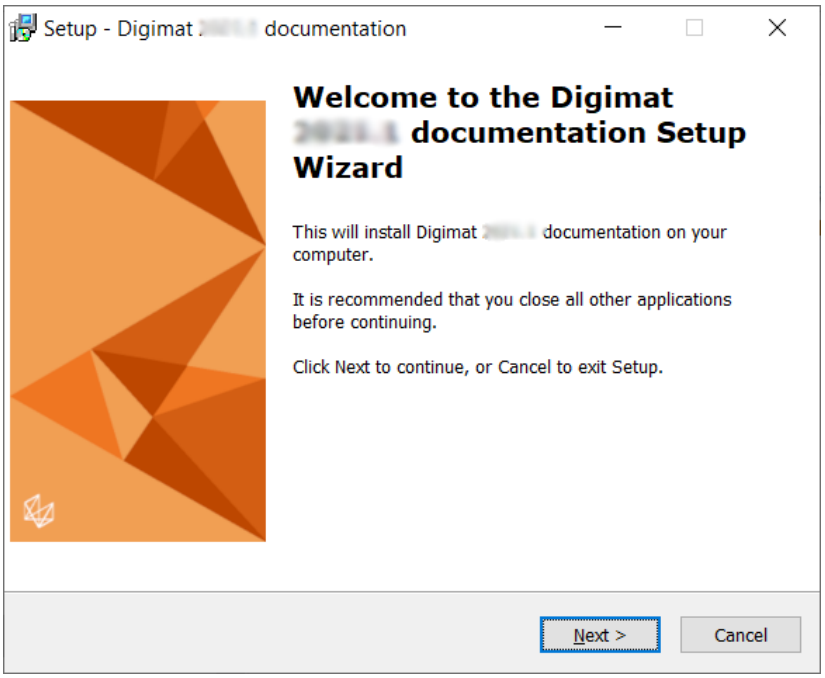


Figure I.3.1: Opening prompt of the Digimat documentation installer. Follow the given instructions step-by-step.

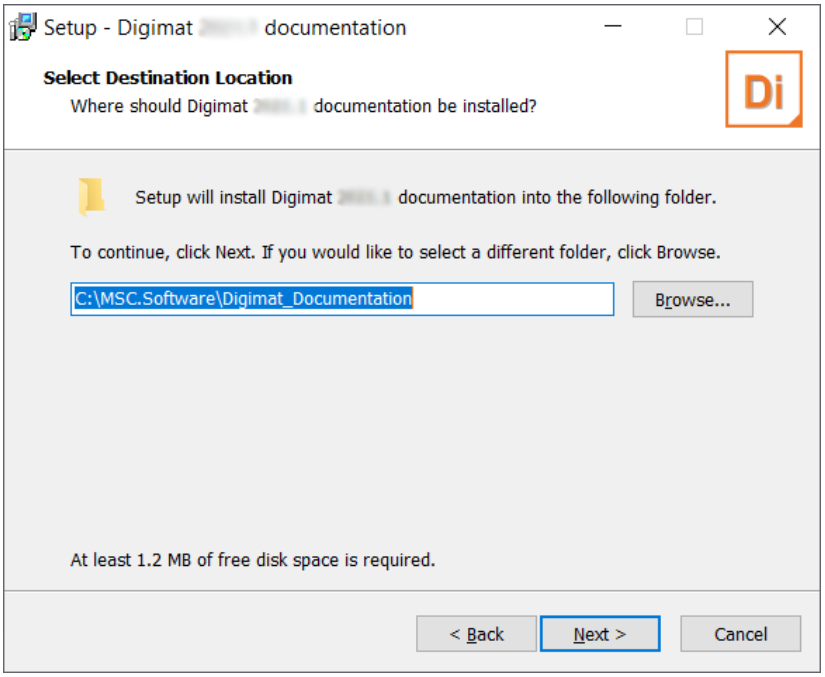


Figure I.3.2: The destination folder for the Digimat documentation installation has to be given. A 2021.2 directory will be automatically created.

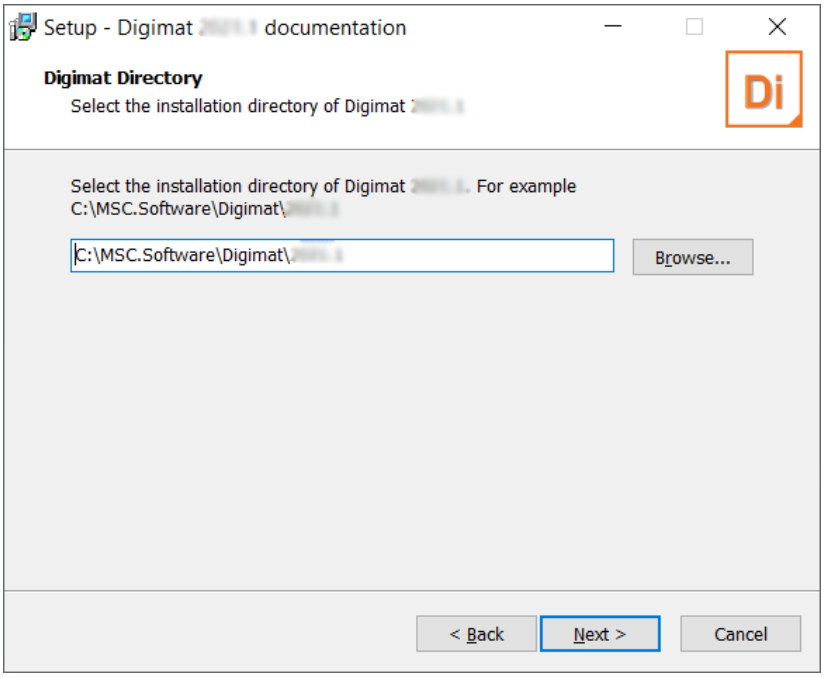


Figure I.3.3: User has to point to an existing Digimat directory. So the settings of Digimat will be automatically updated to point to this documentation directory. This field can remain blank if Digimat will be installed in a second step. In that case, when installing Digimat software, user has to select this Digimat documentation installation directory (see figure I.2.10). Note that user cannot point to a Digimat prior to Digimat 2016.0.

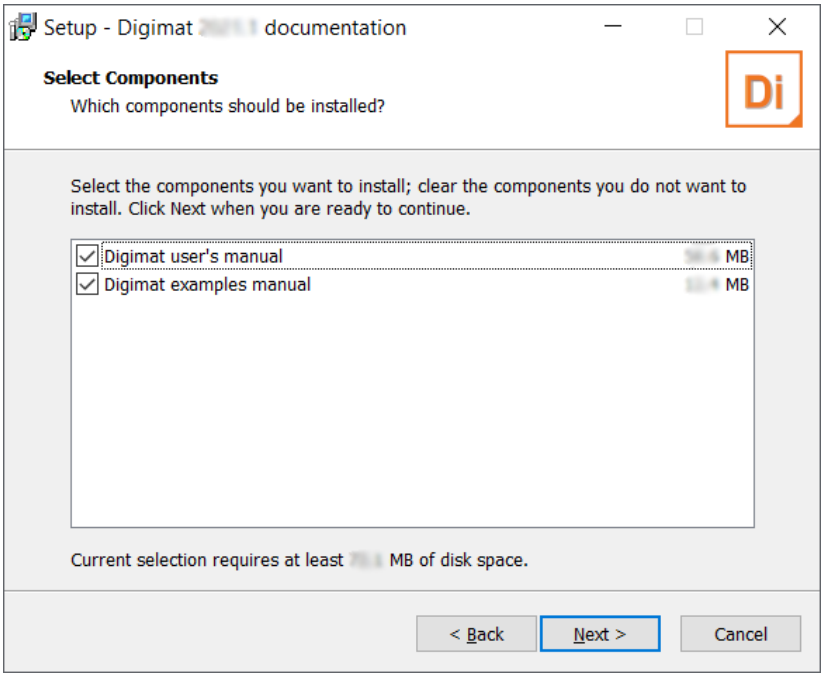


Figure I.3.4: The required Digimat documentation modules can be chosen individually to save disk space for the installation. In the default case as used here all modules will be installed.

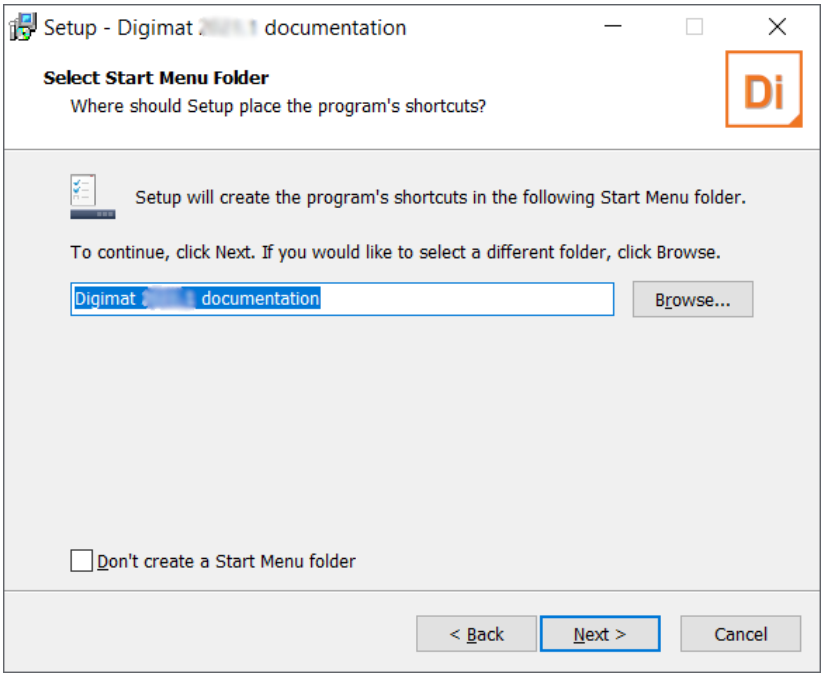


Figure I.3.5: An individual name for the Digimat documentation shortcut can be specified.

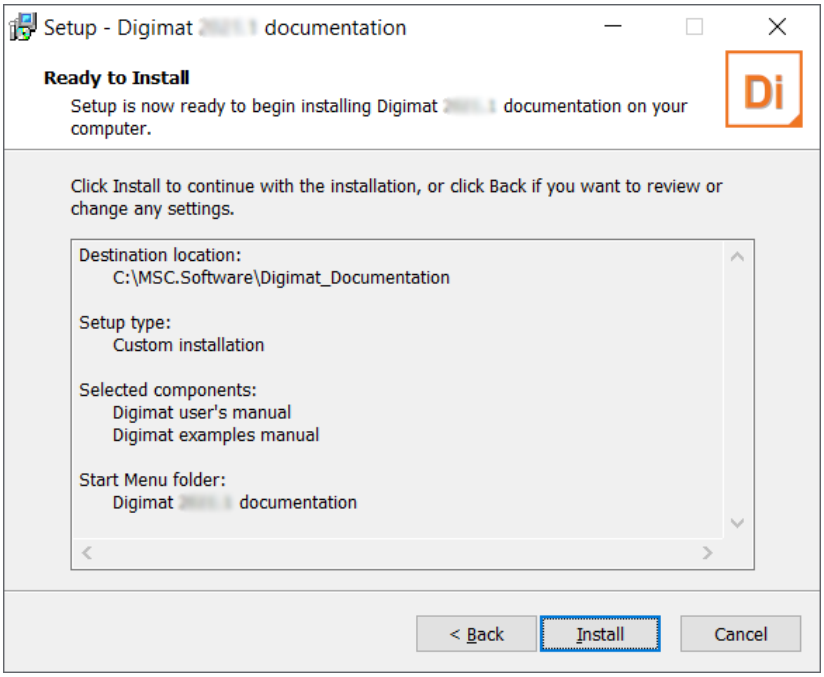


Figure I.3.6: A summary of the installation details is given and can be checked. Proceeding with the "Install" button will start the installation of Digimat documentation.

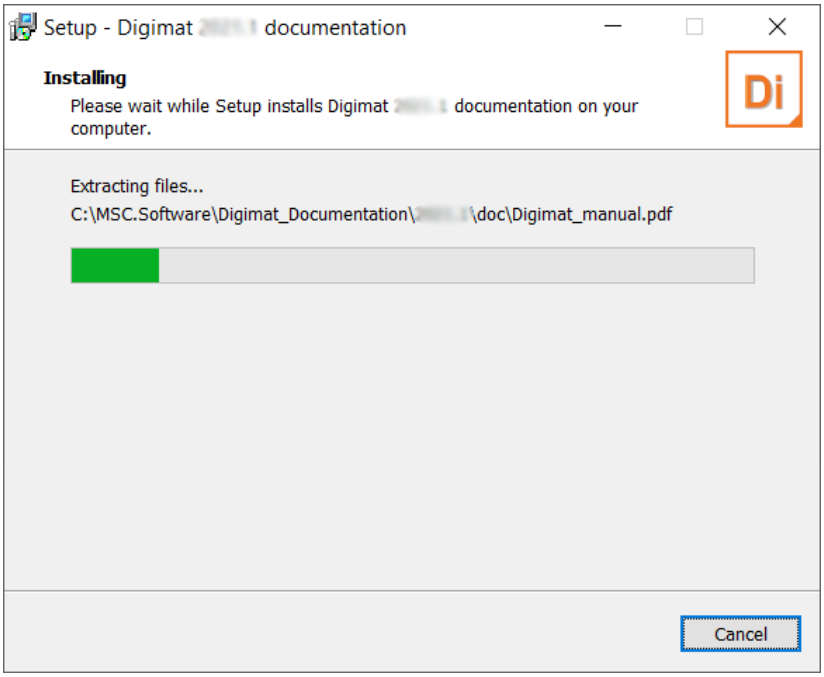


Figure I.3.7: The installation of the Digimat documentation is executed.

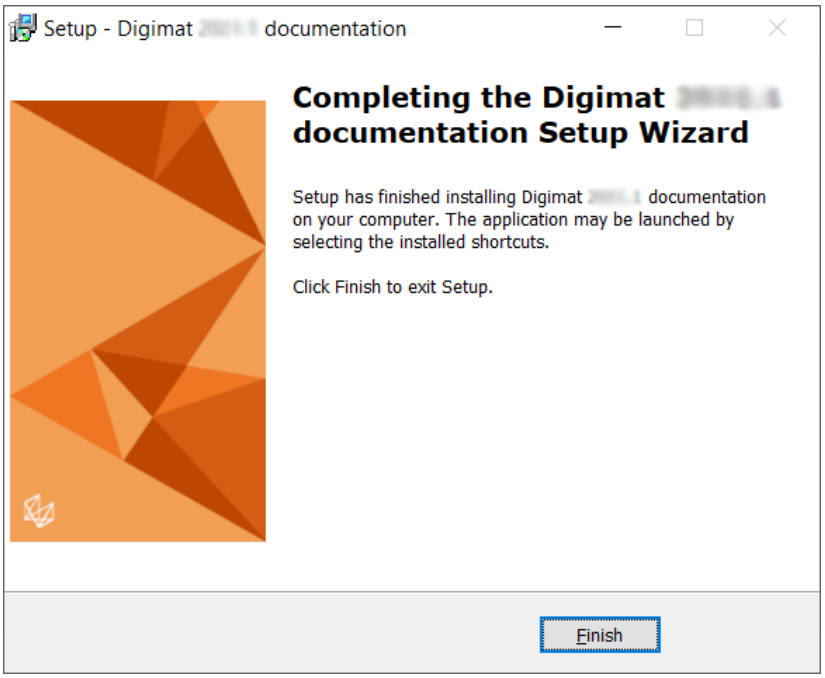


Figure I.3.8: Finalization of the installation.

Installation I.4

Digimat-CAE interfaces

I.4.1 Digimat-CAE/Generalities

This section describes common settings to be able to run Digimat-CAE simulations. They apply to all supported interfaces.

In case of *parallel computation*, one structural feature seat is first used, and for the other *n-1* processors used for the parallel computation, *n-1* Digimat tokens are checked out. For example, a Digimat-CAE/Marc parallel run on 4 processors consumes 1 seat of a structural feature as well as 3 Digimat tokens.

When performing parallel computations using distributed storage devices, Digimat requires definition of `DIGIMAT2CAE_Working_Directory` setting in `DIGIMAT_Settings.ini` file (see Section I.2.6). This setting has to indicate a global, unique, location which can be accessed by all the processes. **If this setting is not defined, it can result in an overconsumption of license features!**

Linking with CAE software

- Linking Digimat with the external CAE software has to be carefully set up and tested.
- Please note that depending on the solver type and platform special linker software might be required.
- The detailed linking procedure for each CAE solver is described in detail in this chapter
  - Please refer to the individual section of the required CAE code below.

I.4.2 Digimat-CAE/Abaqus

The objective of this section is to explain how to install the interface between Digimat and Abaqus. For more information concerning supported Abaqus releases and platforms, please refer to the below section I.4.2.

Supported versions

Digimat 2021.2 supports following Abaqus versions:

- Abaqus 2018 GA
- Abaqus 2019 GA
- Abaqus 2020 GA

Abaqus HotFix version are not officially supported. Please contact digimat.support@mscsoftware.com in case of issue with HotFix. All Abaqus 201X-EFy versions or similar are not supported.

Digimat 2021.2 supports following platforms for Abaqus interface:

- Windows 10 64bits
- Linux Red Hat 6.3 using GLIBC $\geq$ 2.12 and GLIBCXX $\geq$ 3.4.13 (for Abaqus older than 2020)
- Linux Red Hat 7.3 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.5 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.7 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux SUSE 12 SP1
- Linux SUSE 12 SP2
- Linux SUSE 12 SP4

Digimat 2021.2 supports following parallelization methods:

- For Windows platforms
  - Shared Memory Parallelization (SMP)
  - Distributed Memory Parallelization (DMP) using MS-MPI (default in Abaqus)
- For Linux platforms
  - Shared Memory Parallelization (SMP)
  - Distributed Memory Parallelization (DMP) using Platform-MPI (default in Abaqus)
  - Mixed SMP/DMP computation using Platform-MPI (default in Abaqus)

Digimat 2021.2 supports following Abaqus solutions:

- Abaqus Standard
- Abaqus Explicit single precision
- Abaqus Explicit double precision

Installation procedure

Digimat-CAE/Abaqus is provided as a set of dynamic libraries. These libraries contain Digimat capabilities, allowing the use of Digimat materials in Abaqus analyses. This link is performed on both Linux and Windows operating systems.

Dynamic libraries are version dependent. For example, this means that libraries provided for Abaqus 2020 cannot be used with previous Abaqus versions.

Dynamic libraries are located in the directory

```
DIGIMAT_DIR\DigimatCAE\exec\digi2aba
```

of the Digimat installation. `DIGIMAT_DIR` is Digimat installation directory, e.g.,

- C:\MSC.Software\Digimat\2021.2 (Windows)
- /opt/software/Digimat/2021.2 (Linux)

This directory contains subfolders, each subfolder corresponding to a given supported Abaqus versions. Each of these folders contains three dynamic libraries:

- One single precision library for Abaqus/Explicit:
  - explicitU.dll (Windows)
  - libexplicitU.so (Linux)
- One double precision library for Abaqus/Explicit:
  - explicitU-D.dll (Windows)
  - libexplicitU-D.so (Linux)
- One double precision library for Abaqus/Standard:
  - standardU.dll (Windows)
  - libstandardU.so (Linux)

digi2aba directory also contains dynamic libraries for Digimat kernel (those libraries are common for all Abaqus versions):

- One single precision library for Abaqus/Explicit:
  - digi2abaExp.dll (Windows)
  - libdigi2abaExp.so (Linux)
- One double precision library for Abaqus/Explicit:
  - digi2abaExpDouble.dll (Windows)
  - libdigi2abaExpDouble.so (Linux)
- One double precision library for Abaqus/Standard:
  - digi2abaStd.dll (Windows)
  - libdigi2abaStd.so (Linux)

Finally, third-party components

- boost_chrono-mt-x64.dll
- boost_filesystem-mt-x64.dll
- boost_iostreams-mt-x64.dll
- boost_regex-mt-x64.dll
- boost_system-mt-x64.dll
- boost_thread-mt-x64.dll
- boost_zlib-mt-x64.dll
- digimathdf5.dll
- digimathdf5_cpp.dll
- digimathdf5_hl.dll
- digimatMathTools.dll
- digimatPocoFoundation.dll
- impi.dll
- lapi.dll
- libfabric.dll
- tinyxmlSTL.dll
- VMAP.dll

are located in digi2aba directory under Windows and in Digimat/lib directory under Linux. If the location of the dynamic libraries is changed, usub_lib_dir variable defined in abaqus_v6.env file must be changed accordingly (see below for abaqus_v6.env configuration).

Abaqus environment file `abaqus_v6.env`

To make communication between Abaqus and Digimat, an environment file `abaqus_v6.env` is provided with Digimat installation for each supported Abaqus version. This file depends on:

- targetted Abaqus version.
- parallelization that will be used:
  - SMP
  - DMP

For example, if Abaqus 2020 with DMP parallelization is targetted, it is needed to use `abaqus_v6.env` files located in directory:

`DIGIMAT_DIR/DigimatCAE/exec/digi2aba/2020/DMP`

where `DIGIMAT_DIR` is Digimat installation directory, e.g., `C:\MSC.Software\Digimat\2021.2`.

Abaqus environment file `abaqus_v6.env` for Windows platforms

If `DIGIMAT_DIR` is Digimat installation directory, e.g., `C:\MSC.Software\Digimat\2021.2`, and if Abaqus targetted version is 2020, `abaqus_v6.env` environment file provided in Digimat installation contains following information:

- Path to Digimat-CAE/Abaqus libraries and its dependencies:

  ```
  usub_lib_dir=r"DIGIMAT_DIR\DigimatCAE\exec\digi2Aba\2020"
  usub_lib_dir+="DIGIMAT_INST_DIR\DigimatCAE\exec\digi2Aba"
  ```

- Path to plugin directory:

  ```
  plugin_central_dir=r"DIGIMAT_DIR\DigimatCAE\exec\digi2Aba\abaqus_plugins"
  ```

- Abaqus version:

  ```
  os.environ["ABAQUS_VERSION"] = "2020"
  ```

- Parallelization method information:
  - For SMP computations:

    ```
    mp_mode=THREADS
    ```

  - For DMP computations:

    ```
    cpus = globals().get("cpus", locals().get("cpus", 1))
    standard_parallel=ALL
    os.environ["ABA_MPI_SKIP_BUNCH_NODES"] = "1"
    mp_host_list = [[socket.gethostname(), 1]]*cpus
    mp_mode=MPI
    ```

    Environment variable `ABA_MPI_SKIP_BUNCH_NODES` is needed to force pure DMP computations.

More information about the Abaqus environment file are provided in Abaqus documentation (Environment file settings section).

Abaqus environment file `abaqus_v6.env` for Linux platforms

If `DIGIMAT_DIR` is Digimat installation directory, e.g., `/opt/msc/Digimat/2021.2` and if Abaqus targetted version is 2020, `abaqus_v6.env` environment file provided in Digimat installation contains following information:

- Path to Digimat-CAE/Abaqus libraries and its dependencies:

  ```
  usub_lib_dir='DIGIMAT_DIR/DigimatCAE/exec/digi2aba'
  usub_lib_dir+='DIGIMAT_DIR/DigimatCAE/exec/digi2aba/2020'
  usub_lib_dir+='DIGIMAT_DIR/Digimat/lib'
  ```

- Abaqus version:

  ```
  os.environ['ABAQUS_VERSION'] = '2020'
  ```

- Environment variables to passed to Abaqus computations:

  ```
  os.environ['DIGIMAT_BIN_20212']='DIGIMAT_DIR/Digimat/exec'
  os.environ['MSC_LICENSE_FILE']='27500@hostname'
  os.environ['FLEXLM_TIMEOUT']='5000000'
  mp_environment_export =
  tuple(list(mp_environment_export)+['DIGIMAT_BIN_20212']+['MSC_LICENSE_FILE']
  +['FLEXLM_TIMEOUT'])
  ```

  Definition of `FLEXLM_TIMEOUT` environment variable can be needed when using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000.

- Parallelization method information:
  - For SMP computations:

    ```
    standard_parallel=ALL
    mp_mode=THREADS
    cpus=globals().get('cpus',locals().get('cpus',1))
    mp_host_list=[]
    ```

  - For DMP computations:

    ```
    os.environ['ABA_MPI_SKIP_BUNCH_NODES'] = '1'
    standard_parallel=ALL
    mp_mode=MPI
    cpus=globals().get('cpus',locals().get('cpus',1))
    mp_host_list=[]
    ```

    Environment variable `ABA_MPI_SKIP_BUNCH_NODES` is needed to force pure DMP computations. Environment variable `mp_host_list=[]` must be completed with list of hosts where Digimat-CAE/Abaqus computation will run, e.g., to run on 2 nodes named `node1` and `node2` and 4 CPUs on each node:
    `mp_host_list = [['node1', 4], ['node2', 4]]`

  - For mixed SMP/DMP computations:

    ```
    standard_parallel=ALL
    mp_mode=MPI
    cpus=globals().get('cpus',locals().get('cpus',1))
    mp_host_list=[]
    ```

    Environment variable `mp_host_list=[]` must be completed with list of hosts where Digimat-CAE/Abaqus computation will run, e.g., to run on 2 nodes named `node1` and `node2` and 4 CPUs on each node:
    `mp_host_list = [['node1', 4], ['node2', 4]]`

More information about the Abaqus environment file are provided in Abaqus documentation (Environment file settings section).

Running coupled Digimat-CAE/Abaqus analysis

Windows platforms

To run Digimat to Abaqus coupled analysis using command line, it is needed to copy the `abaqus_v6.env` of targetted Abaqus version and parallelization method (SMP or DMP) from Digimat installation directory to working directory. Once it is done, following script example can be used:

```
set FLEXLM_TIMEOUT=5000000
set MSC_LICENSE_FILE=27500@localhost
C:\Simulia\Commands\abaqus.bat job=test.inp cpus=N
```

First line is needed when using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000. Definition of `MSC_LICENSE_FILE` is needed if it is not defined as a global environment variable. `N` is the number of threads (SMP) or domains (DMP).

When running Digimat-CAE/Abaqus coupled simulations using Digimat-RP, it is not needed to take care on copying `abaqus_v6.env` file. User has just to select Abaqus location in Digimat-RP settings (see Figure I.4.1) and to select SMP or DMP computation in Digimat-RP GUI when running simulation (see Figure I.4.2).

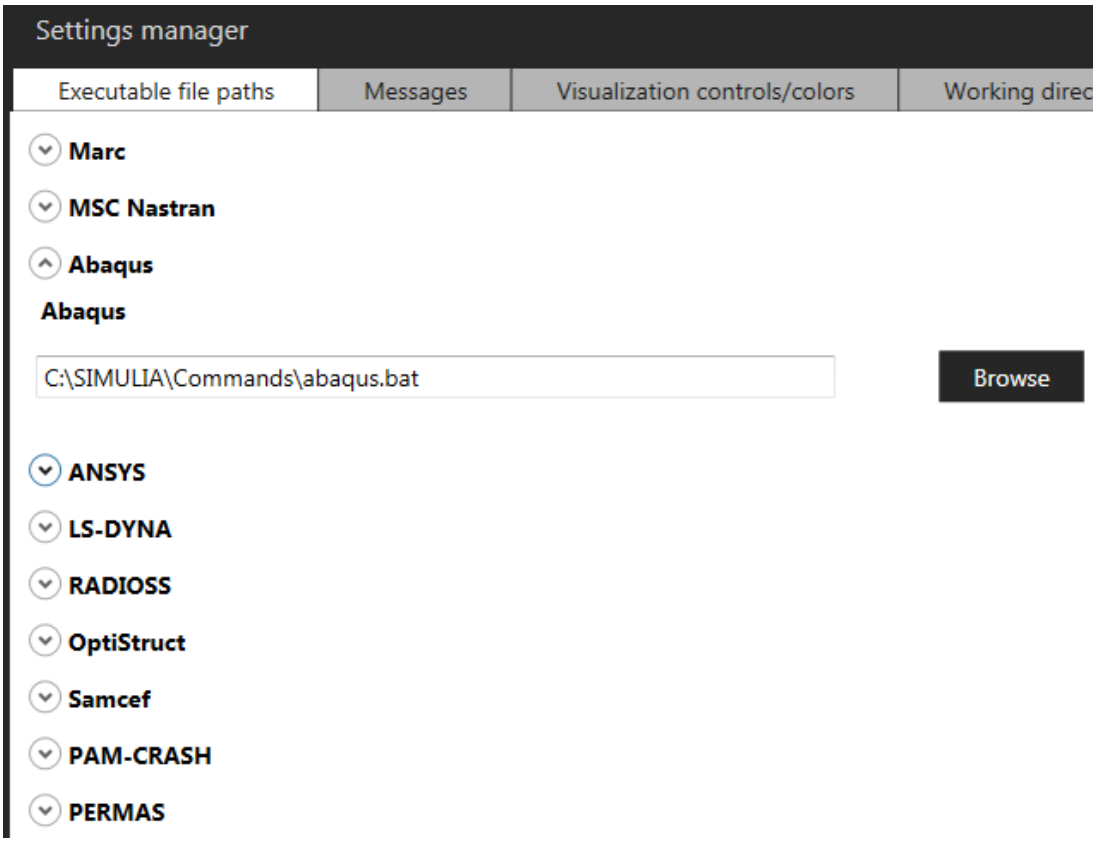


Figure I.4.1: Setting Abaqus location in Digimat-RP.

Linux platforms

To run Digimat to Abaqus coupled analysis, it is needed to copy the `abaqus_v6.env` of targetted Abaqus version and parallelization method (SMP or DMP) from Digimat installation directory to working directory. `abaqus_v6.env` file can also be generated "on the fly" by launching script, based on what is provided in Digimat installation.

As soon as `abaqus_v6.env` file exists in working directory, coupled Digimat-CAE/Abaqus simulation can run using command:

```
/opt/DassaultSystemes/SIMULIA/Commands/abaqus job=test.inp cpus=N
```

where `N` is the targetted number of threads (SMP) or domains (DMP).

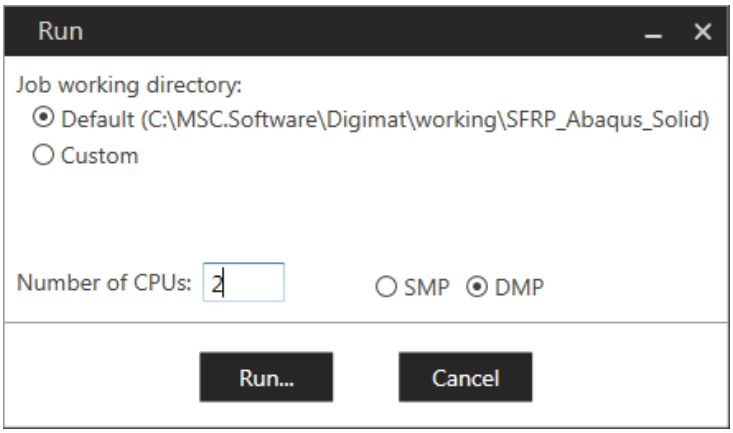


Figure I.4.2: Choice of parallelization method in Digimat-RP.

Digimat-to-Abaqus plugin installation

The path to the Abaqus installation must be specified during the installation of Digimat. The Digimat plugins are automatically installed for this version of Abaqus, e.g., if Abaqus targetted version is 2020, the required script files are copied to the folder:

`C:\SIMULIA\EstProducts\2020\abaqus_plugins`

To use the plugins in another version of Abaqus, you can either:

- Copy the `abaqus_plugins` folder to the appropriate Abaqus installation folder
- Add (or edit) the following line in the default `abaqus_v6.env` file:

```
plugin_central_dir = r"DIGIMAT_DIR\DigimatCAE\exec\digi2Aba\abaqus_plugins\"
```

where `DIGIMAT_DIR` is the Digimat installation directory, e.g., `C:\MSC.Software\Digimat\2021.2`.

Remark:

- If you did both operations (e.g. copy the `abaqus_plugins` folder and edit the `abaqus_v6.env` file), Abaqus will warn you at startup that duplicate scripts files are found, and will use the ones from the `abaqus_plugins` folder. So if you want to use a different version of the plugin with Abaqus, you shall modify those `abaqus_plugins` files.
- The Abaqus default working directory (typically `C:\temp` may contain residual files from previous installations; e.g., an `abaqus_plugins` folder, a `DIGIMAT_Settings.ini` file, and a `abaqus_v6.env` file. These files must be removed manually for the plugin to behave correctly.
- To be able to use plugin, it is mandatory to define global `DIGIMAT_BIN_20212` environment variable pointing to the Digimat directory containing `DIGIMAT_Settings.ini` file, e.g., `C:\MSC.Software\Digimat\2021.2\Digimat\exec`
- The plugin version and the Digimat version are independent, e.g., you can use a version of the plugin with a different Digimat version:
  - The plugin version is given directly in the plugin script files;
  - The Digimat version used by the plugin (e.g. to generate the interface file, call Digimat-MX, etc.) is determined through the `DIGIMAT_BIN_20212` environment variable;
  - The Digimat version used to run Digimat/Abaqus coupled analyses is given in the `abaqus_v6.env` file by the `usub_lib_dir` line.

I.4.3 Digimat-CAE/ANSYS

The objective of this section is to explain how to install the interface between Digimat and ANSYS. For more information concerning supported ANSYS releases and platforms, please refer to the below section I.4.3.

Supported versions

Digimat 2021.2 supports the following releases of ANSYS software:

- ANSYS 2019R3 (aka 19.5)
- ANSYS 2020R1 (aka 20.1)
- ANSYS 2020R2 (aka 20.2)

The ACT Digimat plug-in for ANSYS Workbench is supported for the following versions of ANSYS software:

- ANSYS 2019R3 (Windows platform) (aka 19.5)
- ANSYS 2020R1 (Windows platform) (aka 20.1)
- ANSYS 2020R2 (Windows platform) (aka 20.2)

Digimat 2021.2 supports the following platforms for ANSYS interface:

- Windows 10 (64-bit)
- Linux Red Hat 7.3 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.5 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.7 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux SUSE 12 SP1
- Linux SUSE 12 SP2
- Linux SUSE 12 SP4

Digimat 2021.2 supports following parallelization methods:

- For Windows platforms
  - Shared Memory Parallelization (SMP)
  - Distributed Memory Parallelization (DMP) using Intel-MPI (default in ANSYS)
  - Distributed Memory Parallelization (DMP) using Platform-MPI (only for ANSYS version older than 2020R2)
  - Distributed Memory Parallelization (DMP) using MS-MPI
- For Linux platforms
  - Shared Memory Parallelization (SMP)
  - Distributed Memory Parallelization (DMP) using Intel-MPI (default in ANSYS)
  - Distributed Memory Parallelization (DMP) using Platform-MPI (only for ANSYS version older than 2020R2)

Digimat-CAE/ANSYS for Windows

Digimat-CAE/ANSYS is provided as a set of dynamic libraries. These libraries contain Digimat capabilities, allowing the use of Digimat materials in ANSYS analyses. This link is performed on both Linux and Windows operating systems.

Dynamic libraries are version dependent. For example, it means that libraries provided for ANSYS 2020R2 cannot be used with previous ANSYS versions.

Dynamic libraries are located in the directory

```
DIGIMAT_DIR\DigimatCAE\exec\digi2ansys
```

of Digimat installation. DIGIMAT_DIR is main Digimat installation directory, e.g.,

```
C:\MSC.Software\Digimat\2021.2
```

This directory contains subfolders, each subfolder corresponding to a given supported ANSYS versions. Each of these folders contains subfolders corresponding to the different supported parallelization versions:

- SMP folder for Shared Memory Parallelization.
- DMP_INTELMPI folder for Distributed Memory parallelization using Intel-MPI.
- DMP_PCMPI folder for Distributed Memory parallelization using Platform-MPI.
- DMP_MSMPI folder for Distributed Memory parallelization using Microsoft-MPI.

Each of these folders contains three dynamic libraries needed by ANSYS:

- UserMatLib.dll
- USolBegLib.dll
- USolFinLib.dll

digi2ansys directory also contains dynamic library digi2ansys.dll containing Digimat kernel. This library is common for all ANSYS versions. Finally, third-party components

- boost_chrono-mt-x64.dll
- boost_filesystem-mt-x64.dll
- boost_iostreams-mt-x64.dll
- boost_regex-mt-x64.dll
- boost_system-mt-x64.dll
- boost_thread-mt-x64.dll
- boost_zlib-mt-x64.dll
- digimathdf5.dll
- digimathdf5_cpp.dll
- digimathdf5_hl.dll
- digimatMathTools.dll
- digimatPocoFoundation.dll
- impi.dll
- lapi.dll
- libfabric.dll
- tinyxmlSTL.dll
- VMAP.dll

are located in digi2ansys directory.

In order to use Digimat-CAE/ANSYS in command line or via Digimat ACT plugin (see section I.4.3), following manual operations are needed:

- The PATH environment variable must be updated by preprending it the path to Digimat to ANSYS directory, e.g.,
  `C:\MSC.Software\Digimat\2021.2\DigimatCAE\exec\digi2Ansys`
  The procedure to edit the PATH environment variable is detailed below.
  Remark:
  - It is recommended to *prepend* the digi2Ansys directory to the PATH, not to *append* it.
  - The PATH should contain only once the digi2Ansys directory.

- The environment variable ANS_USER_PATH must be defined and must point to the directory containing the required dynamic libraries. ANS_USER_PATH value depends on the parallelization method that will be used for the ANSYS solver:
  - **SMP**: Point the environment variable to the sub-folder called SMP
  - **DMP - Intel-MPI**: Point the environment variable to the sub-folder called DMP_INTELMPI
  - **DMP - Platform-MPI**: Point the environment variable to the sub-folder called DMP_PCMPI
  - **DMP - MS-MPI**: Point the environment variable to the sub-folder called DMP_MSMPI

  Remark:
  - When using ANSYS Workbench, the default MPI library is Intel-MPI.

  - If the ANS_USER_PATH variable is incorrectly defined, the ANSYS computation may still run, but yield incorrect results (null stress everywhere and deformation localized around boundary conditions).
- MSC_LICENSE_FILE environment variable must be defined and must point to the license server address (including port number).
- FLEXLM_TIMEOUT environment variable can be needed if using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000.

The environment variables can be accessed by Control panel in "System and Security" section. The "Advanced settings" will contain a choice to set "Environment variables...". Please refer to Figures I.4.3 to I.4.5 for an example related to Windows 10 operating system.

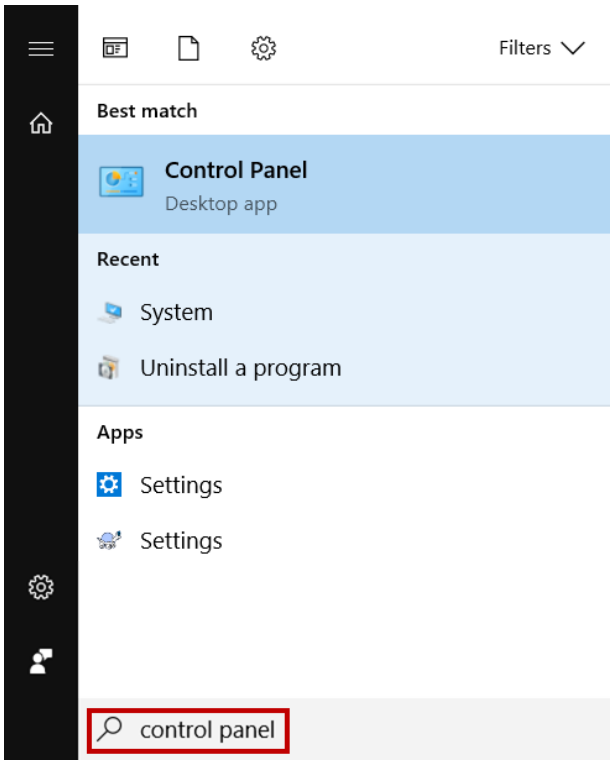


Figure I.4.3: Setting the ANS_USER_PATH environment variable under Windows 10 operating system - step 1.

Alternatively, when using command line, the Windows command prompt can be used to set the environment variables. This is done by executing a command line (C:\Windows\system32\cmd.exe), e.g., for computations using Intel-MPI parallelization:

```
set FLEXLM_TIMEOUT=5000000
set MSC_LICENSE_FILE=27500@localhost
set PATH=DIGIMAT_DIR\DigimatCAE\exec\digi2Ansys;%PATH%
set ANS_USER_PATH=DIGIMAT_DIR\DigimatCAE\exec\digi2Ansys\DMP_INTELMPI
```

where DIGIMAT_DIR is the Digimat installation directory, e.g.,

```
C:\MSC.Software\Digimat\2021.2
```

Definition of FLEXLM_TIMEOUT environment variable can be needed if using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000. Definition of MSC_LICENSE_FILE is needed if it is not defined as a global environment variable.

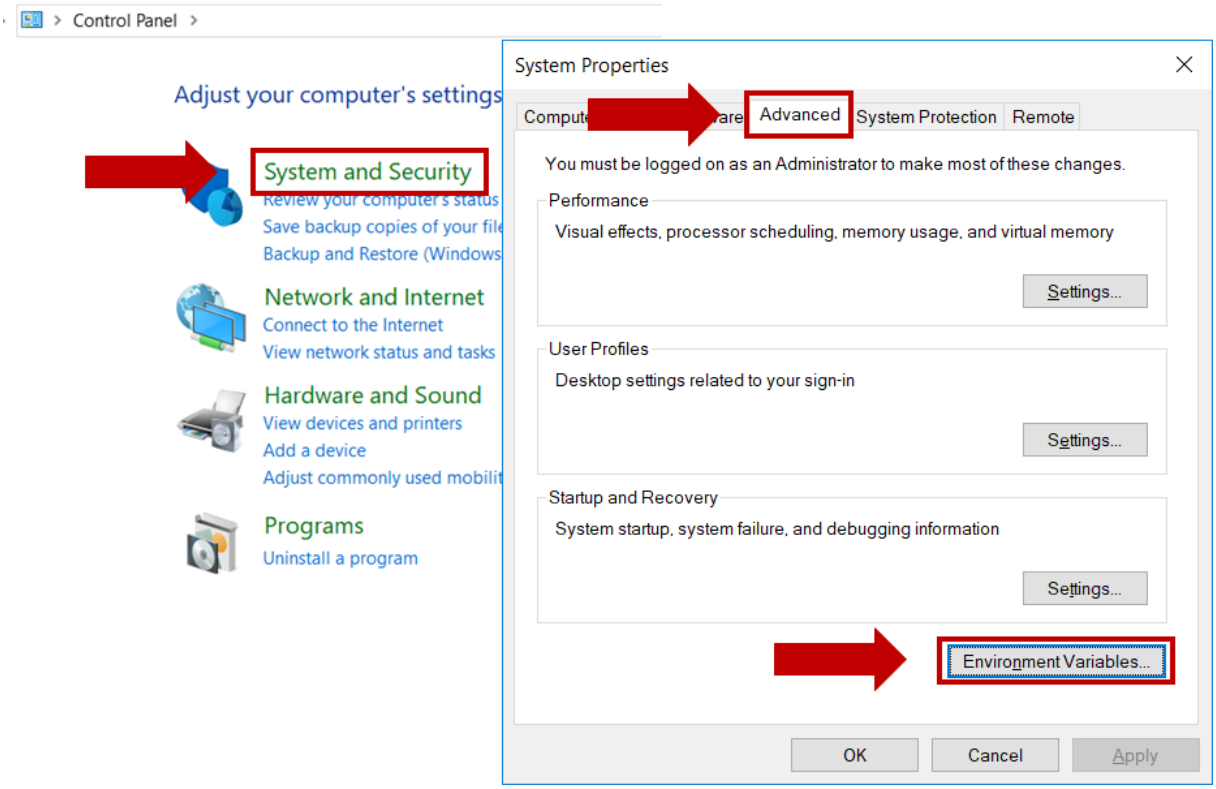


Figure I.4.4: Setting the `ANS_USER_PATH` environment variable under Windows 10 operating system - steps 2 and 3.

If `digi2ansys.dll` library and third-party libraries

- `boost_chrono-mt-x64.dll`
- `boost_filesystem-mt-x64.dll`
- `boost_iostreams-mt-x64.dll`
- `boost_regex-mt-x64.dll`
- `boost_system-mt-x64.dll`
- `boost_thread-mt-x64.dll`
- `boost_zlib-mt-x64.dll`
- `digimathdf5.dll`
- `digimathdf5_cpp.dll`
- `digimathdf5_hl.dll`
- `digimatMathTools.dll`
- `digimatPocoFoundation.dll`
- `impi.dll`
- `lapi.dll`
- `libfabric.dll`
- `tinyxmlSTL.dll`
- `VMAP.dll`

are moved to another directory, `PATH` variable has to be updated by adding the location of this new directory.

Distributed computation with MS-MPI can be executed only if the Microsoft MPI is installed. This can be downloaded at the Microsoft homepage.

If a bad version of MS-MPI is used, the computation will stop immediately.

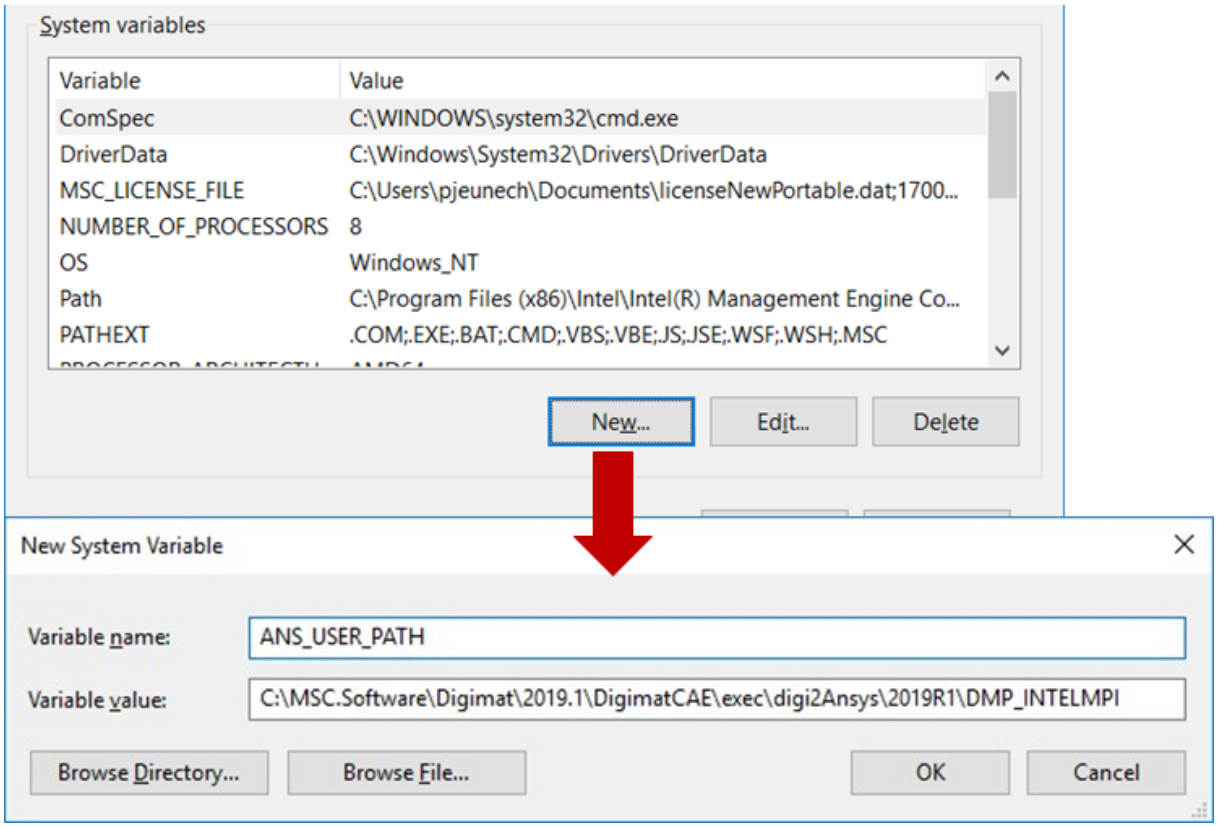


Figure I.4.5: Setting the `ANS_USER_PATH` environment variable under Windows 10 operating system - steps 4 and 5.

Multiple installation of Digimat software In case the user wants to have several versions of Digimat installed in parallel, the `PATH` (system or user) variable has to be adjusted manually and must point at first to the location of the desired version of Digimat installation for the ANSYS interface, e.g.,

`C:\MSC.Software\Digimat\2021.2\DigimatCAE\exec\digi2Ansys`.

Note: When uninstalling Digimat, this information given in the `PATH` variable is not deleted.

Digimat-CAE/ANSYS Workbench ACT plugin for Windows

Digimat offers an ANSYS Workbench Customization Toolkit (ACT) extension for ANSYS Workbench. This extension simplifies the integration of Digimat materials in an structural analysis, the post-processing of some Digimat history variables, and provides a better integration with Digimat-MAP. It does not require any specific licensing feature.

To install the **DigimatACTplugin extension**, follow this procedure:

1. Open ANSYS Workbench.
2. Browse the *"Extensions"* menu and select *"Install Extension..."* (Figure I.4.6).
3. Browse to the **"DigimatACTplugin.wbex"** file, provided in the Digimat directory, in the sub-folder: `DigimatCAE\exec\digi2Ansys\workbenchACTplugin`.

This will install the extension by copying the corresponding files in ANSYS installation directory:
`%appdata%\Ansys\v202\ACT\extensions`

For each new ANSYS Workbench session where the Digimat ACT plugin is needed, it must be loaded by browsing the *"Extensions"* menu, selecting *"Manage Extensions..."*, and ticking the box in front of *Digimat-ACTplugin* (Figure I.4.7).

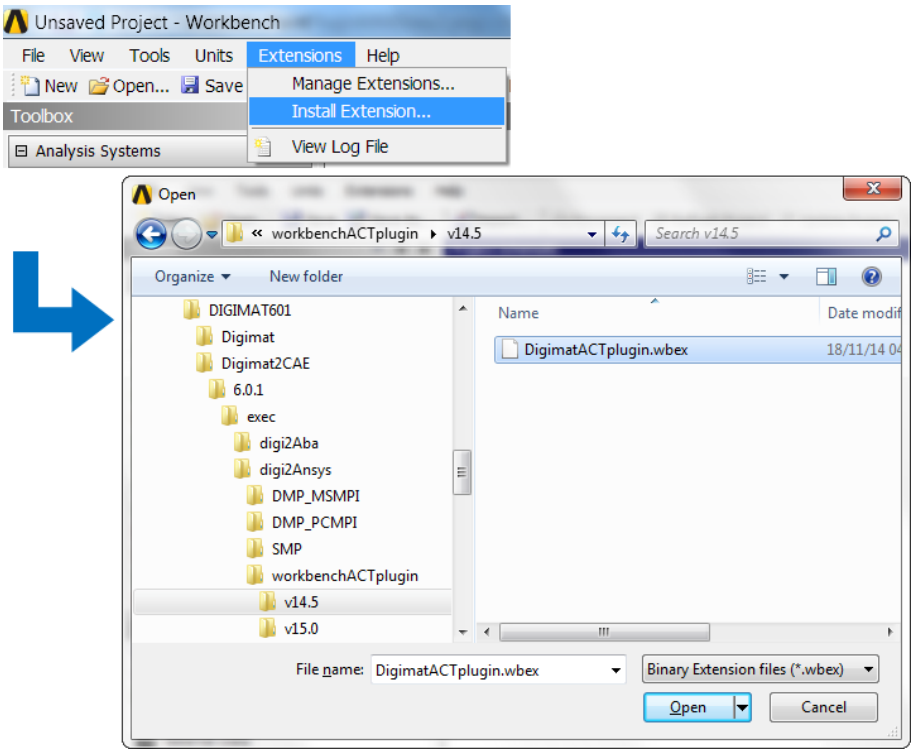


Figure I.4.6: Installing the DigimatACTplugin extension for ANSYS Workbench.

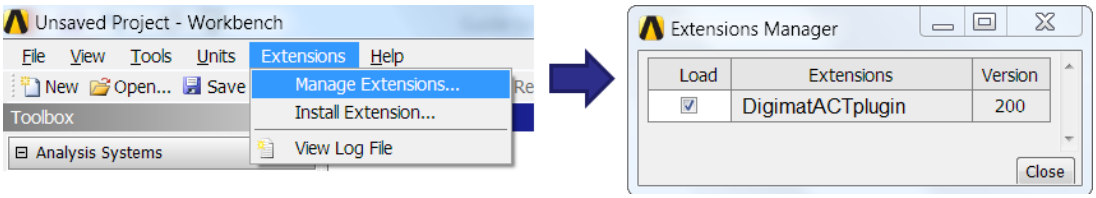


Figure I.4.7: Loading the DigimatACTplugin extension for ANSYS Workbench.

Remark:

- The Digimat ACT plugin is specific to given ANSYS Workbench and Digimat versions; it needs being reinstalled when upgrading ANSYS or Digimat.
- In complement of definition of `ANS_USER_PATH` environment variable, it is mandatory to define 3 other global environment variables:
  - `DIGIMAT_BIN_20212` environment variable pointing to the Digimat directory containing `DIGIMAT_Settings.ini` file, e.g.,
    `C:\MSC.Software\Digimat\2021.2\Digimat\exec`
  - `MSC_LICENSE_FILE` pointing to Digimat license server/file
  - If using geographically distant license server it can be needed to define `FLEXLM_TIMEOUT` environment variable to avoid failing of license checkout if answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000.

Digimat-CAE/ANSYS for Linux

Under Linux, the Digimat-CAE/ANSYS interface is distributed using the shared library `libansuser.so`. This library is located in Digimat installation directory and depends on targetted parallelization method:

```
DIGIMAT_DIR/DigimatCAE/exec/digi2ansys/INTELMPI
DIGIMAT_DIR/DigimatCAE/exec/digi2ansys/PCMPI
DIGIMAT_DIR/DigimatCAE/exec/digi2ansys/SMP
```

where `DIGIMAT_DIR` is Digimat installation directory, e.g., `/opt/msc/Digimat/2021.2`.

In order to use Digimat-CAE/ANSYS, environment variables `MSC_LICENSE_FILE`, `DIGIMAT_BIN_20212` and `ANS_USER_PATH` must be defined. `MSC_LICENSE_FILE` must point to the adress of Digimat license server. `ANS_USER_PATH` must point to the directory containing the `libansuser.so`. `DIGIMAT_BIN_20212` environment variable must point to a valid `DIGIMAT_Settings.ini` file. `FLEXLM_TIMEOUT` environment variable is needed if using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000.

This can be done for example by executing a script containing the following line, e.g., for `INTELMPI` computation:

```
export MSC_LICENSE_FILE=27500@localhost
export DIGIMAT_BIN_20212=/opt/msc/Digimat/2021.2/Digimat/exec
export FLEXLM_TIMEOUT=5000000
export ANS_USER_PATH=/opt/msc/Digimat/2021.2/DigimatCAE/exec/digi2ansys/INTELMPI:
     /opt/msc/Digimat/2021.2/Digimat/lib
```

Configuration of Remote Solve Manager

In order to run Digimat/ANSYS coupled analyses through the Remote Solve Manager, it is necessary to modify the following configuration file (assuming a default installation of ANSYS):
`C:\Program Files\ANSYS Inc\v202\RSM\Config\xml\Mechanical_ANSYSJob.xml`.

This file must be replaced (or edited) following the eponymous file provided in the Digimat sub-folder:
`DigimatCAE\exec\digi2Ansys\RemoteSolveManager\2020R2`.

Remark: This operation may require administrator rights.

The additional lines will force the Remote Solve Manager to copy the Digimat input files (material file, orientation file, etc...) from the local analysis directory to the remote scratch directory, and to retieve the Digimat files after computation.

Remark: **The RSM configuration file must be edited on the local machine, but also on the master node of the remote machine.** This is especially important when the remote machine is a multi-node cluster.

I.4.4 Digimat-CAE/Marc

The objective of this section is to explain how to install the interface between Digimat and Marc.

Installation procedure

Digimat-CAE/Marc is the module containing the Digimat capabilities and the required libraries in order to be used with the Marc implicit solver. For more information on supported versions and platforms, please refer to the below section I.4.4.

Supported versions

Digimat 2021.2 supports the following releases of Marc software:

- Marc 2019
- Marc 2019 FP1
- Marc 2020

Digimat 2021.2 supports the following releases of Marc Mentat software (for Digimat to Marc Mentat plugin):

- Marc Mentat 2019
- Marc Mentat 2019 FP1
- Marc Mentat 2020

Digimat 2021.2 supports the following platforms for Marc interface:

- Windows 10 (64-bit)
- Linux Red Hat 7.3 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.5 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.7 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux SUSE 12 SP1
- Linux SUSE 12 SP2
- Linux SUSE 12 SP4

Digimat 2021.2 supports following parallelization methods:

- For Windows platforms
  - Shared Memory Parallelization (SMP)
  - Distributed Memory Parallelization (DMP) using Intel-MPI (default in Marc)
  - Distributed Memory Parallelization (DMP) using MS-MPI
- For Linux platforms
  - Shared Memory Parallelization (SMP)
  - Distributed Memory Parallelization (DMP) using Intel-MPI

Windows platforms

The Digimat-CAE/Marc functionalities are embedded inside a new Marc executable `digi2marc.exe` shipped with Digimat installation. The `digi2marc.exe` executable is located in:

```
DIGIMAT_INSTALL_DIR\DigimatCAE\exec\digi2marc
```

where DIGIMAT_INSTALL_DIR is Digimat installation directory, e.g. C:\MSC.Software\Digimat\2021.2. User has then to choose Marc version and MPI versions in the directory tree. For example, if Marc 2020 is selected using INTEL-MPI,

```
DIGIMAT_INSTALL_DIR\DigimatCAE\exec\digi2marc\2020.0\INTELMPI\digi2marc.exe
```

file must be selected.

Prerequisites to use Digimat-CAE/Marc interface

Microsoft MPI is requested if user intents to perform parallel computation using MS-Message Passing Interface (MS-MPI). It can be downloaded at the following address: Microsoft home page.

If digi2marc.exe file is moved to another directory, it is required to also move in this directory the following files:

- digi2marc.dll
- vaPlyCalibrator.dll
- MeshDataStructure.dll

and the third-party component libraries:

- boost_chrono-mt-x64.dll
- boost_filesystem-mt-x64.dll
- boost_iostreams-mt-x64.dll
- boost_regex-mt-x64.dll
- boost_system-mt-x64.dll
- boost_thread-mt-x64.dll
- boost_zlib-mt-x64.dll
- digimathdf5.dll
- digimathdf5_cpp.dll
- digimathdf5_hl.dll
- digimatMathTools.dll
- digimatPocoFoundation.dll
- impi.dll
- lapi.dll
- libfabric.dll
- tinyxmlSTL.dll
- VMAP.dll

Launching Digimat-CAE/Marc computations on Windows platforms

For a single processor application, in a DOS command prompt, execute the commands:

```
set FLEXLM_TIMEOUT=5000000
MARC_INSTALL_DIR\tools\run_marc.bat -j model.dat -prog DIGI2MARC_DIR\digi2marc
```

MARC_INSTALL_DIR is the Marc installation directory. DIGI2MARC_DIR the directory where digi2marc.exe is located. First line is needed when using geographically distant license server to avoid failing of license checkout is answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000.

SMP computations can be executed by using the command in a command prompt:

```
set FLEXLM_TIMEOUT=5000000
MARC_INSTALL_DIR\tools\run_marc.bat -j model.dat -prog DIGI2MARC_DIR\digi2marc -nts N
```

where N is the number of threads. First line is needed when using geographically distant license server to avoid failing of license checkout is answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000.

DDM computations using INTELM-MPI can be executed by using the command in a command prompt:

```
set FLEXLM_TIMEOUT=5000000
MARC_INSTALL_DIR\tools\run_marc.bat -j model.dat -prog DIGI2MARC_DIR\digi2marc -nps N
```

where N is the number of CPUs. First line is needed when using geographically distant license server to avoid failing of license checkout is answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000.

DDM run using MS-MPI can be executed by using the command in a command prompt:

```
set FLEXLM_TIMEOUT=5000000
MARC_INSTALL_DIR\tools\run_marc.bat
 -j model.dat -prog DIGI2MARC_DIR\digi2marc -nps N -mpi ms-mpi
```

where N is the number of CPUs. First line is needed when using geographically distant license server to avoid failing of license checkout is answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000.

Launching Digimat-CAE/Marc computations using Marc Mentat

To use Marc Mentat to launch computations, it is needed to supersede the original executable marc.exe file:

1. Create a backup of the original file
   MARC_INSTALL_DIR\bin\win64i8\marc.exe (e.g., marc_orig.exe).

2. Copy the file digi2marc.exe in the directory MARC_INSTALL_DIR\bin\win64i8. Rename it marc.exe.

3. Copy in the directory MARC_INSTALL_DIR\lib\win64i8 the files
   - digi2marc.dll
   - vaPlyCalibrator.dll
   - MeshDataStructure.dll

   and the third-party component libraries
   - boost_chrono-mt-x64.dll
   - boost_filesystem-mt-x64.dll
   - boost_iostreams-mt-x64.dll
   - boost_regex-mt-x64.dll
   - boost_system-mt-x64.dll
   - boost_thread-mt-x64.dll
   - boost_zlib-mt-x64.dll
   - digimathdf5.dll
   - digimathdf5_cpp.dll
   - digimathdf5_hl.dll
   - digimatMathTools.dll
   - digimatPocoFoundation.dll
   - impi.dll
   - lapi.dll
   - libfabric.dll
   - tinyxmlSTL.dll
   - VMAP.dll

Linux platforms

The Digimat-CAE/Marc functionalities are embedded inside a new Marc executable digi2marc.exec shipped with Digimat installation. For example, for Marc 2020, the digi2marc.exec executable is located in:

```
DIGIMAT_INSTALL_DIR/DigimatCAE/exec/digi2marc/2020.0
```

where DIGIMAT_INSTALL_DIR is the installation directory of Digimat 2021.2, e.g.,

```
/opt/msc/Digimat/2021.2
```

Launching Digimat-CAE/Marc computations on Linux platforms

To launch computations under Linux platforms, write a script containing the following lines:

```
export MSC_LICENSE_FILE=27500localhost
export FLEXLM_TIMEOUT=5000000
MARC_INSTALL_DIR/tools/run_marc -j nameProblem.dat -prog
 DIGIMAT_INSTALL_DIR/DigimatCAE/exec/digi2marc/2020.0/digi2marc -nps N
```

where

- MSC_LICENSE_FILE environment variable points to MSC license server (including port).
- DIGIMAT_INSTALL_DIR is the Digimat installation directory.
- N the number of CPUs.
- The nps argument is not mandatory for 1 CPU. This argument can be replaced by nts, nte or nsolver according to the considered parallelization.
- If using geographically distant license server it can be needed to define FLEXLM_TIMEOUT environment variable to avoid failing of license checkout is answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000.

Installation of the Digimat plugin for Marc Mentat

Remark:

- **Digimat 2021.2 uses dedicated Marc card to define Digimat material. To be able to use this dedicated material card, it is needed to start Marc Mentat with -digimat extra argument. This argument can be added in Marc Mentat Start Menu Shortcuts like illustrated in Figure I.4.8.**

The plugin files are stored in Digimat installation in directory

DIGIMAT_INSTALL_DIR\DigimatCAE\exec\digi2marc\mentat_plugin

where DIGIMAT_INSTALL_DIR is Digimat installation, e.g., C:\MSC.Software\Digimat \2021.2. During the Digimat installation procedure, those files are also copied in a Digimat folder in the Marc Mentat installation directory selected during Digimat installation, e.g.:

MARC_ROOT_INSTALL_DIR\mentat2020\digimat

where MARC_ROOT_INSTALL_DIR is the Marc root installation directory, e.g.,

C:\MSC.Software for version 2018.1 or
C:\Program Files\MSC.Software for versions 2019.0 and higher.

If the Marc Mentat installation directory does not contain a Digimat folder, copy it from the Digimat installation (cf. mentat_plugin directory here above). This might happen if Marc Mentat was installed after Digimat or if several versions of Marc Mentat are installed; in which case, the Digimat folder was created only in the installation directory of the latest version.

To be able to use the plugin from within Marc Mentat, perform the following steps.

1. Insert the content of the file

   MARC_ROOT_INSTALL_DIR\Marc\2020.0.0\mentat2020.0\digimat\mentatPlugin.xml

   at the end of the file

   MARC_ROOT_INSTALL_DIR\Marc\2020.0.0\mentat2020.0\menus\menubar.xml

   (just before the last line, containing </menubar>). Create first a backup of the original file menubar.xml (e.g., menubar_orig.xml) and possibly disable the "Read only" status in the file properties.

2. Compile the Digimat plugin menu file digimat.ms by running the following MS-DOS commands:

   cd "MARC_ROOT_INSTALL_DIR\Marc\2020.0.0\mentat2020.0\digimat"

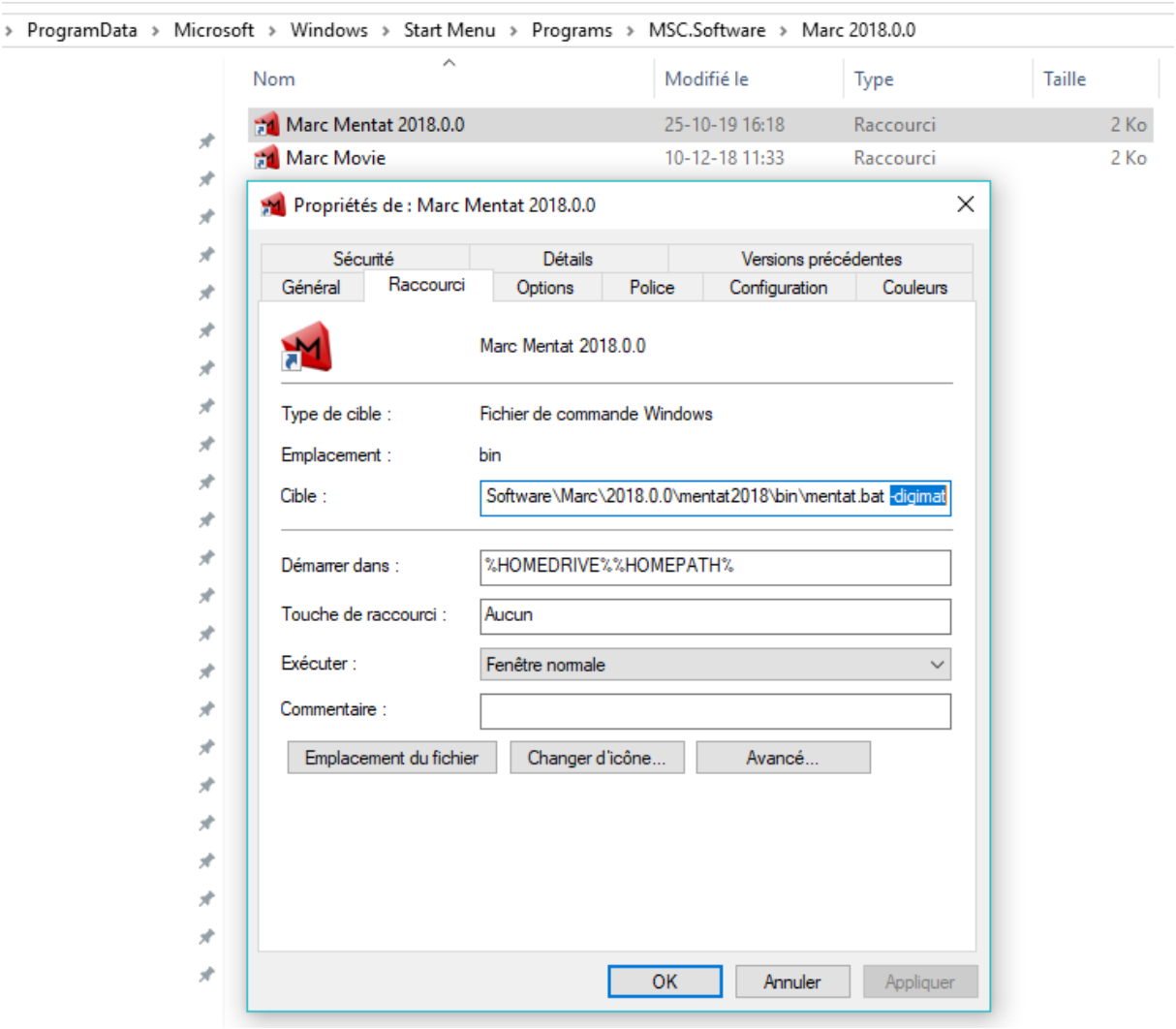


Figure I.4.8: Add `-digimat` extra argument in Marc Mentat shortcut.

```
..\bin\mentat -compile main.msb
```

Note that it may be required to start the MS-DOS command prompt with administrator rights, especially if Marc is installed in the "C:\Program Files" folder.

3. Copy the new file `main.msb` in `MENTAT_INSTALL_DIR\menus\win64` after having created a backup of the original file `main.msb` (e.g., `main_orig.msb`).

To launch computations set up using the plugin from within Marc Mentat, supersede the original executable `marc.exe` (cf. section about launching Digimat-CAE/Marc computations via Marc Mentat here above).

Remark: It is mandatory to define global `DIGIMAT_BIN_20212` environment variable pointing to the Digimat directory containing initial `DIGIMAT_Settings.ini` file, e.g.,

```
C:\MSC.Software\Digimat\2021.2\Digimat\exec
```

If using geographically distant license server it can be needed to define `FLEXLM_TIMEOUT` environment variable to avoid failing of license checkout is answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000.

I.4.5 Digimat-CAE/MSC Nastran SOL400

The objective of this section is to explain how to install the interface between Digimat and MSC Nastran SOL400.

Supported versions

Since Digimat libraries are shipped with the MSC Nastran installer after the Digimat release, please refer to the MSC Nastran SOL400 documentation to know which Digimat version is supported.

Digimat 2021.2 supports the following platforms:

- Windows 10 (64-bit)
- Linux Red Hat 7.3 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19

Digimat 2021.2 supports following parallelization methods:

- Shared Memory Parallelization (SMP)
- Distributed Memory Parallelization (DMP)

For Digimat 2021.2, parallel processing using DMP is not stable and currently not recommended. It is recommended to use SMP parallelization.

Installation procedure

Digimat and MSC Nastran SOL400 can be coupled together by the use of dynamic libraries. These libraries contain Digimat capabilities, allowing to use Digimat materials in MSC Nastran SOL400 analyses. This link is performed on both Linux and Windows operating systems. Dynamic libraries are distributed by MSC in MSC Nastran installation.

Remark: `FLEXLM_TIMEOUT` environment variable can be needed if using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000.

Executing a job under Windows 64-bit using command line

```
MSC_INSTALL_DIR\MSC_Nastran\20XXX\bin\nast20XXX.exe nameOfInputDeck.bdf
```

where `MSC_INSTALL_DIR` is the installation directory of MSC Software.

Executing a job under Windows 64-bit using MSC Nastran configuration GUI

Launch MSC Nastran. Then select the input deck to be used and click on Run. Note that, as Digimat commands are not recognized by Patran, it is not possible to launch a coupled Digimat MSC Nastran SOL400 computation from Patran.

I.4.6 Digimat-CAE/Samcef

The objective of this section is to explain how to install the interface between Digimat and Samcef/Mecano and Samcef/Dynam.

Supported versions

Digimat 2021.2 supports the following releases of Samcef software:

- Samcef 16.3 (a.k.a. 16.1-04) i8 64bits (Windows and Linux)
- Samcef 17.2 (a.k.a. 17.1-03) i8 64bits (Windows and Linux)

Digimat 2021.2 supports the following platforms for Samcef interface:

- Windows 7 (64-bit)
- Linux Red Hat 7.3 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.5 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.7 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux SUSE 12 SP1
- Linux SUSE 12 SP2
- Linux SUSE 12 SP4

Digimat 2021.2 supports following parallelization methods:

- For Windows platforms: MS-MPI (default parallelization method)
- For Linux platforms: MPICH (default parallelization method)

Installation procedure

Digimat-CAE/Samcef is the module containing the Digimat capabilities and the required interfaces in order to be linked with the Samcef/Mecano implicit solver and Samcef/Dynam modal solver. Linking is performed in a static way. For more information on supported versions and platforms, please refer to the section I.4.6.

The Digimat material library is embedded inside the Samcef/Mecano and Samcef/Dynam executables by linking both the libraries together.

Official Samcef installation is shipped with the Samcef libraries that are necessary to use Digimat-CAE/Samcef. As Digimat interacts with Samcef as a user material, the user has to install these user material libraries.

A link must then be performed between Samcef and the Digimat material library. This link between Digimat and Samcef libraries provides new Samcef/Mecano and Samcef/Dynam executables called `my_mecano.exe` and `my_dynam.exe`.

Installation procedure for Windows platforms

Prerequisites for the link between Digimat and Samcef

To link Digimat and Samcef/Mecano and Samcef/Dynam libraries together, a linker is needed. Before linking Digimat-CAE/Samcef, Microsoft Visual Studio 2012 Express for Windows Desktop must be installed (See Section III.1.2 on how to install this software).

Building Digimat/Samcef executables

The Digimat-CAE/Samcef material library (`digi2samcef.obj`) is provided with the Digimat installation, typically in:
`C:\MSC.Software\Digimat\2021.2\DigimatCAE\exec\digi2samcef\v17.2_i8`

To link the Samcef/Mecano and Samcef/Dynam executables with the Digimat libraries, the following procedure is to be applied.

1. Go to the directory of Samcef version to be used. This directory depends on the Samcef version that user wants to couple with Digimat. For example, if using Samcef 17.2(i8), the directory
   `C:\MSC.Software\Digimat\2021.2\DigimatCAE\exec\digi2samcef\v17.2_i8`
   must be selected.

2. Edit the `SAMCEF_DIR` of the file makefile to point to the right Samcef installation directory.

3. Double-click on the `nmake_x64.bat` file located next to the makefile.

4. Add the following lines in the `samrc.ini` file found in the `Exec` directory of the Samcef installation (adapt the Digimat install path, version, and Samcef version):

```
module*mm.me:  my_mecano
  C:\MSC.Software\Digimat\2021.2\DigimatCAE\exec\digi2Samcef\v17.2_i8\my_Mecano.exe
module*md.dy:  my_dynam
  C:\MSC.Software\Digimat\2021.2\DigimatCAE\exec\digi2Samcef\v17.2_i8\my_Dynam.exe
```

If the location of the executables `my_mecano.exe` and/or `my_dynam.exe` are changed, the `digi2samcef.dll` library and the third-party libraries

- `boost_chrono-mt-x64.dll`
- `boost_filesystem-mt-x64.dll`
- `boost_iostreams-mt-x64.dll`
- `boost_regex-mt-x64.dll`
- `boost_system-mt-x64.dll`
- `boost_thread-mt-x64.dll`
- `boost_zlib-mt-x64.dll`
- `digimathdf5.dll`
- `digimathdf5_cpp.dll`
- `digimathdf5_hl.dll`
- `digimatMathTools.dll`
- `digimatPocoFoundation.dll`
- `impi.dll`
- `lapi.dll`
- `libfabric.dll`
- `tinyxmlSTL.dll`
- `VMAP.dll`

must also move to this new location.

Installation procedure for Linux platforms

Prerequisites for the link between Digimat and Samcef

Ensure that g++ the GNU c++ compiler is available.

Building Digimat/Samcef executables

The Digimat-CAE/Samcef material library (digi2samcef.o) is provided with the Digimat installation, typically in:
/opt/msc/Digimat/2021.2/DigimatCAE/exec/digi2samcef/v17.2_i8

To link the Samcef/Mecano and Samcef/Dynam executables with the Digimat libraries, the following procedure is to be applied.

1. Edit the makefile located in the /opt/msc/Digimat/2021.2/DigimatCAE/exec/digi2samcef/v17.2_i8 directory to point to the Samcef installation (e.g., /opt/samcef/v17.2/i8/).

2. Compile by typing make my_mecano and make my_dynam.

3. Add the following lines in the samrc.ini file found in the Exec directory of the Samcef installation (adapt the Digimat install path, version, and Samcef version):

```
module*mm.me:  my_mecano
   /opt/msc/Digimat/2021.2/DigimatCAE/exec/digi2samcef/v17.2_i8/my_mecano
module*md.dy:  my_dynam
   /opt/msc/Digimat/2021.2/DigimatCAE/exec/digi2samcef/v17.2_i8/my_dynam
```

MSC_LICENSE_FILE environment variable must be defined in running script to point on MSC license server (including port). FLEXLM_TIMEOUT environment variable can be needed if using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000. This environment variable can be added to the running script like:

Launching Digimat-CAE/Samcef computations

To launch a Samcef/Mecano analysis under Windows, one must replace the usual me by mm in the command line, for instance:

```
set FLEXLM_TIMEOUT=5000000
set MSC_LICENSE_FILE=27500@localhost
set PATH=C:\Program Files\Samtech\Samcef\V17.2_x64_i8\Exec;%PATH%
samcef ba,mm,bp [analysisName] n 2 banque=analyis.dat [zone=125000000]
```

where:

- FLEXLM_TIMEOUT environment variable can be needed if using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000.
- MSC_LICENSE_FILE is the address of msc license server (including port)
- analysisName (optional) is the problem name,
- n 2 triggers batch mode,
- analyis.dat is the name of the bank file,
- the zone argument (optional) specifies the size of the memory block allocated for computation.

To launch a Samcef/Dynam analysis, one must replace the usual dy by md in the command line, for instance:

```
set PATH=C:\Program Files\Samtech\Samcef\V17.2_x64_i8\Exec;%PATH%
samcef ba,md,bp [analysisName] n 2 banque=analyis.dat [zone=125000000]
```

It is also required to prepend the Samcef execution directory to the PATH Windows environment variable, as shown on the first line of above commands (assuming a default Samcef installation directory). This is

mandatory since the Digimat-CAE/Samcef executable requires some DLLs provided by Samcef. Alternatively, one can also directly modify the PATH system environment variable. On Windows, the environment variables can be accessed by right-clicking "computer" and moving to the "Properties" option. The "Advanced settings" will contain a choice to set "Environment variables...". Please refer to Figures I.4.9 to I.4.11 for an example related to Windows 7 operating system.

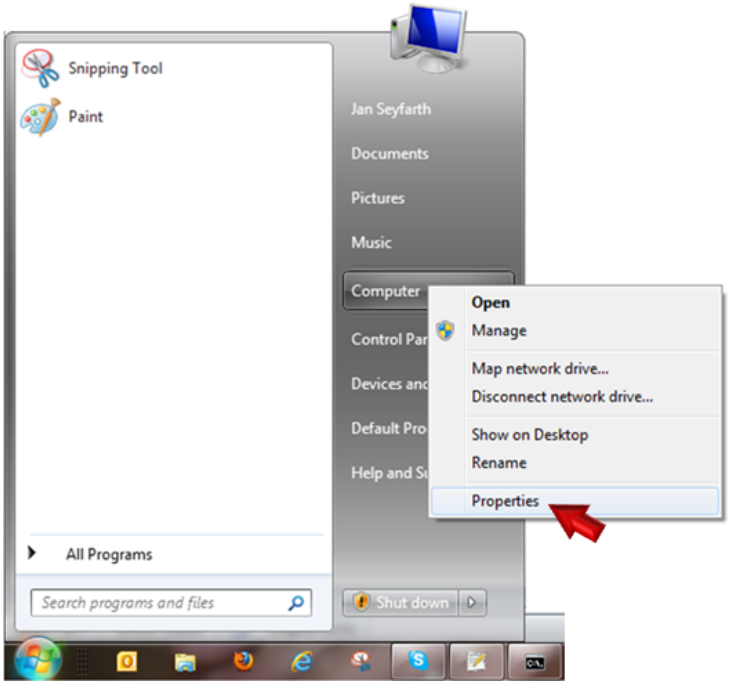


Figure I.4.9: Edit the PATH environment variable under Windows 7 operating system - step 1.

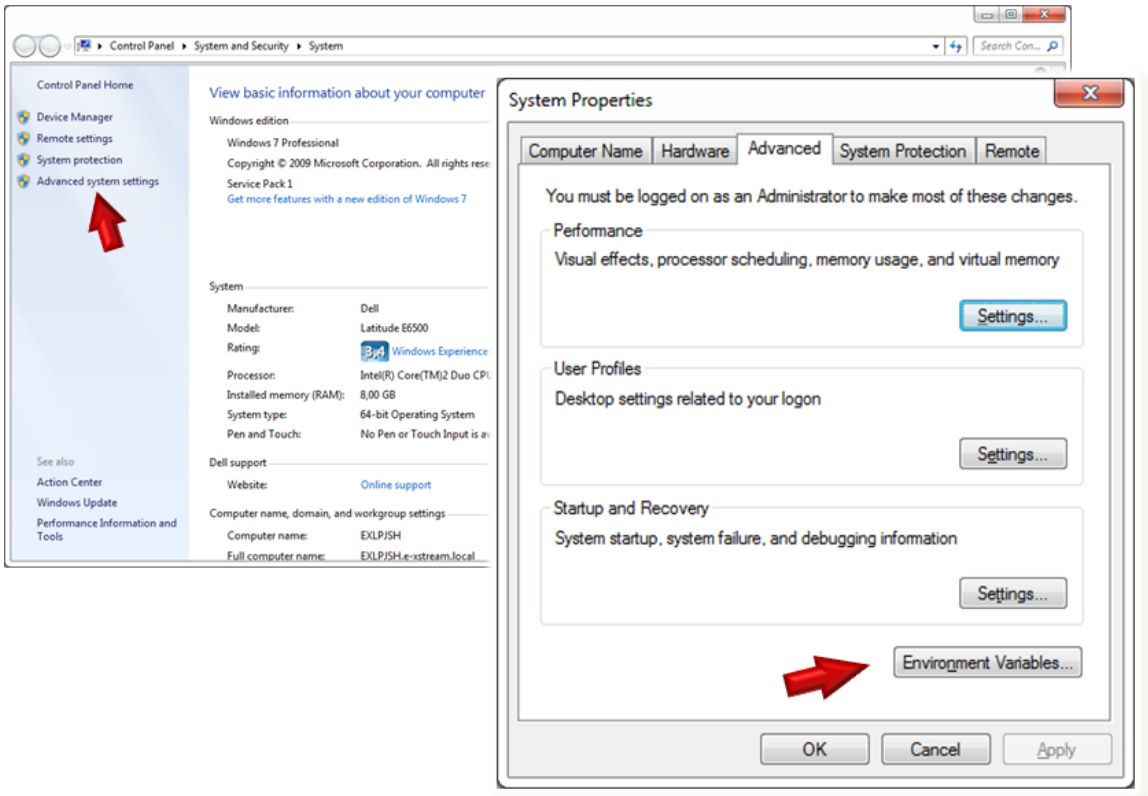


Figure I.4.10: Edit the PATH environment variable under Windows 7 operating system - steps 2 and 3.

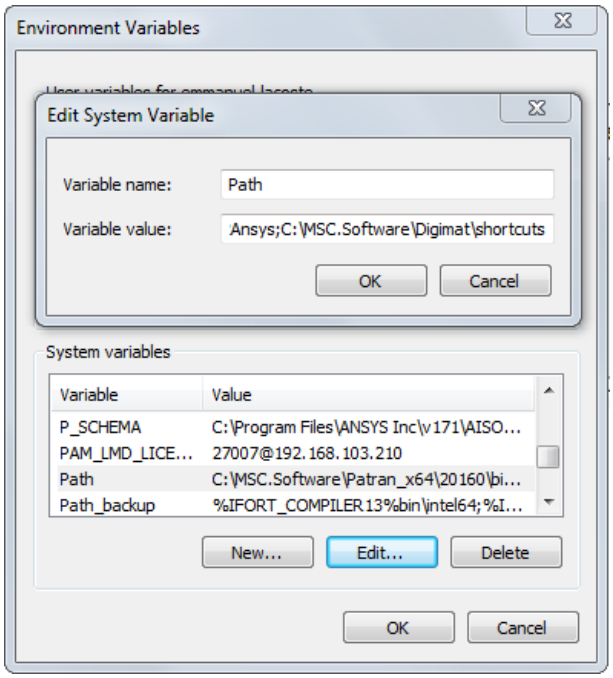


Figure I.4.11: Edit the PATH environment variable under Windows 7 operating system - step 4 and 5.

I.4.7 Digimat-CAE/LS-DYNA

The objective of this section is to explain how to install the interface between Digimat and LS-DYNA. For more information concerning supported LS-DYNA releases and platforms, please refer to the below section I.4.7.

Supported versions

Digimat 2021.2 supports the following releases of LS-DYNA software:

- LS-DYNA R9.3.0
- LS-DYNA R10.2
- LS-DYNA R11.1

Digimat 2021.2 supports the following platforms for LS-DYNA interface:

- Windows 10 (64-bit)
- Linux Red Hat 6.3 using GLIBC $\geq$ 2.12 and GLIBCXX $\geq$ 3.4.13
- Linux Red Hat 7.3 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.5 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.7 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux SUSE 12 SP1
- Linux SUSE 12 SP2
- Linux SUSE 12 SP4

Digimat 2021.2 supports following parallelization methods:

- For Windows platforms
  - Distributed Memory Parallelization (MPP) using Intel-MPI
  - Distributed Memory Parallelization (MPP) using Platform-MPI
  - Distributed Memory Parallelization (MPP) using MS-MPI
- For Linux platforms
  - Distributed Memory Parallelization (MPP) using Intel-MPI
  - Distributed Memory Parallelization (MPP) using Platform-MPI
  - Hybrid Memory Parallelization using Intel-MPI, **only for LS-DYNA R10.2**
  - Hybrid Memory Parallelization using Platform-MPI, **only for LS-DYNA R10.2**

Installation procedure

Digimat-CAE/LS-DYNA is the module containing the Digimat capabilities and the required interfaces in order to be linked with the LS-DYNA explicit and implicit solvers. Depending on the platform that is used, linking is performed either in a dynamic or a static way.

Installation procedure for Linux platforms

Under Linux operating system Digimat-CAE/LS-DYNA interface is provided as a set of dynamic libraries.

LS-DYNA version	Precision	MPI	Executable name
R9.3.0	Double	Platform-MPI	ls-dyna_mpp_d_R9_3_0_x64_redhat54_ifort131_sse2_platformmpi_sharelib
		Intel-MPI	ls-dyna_mpp_d_R9_3_0_x64_redhat54_ifort131_sse2_intelmpi-413_sharelib
	Single	Platform-MPI	ls-dyna_mpp_s_R9_3_0_x64_redhat54_ifort131_sse2_platformmpi_sharelib
		Intel-MPI	ls-dyna_mpp_s_R9_3_0_x64_redhat54_ifort131_sse2_intelmpi-413_sharelib
R10.2	Double	Platform-MPI	ls-dyna_mpp_d_R10_2_0_x64_centos65_ifort160_sse2_platformmpi_sharelib
		Intel-MPI	ls-dyna_mpp_d_R10_2_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib
	Single	Platform-MPI	ls-dyna_mpp_s_R10_2_0_x64_centos65_ifort160_sse2_platformmpi_sharelib
		Intel-MPI	ls-dyna_mpp_s_R10_2_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib
R10.2	Double	Hybrid Platform-MPI	ls-dyna_hyb_d_R10_2_0_x64_centos65_ifort160_sse2_platformmpi_sharelib
		Hybrid Intel-MPI	ls-dyna_hyb_d_R10_2_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib
	Single	Hybrid Platform-MPI	ls-dyna_hyb_s_R10_2_0_x64_centos65_ifort160_sse2_platformmpi_sharelib
		Hybrid Intel-MPI	ls-dyna_hyb_s_R10_2_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib
R11.1	Double	Platform-MPI	ls-dyna_mpp_d_R11_1_0_x64_centos65_ifort160_sse2_platformmpi_sharelib
		Intel-MPI	ls-dyna_mpp_d_R11_1_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib
	Single	Platform-MPI	ls-dyna_mpp_s_R11_1_0_x64_centos65_ifort160_sse2_platformmpi_sharelib
		Intel-MPI	ls-dyna_mpp_s_R11_1_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib

Table I.4.1: LS-DYNA executables files to run with Digimat coupled analysis.

LS-DYNA version	Precision	Library name
R9.3.0	Double	libmppdyna_d_125554.113060_usermat.so
	Single	libmppdyna_s_125554.113060_usermat.so
R10.2	Double	libmppdyna_d_113025.117897_usermat.so
	Single	libmppdyna_s_113025.117897_usermat.so
R11.1	Double	libmppdyna_d_138999.137278.so
	Single	libmppdyna_s_138999.137278.so

Table I.4.2: LS-DYNA library files to run with Digimat coupled analysis (provided in Digimat installation).

LS-DYNA executables and libraries

The dynamic Digimat-CAE/LS-DYNA libraries and associated LS-DYNA executables are summarized in tables I.4.1 and I.4.2. Note that library name is independent of targetted MPI.

Supported MPI versions are:

- Platform-MPI 9.1.2
- Intel-MPI 2018.1 for LS-DYNA R10.2 and R11.1
- Intel-MPI 4.1.3 for LS-DYNA R9.3

LS-DYNA executables to use with Digimat materials need to be requested from LSTC distributor. Those executables are contained in a `tar.gz` archive. This archive also contains pristine shared library. This pristine shared library must be replaced by shared libraries provided in Digimat installation. Executables depends on LS-DYNA version, targetted precision (single or double precision) and used MPI (Platform-MPI, Intel-MPI, hybrid, MPP). Archive names and sizes are listed in table I.4.3.

LS-DYNA version	Precision	MPI	Archive name	Archive size
R9.3.0	Double	Platform-MPI	ls-dyna_mpp_d_R9_3_0_x64_redhat54_ifort131_sse2_platformmpi_sharelib.tar.gz	71261 Ko
		Intel-MPI	ls-dyna_mpp_d_R9_3_0_x64_redhat54_ifort131_sse2_intelmpi-413_sharelib.tar.gz	74963 Ko
	Single	Platform-MPI	ls-dyna_mpp_s_R9_3_0_x64_redhat54_ifort131_sse2_platformmpi_sharelib.tar.gz	54855 Ko
		Intel-MPI	ls-dyna_mpp_s_R9_3_0_x64_redhat54_ifort131_sse2_intelmpi-413_sharelib.tar.gz	58552 Ko
R10.2	Double	Platform-MPI	ls-dyna_mpp_d_R10_2_0_x64_centos65_ifort160_sse2_platformmpi_sharelib.tar.gz	80798 Ko
		Intel-MPI	ls-dyna_mpp_d_R10_2_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib.tar.gz	84271 Ko
	Single	Platform-MPI	ls-dyna_mpp_s_R10_2_0_x64_centos65_ifort160_sse2_platformmpi_sharelib.tar.gz	66400 Ko
		Intel-MPI	ls-dyna_mpp_s_R10_2_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib.tar.gz	70280 Ko
R10.2	Double	Hybrid Platform-MPI	ls-dyna_hyb_d_R10_2_0_x64_centos65_ifort160_sse2_platformmpi_sharelib.tar.gz	82821 Ko
		Hybrid Intel-MPI	ls-dyna_hyb_d_R10_2_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib.tar.gz	86311 Ko
	Single	Hybrid Platform-MPI	ls-dyna_hyb_s_R10_2_0_x64_centos65_ifort160_sse2_platformmpi_sharelib.tar.gz	69162 Ko
		Hybrid Intel-MPI	ls-dyna_hyb_s_R10_2_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib.tar.gz	73043 Ko
R11.1	Double	Platform-MPI	ls-dyna_mpp_d_R11_1_0_x64_centos65_ifort160_sse2_platformmpi_sharelib.tar.gz	95783 Ko
		Intel-MPI	ls-dyna_mpp_d_R11_1_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib.tar.gz	99268 Ko
	Single	Platform-MPI	ls-dyna_mpp_s_R11_1_0_x64_centos65_ifort160_sse2_platformmpi_sharelib.tar.gz	63223 Ko
		Intel-MPI	ls-dyna_mpp_s_R11_1_0_x64_centos65_ifort160_sse2_intelmpi-2018_sharelib.tar.gz	67104 Ko

Table I.4.3: LS-DYNA archive files to run with Digimat coupled analysis.

Configure Digimat-CAE/LS-DYNA computations

The following operations have to be performed to be able to use the shared Digimat-CAE/LS-DYNA library on Linux system, e.g., for LS-DYNA R11.1 in double precision using Platform-MPI parallelization:

- Update `LD_LIBRARY_PATH` to point to LS-DYNA/Digimat coupled libraries and to Digimat third-party libraries:

  ```
  $ export LD_LIBRARY_PATH=DIGIMAT_DIR/Digimat/lib/:
    DIGIMAT_DIR/DigimatCAE/exec/digi2dyna/R11.1/Double/PCMPI
  ```

  where `DIGIMAT_DIR` is Digimat installation directory, e.g., `/opt/msc/Digimat/2021.2`.

- Ensure that `LD_LIBRARY_PATH` is correctly passed to each computation node. This can be done by adding on MPI command line option
  - For Platform-MPI:
    `-e LD_LIBRARY_PATH=$LD_LIBRARY_PATH`
  - For Intel-MPI:
    `-genvall`

Launching Digimat-CAE/LS-DYNA under Linux

To launch a Linux job of Digimat-CAE/LS-DYNA, the very same procedure as to launch a LS-DYNA standalone job can be followed. The only differences are:

- Use the correct version of LS-DYNA, i.e., the one that looks for a user material library (see table I.4.1 for LS-DYNA executable list)
- Make sure that this executable sees the right `LD_LIBRARY_PATH` environment variable as explained above
- Below is an example of a bash script containing all commands:

  ```
  #!/bin/bash
  export DIGIMAT_BIN_20212 =DIGIMAT_DIR/Digimat/exec
  export MSC_LICENSE_FILE=27500@localhost
  export FLEXLM_TIMEOUT=5000000
  export LD_LIBRARY_PATH=DIGIMAT_DIR/Digimat/lib:
    DIGIMAT_DIR/DigimatCAE/exec/digi2dyna/R11.1/Double/PCMPI:$LD_LIBRARY_PATH
  ls-dyna_mpp_d_R11_1_0_x64_centos65_ifort160_sse2_platformmpi_sharelib$@
  ```

  where `DIGIMAT_DIR` is the Digimat installation directory, e.g., `/opt/digimat/2021.2`. `FLEXLM_TIMEOUT` definition can be needed when using geographically distant license server to avoid failing of license

checkout if answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000. Make this script executable:

```
chmod a+x launch_script.sh
```

and call this script rather than the LS-DYNA executable, with the very same arguments, i.e.,

```
mpirun -np 4 path_to_my_launch_script.sh i=input.k
```

Windows platform

Prerequisites for usage of Digimat and LS-DYNA

To link Digimat and LS-DYNA libraries together on Windows platforms, a linker is needed. Before linking Digimat-CAE/LS-DYNA, Microsoft Visual Studio 2017 must be installed (See Section III.1.1 on how to install this software).

To be able to run parallel computations, a MPI must be installed, depending on the targetted MPI:

- Microsoft MPI (needed for MS-MPI versions)
  - An installer can be downloaded at Microsoft home page
- Platform MPI (needed for PC-MPI versions)
  - An installer can be downloaded at IBM home page. This software is not free.
- Intel-MPI
  - An installer can be downloaded at Intel home page

Building Digimat/LS-DYNA executable

Under Windows operating system a static linking procedure must be followed to be able to use Digimat/LS-DYNA interface.

For each version provided, the process to link the Digimat-CAE/LS-DYNA executable is the same:

- Digimat-CAE to LS-DYNA directory is located in:

  `C:\MSC.Software\Digimat\2021.2\DigimatCAE\exec\digi2dyna`

- On the machine where linking procedure is achieved, following operations are needed:
  - Make sure Microsoft Visual Studio 2017 is installed (See Section III.1.1 on how to install this software). Installation of Microsoft Visual Studio 2017 must be achieved only once. When upgrading Digimat version, it is not needed to reinstall Microsoft Visual Studio 2017, but only to update Digimat-CAE to LS-DYNA libraries.
  - Get LS-DYNA libraries `libdyna.lib` and `libansys.lib` from your LS-DYNA distributor. Those libraries depends on LS-DYNA version, targetted precision (single or double precision) and used MPI (Platform-MPI, Intel-MPI or MS-MPI). Requested archive containing the LS-DYNA libraries to use with Digimat material are listed in table I.4.4.
  - Copy the libraries in the Digimat directory corresponding to the targetted LS-DYNA version, e.g., for LS-DYNA R11.1 in Double precision using Platform-MPI:
    `C:\MSC.Software\Digimat\2021.2\DigimatCAE\exec\digi2dyna\R11.1\Double\PCMPI`
  - Double-click on the `nmake_x64.bat`.
  - An executable should be created named `mppdyna.exe` or `mppdyna_d.exe` depending on the version (single or double precision).
  - Result of link procedure is redirected to `out.txt` file next to the `nmake_x64.bat` file.
  - If the executable is not created, check the following:
    * The path to the installation of Microsoft Visual Studio 2017 in the .bat script if Microsoft Visual Studio 2017 has not been installed in the default directory.
    * Error messages are written in `out.txt` file. In case of issue, contact digimat.support@mscsoftware.com by including this `out.txt` file.

  - Once linking procedure is achieved, generated executable can be moved to any other machine in appropriate installation directory. If copying generated executables, pay attention to also copy all the DLL that are located in directory of initial build.
- The `lstc_client.exe` executable next to the Digimat-CAE/LS-DYNA one is needed. It can be found in LS-DYNA installation.

LS-DYNA version	Precision	MPI	Archive name	Archive size
R9.3.0	Double	Intel-MPI	ls-dyna_mpp_d_R9_3_0_135710_winx64_ifort2017vs2017_impi_lib.zip	87581 Ko
		MS-MPI	ls-dyna_mpp_d_R9_3_0_135710_winx64_ifort2017vs2017_msmpi_lib.zip	87309 Ko
		Platform-MPI	ls-dyna_mpp_d_R9_3_0_135710_winx64_ifort2017vs2017_pmpi_lib.zip	87592 Ko
	Single	Intel-MPI	ls-dyna_mpp_s_R9_3_0_135710_winx64_ifort2017vs2017_impi_lib.zip	87650 Ko
		MS-MPI	ls-dyna_mpp_s_R9_3_0_135710_winx64_ifort2017vs2017_msmpi_lib.zip	87735 Ko
		Platform-MPI	ls-dyna_mpp_s_R9_3_0_135710_winx64_ifort2017vs2017_pmpi_lib.zip	87671 Ko
R10.2	Double	Intel-MPI	ls-dyna_mpp_d_R10_2_135479_winx64_ifort2017vs2017_impi_lib.zip	95028 Ko
		MS-MPI	ls-dyna_mpp_d_R10_2_135479_winx64_ifort2017vs2017_msmpi_lib.zip	94441 Ko
		Platform-MPI	ls-dyna_mpp_d_R10_2_135479_winx64_ifort2017vs2017_pmpi_lib.zip	94714 Ko
	Single	Intel-MPI	ls-dyna_mpp_s_R10_2_135479_winx64_ifort2017vs2017_impi_lib.zip	94708 Ko
		MS-MPI	ls-dyna_mpp_s_R10_2_135479_winx64_ifort2017vs2017_msmpi_lib.zip	94787 Ko
		Platform-MPI	ls-dyna_mpp_s_R10_2_135479_winx64_ifort2017vs2017_pmpi_lib.zip	94720 Ko
R11.1	Double	Intel-MPI	ls-dyna_mpp_d_R11_1_0_139588_winx64_ifort2017vs2017_impi_lib.zip	108220 Ko
		MS-MPI	ls-dyna_mpp_d_R11_1_0_139588_winx64_ifort2017vs2017_msmpi_lib.zip	108311 Ko
		Platform-MPI	ls-dyna_mpp_d_R11_1_0_139588_winx64_ifort2017vs2017_pmpi_lib.zip	108227 Ko
	Single	Intel-MPI	ls-dyna_mpp_s_R11_1_0_139588_winx64_ifort2017vs2017_impi_lib.zip	108890 Ko
		MS-MPI	ls-dyna_mpp_s_R11_1_0_139588_winx64_ifort2017vs2017_msmpi_lib.zip	108958 Ko
		Platform-MPI	ls-dyna_mpp_s_R11_1_0_139588_winx64_ifort2017vs2017_pmpi_lib.zip	108885 Ko

Table I.4.4: LS-DYNA archive files to run with Digimat coupled analysis.

Supported MPI versions are:

- Platform-MPI 8.1 and 9.1.2
- Intel-MPI 2018.1
- MS-MPI 8.1

Launching Digimat-CAE/LS-DYNA under Windows

To launch a Windows job of Digimat-CAE/LS-DYNA using command line, the following bat script can be used, for example for LS-DYNA R11.1 in double precision using Platform-MPI on 4 processors:

```
set FLEXLM_TIMEOUT=5000000
set PATH="C:\Program Files (x86)\Platform Computing\Platform-MPI\bin";%PATH%
set MSC_LICENSE_FILE=27500localhost
C:\Program Files (x86)\Platform Computing\Platform-MPI\bin\mpirun -np 4
  DIGIMAT_DIR\DigimatCAE\digi2dyna\R11.1\Double\PCMPI\mppdyna_d.exe i=input.k
```

where:

- First line can be needed when using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000.
- Second line add `PATH` to MPI dynamic libraries.
- Third line defines `MSC_LICENSE_FILE` environment variable pointing to MSC license server (including port).
- Last line runs Digimat-CAE/LS-DYNA job.
- `DIGIMAT_DIR` is Digimat installation directory, e.g., `C:\MSC.Software\Digimat \2021.2`.

Generation of encryption key file for Macro solution

When using Digimat-RP with Macro solution, material properties are encrypted. Generation of key is done by doing following blank run of LS-DYNA in Digimat working directory:

```
C:\Program Files (x86)\Platform Computing\Platform-MPI\bin\mpirun -np 1
  DIGIMAT_DIR\DigimatCAE\digi2dyna\R11.1\Double\PCMPI\mppdyna_d.exe pgpkey
```

Then check that the file `lstc_pgpkey.asc` is created. Note that the key file is independant of LS-DYNA version, so, it can be generated with any LS-DYNA executable.

I.4.8 Digimat-CAE/PAM-CRASH

The objective of this section is to explain how to install the interface between Digimat and PAM-CRASH.

Supported versions

Digimat 2021.2 supports the following releases of PAM-CRASH software:

- PAM-CRASH 2018.01
- PAM-CRASH 2019.0
- PAM-CRASH 2020.0

Digimat 2021.2 supports the following platforms for PAM-CRASH interface:

- Windows 10 (64-bit)
- Linux Red Hat 6.3 using GLIBC $\geq$ 2.12 and GLIBCXX $\geq$ 3.4.13
- Linux Red Hat 7.3 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.5 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux Red Hat 7.7 using GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19
- Linux SUSE 12 SP1
- Linux SUSE 12 SP2
- Linux SUSE 12 SP4

Digimat 2021.2 supports following parallelization methods:

- For Windows platforms:
  - For PAM-CRASH 2019.0 and further, Distributed Memory Parallelization (MPP) using Intel-MPI (default parallelization method)
  - For PAM-CRASH 2018.0 and previous versions, Distributed Memory Parallelization (MPP) using Platform-MPI (default parallelization method)
- For Linux platforms:
  - For PAM-CRASH 2020.0 and further, Distributed Memory Parallelization (MPP) using Intel-MPI (default parallelization method)
  - For PAM-CRASH 2019.0 and previous versions, Distributed Memory Parallelization (MPP) using Platform-MPI (default parallelization method)

Installation procedure

Digimat-CAE/PAM-CRASH is the module containing the Digimat capabilities and the required interfaces in order to be linked with the PAM-CRASH explicit solver. For more information on supported versions and platforms, please refer to section I.4.8.

Digimat-CAE/PAM-CRASH is the material library containing the Digimat linear and nonlinear multi-scale material modeling capabilities. For Digimat 2021.2, a set of dynamic libraries is provided for the Digimat-CAE/PAM-CRASH interface, both for single and double precision for all supported PAM-CRASH versions. The installation procedure for the dynamic library is straightforward. While installing Digimat to PAM-CRASH, it installs the necessary libraries, including

Under Windows: `libdigimat_N_sp.dll` and `libdigimat_N_dp.dll` according to targetted precision (single or double).

Under Linux: `libdigimat_N_sp.so` and `libdigimat_N_dp.so` according to targetted precision (single or double).

with $N \in [0, 3]$.

Those libraries will be loaded by the explicit solver (psolid.exe) at runtime. The library `libdigimat_N.dll/.so` and its dependencies contains definition of all possible user defined subroutines. This will allow the user to use all linear and nonlinear small-strain material models capabilities available in Digimat for small-strain analyses. Defining Digimat material model in PAM-CRASH then is just like defining any other PAM-CRASH material model.

Launching Digimat-CAE/PAM-CRASH computations on Windows platform

To run coupled Digimat to PAM-CRASH computations in command line, it is advised to write a .bat file containing all the information needed by PAM-CRASH to allow the call to user subroutine.

Running Digimat-CAE/PAM-CRASH 2018.01 in double precision and 4 CPUs can be done using following script:

```
1.  @echo off
2.  set MSC_LICENSE_FILE=27500@localhost
3.  set PATH=DIGIMAT_INST_DIR\DigimatCAE\exec\digi2Pamcrash;
      DIGIMAT_INST_DIR\DigimatCAE\exec\digi2Pamcrash\2018.0\windows-x86-64;%PATH%
4.  set FLEXLM_TIMEOUT=5000000
5.  set OMP_NUM_THREADS=1
6.  set PAM_USER_PLUGIN_ROOT=DIGIMAT_INST_DIR\DigimatCAE\exec\digi2Pamcrash\2018.0
7.  "PAM_INST_DIR\2018.0\Solver\bin\bin\pamcrash.bat" -np 4 -fp 2 test.pc > "test.out"
```

Running Digimat-CAE/PAM-CRASH for PAM-CRASH 2019.0 and further versions in double precision and 4 CPUs can be done using following script:

```
1.  @echo off
2.  set MSC_LICENSE_FILE=27500@localhost
3.  set PATH=DIGIMAT_INST_DIR\DigimatCAE\exec\digi2Pamcrash;
      DIGIMAT_INST_DIR\DigimatCAE\exec\digi2Pamcrash\2020.0\bin\windows-x64-intel;
      %PATH%
4.  set FLEXLM_TIMEOUT=5000000
5.  set OMP_NUM_THREADS=1
6.  set PAM_USER_PLUGIN_ROOT=DIGIMAT_INST_DIR\DigimatCAE\exec\digi2Pamcrash\2020.0
7.  "PAM_INST_DIR\2020.0\Solver\bin\pamcrash.bat" -np 4 -fp 2 test.pc > "test.out"
```

where

- `DIGIMAT_INST_DIR` is Digimat installation directory, e.g.,
  `C:\MSC.Software\Digimat\2021.2`
- `PAM_INST_DIR` is PAM-CRASH installation directory, e.g.,
  `C:\Program Files\ESI Group\Virtual-Performance`

The first command suppress screen display of command. The second line defines the path to Digimat license path through `MSC_LICENSE_FILE` environment variable. Definition of `MSC_LICENSE_FILE` is needed if it is not defined as a global environment variable. The third command add to `PATH` environment variable the path to Digimat library `digi2pamDouble_N.dll` and Digimat third-party libraries. The fourth command defines `FLEXLM_TIMEOUT` environment variable. This can be needed if using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000. The fifth command specify the number of threads to be used, only 1 thread is supported by Digimat. The sixth command gives to PAM-CRASH the path to the `libdigimat_N.dll` file. The last command is the command to run PAM-CRASH analysis, the `-fp 2` option sets the precision to double precision and the `-np 4` makes running on 4 processes. The command sends the output to the `.out` file. If error is encountered in Digimat, it will be written in this file.

Launching Digimat-CAE/PAM-CRASH computations on Linux platform

To define environment variables needed to run Digimat to PAM-CRASH coupled analysis, user can write a launch script as the one described below:

For Digimat-CAE/PAM-CRASH 2019.0 and further versions :

```
1.  #!/bin/bash
2.  export PAM_USER_PLUGIN_ROOT=DIGIMAT_INST_DIR/DigimatCAE/exec/digi2pamcrash/2020.0
3.  export LD_LIBRARY_PATH=DIGIMAT_INST_DIR/DigimatCAE/exec/digi2pamcrash/:
      DIGIMAT_INST_DIR/Digimat/lib:
      DIGIMAT_INST_DIR/DigimatCAE/exec/digi2pamcrash/2020.0/bin/linux-x64-intel:
      $LD_LIBRARY_PATH
4.  export PAM_LMD_LICENSE_FILE=27007@host
5.  export MSC_LICENSE_FILE=27500@host
6.  export FLEXLM_TIMEOUT=5000000
7.  export OMP_NUM_THREADS=1
8.  export PAMROOT=/opt/pamcrash/2020.0
9.  export PAMHOME=$PAMROOT
10.  $PAMROOT/pamcrash_safe/2020.0/Linux_x86_64/bin/pamcrash
      -np 4 -fp 2 -lic CRASHSAF test.pc > test.out
```

For Digimat-CAE/PAM-CRASH 2018.0:

```
1.  #!/bin/bash
2.  export PAM_USER_PLUGIN_ROOT=DIGIMAT_INST_DIR/DigimatCAE/exec/digi2pamcrash/2018.0
3.  export LD_LIBRARY_PATH=DIGIMAT_INST_DIR/DigimatCAE/exec/digi2pamcrash/:
      DIGIMAT_INST_DIR/Digimat/lib:
      DIGIMAT_INST_DIR/DigimatCAE/exec/digi2pamcrash/2018.0/linux-x64-intel:
      $LD_LIBRARY_PATH
4.  export PAM_LMD_LICENSE_FILE=27007@host
5.  export MSC_LICENSE_FILE=27500@host
6.  export FLEXLM_TIMEOUT=5000000
7.  export OMP_NUM_THREADS=1
8.  export PAMROOT=/opt/pamcrash/2020.0
9.  export PAMHOME=$PAMROOT
10.  $PAMROOT/pamcrash_safe/2020.0/Linux_x86_64/bin/pamcrash
      -np 4 -fp 2 -lic CRASHSAF test.pc > test.out
```

where `DIGIMAT_INST_DIR` is Digimat installation directory, e.g.,

```
/opt/msc/Digimat/2021.2
```

The first command is the header to execute bash scripts. The second command defines the location of the `libdigimat_N.so` shared library. The third command add the path to Digimat third-party libraries to `LD_LIBRARY_PATH` environment variable. For PAM-CRASH 2019, it is needed to also add the full path to `libdigimat_N.so`. The next two commands define the path to Digimat and PAM-CRASH licenses. The sixth command defines `FLEXLM_TIMEOUT` environment variable. This can be needed if using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for `FLEXLM_TIMEOUT` is 5000000. The seventh command specifies the number of threads to be used, only 1 thread is supported by Digimat. The `PAMROOT` gives the path to PAM-CRASH directory. The last command launches PAM-CRASH computation. The `-fp 2` option sets the precision to double precision and the `-np 4` makes running on 4 processes. The command sends the output to the `.out` file. If error is encountered in Digimat, it will be written in this file.

I.4.9 Digimat-CAE/MSC Nastran SOL1XX

The objective of this section is to explain how to install the interface between Digimat and MSC Nastran SOL1XX.

Supported versions

Digimat 2021.2 officially supports the following releases of MSC Nastran software:

- MSC Nastran 2018.1
- MSC Nastran 2019.0
- MSC Nastran 2019 FP1

Digimat should also work with older versions of MSC Nastran. However, these other versions have not been fully tested and, therefore, are not officially supported.

Digimat 2021.2 supports the same platforms as the above versions of MSC Nastran.

Digimat 2021.2 supports the same parallelization methods as the above versions of MSC Nastran.

Installation procedure

Digimat and MSC Nastran SOL1XX can be coupled together without the need for installing anything in particular on top of the classical MSC Nastran and Digimat installations.

Executing a job

Once coupled with one or more Digimat materials, the modified MSC Nastran input deck can be run with MSC Nastran under Windows 64-bit or Linux 64-bit environments like any other input deck, without taking any specific action. Please refer to the MSC Nastran documentation for more information.

For example, to execute a sequential job under Windows 64-bit using the command line, the user needs to type:

```
MSC_INSTALL_DIR/MSC_Nastran/2019.0/bin/nast2019.0.exe inputDeck_DigimatCoupled.bdf
```

where `MSC_INSTALL_DIR` is the installation directory of MSC Software and `inputDeck_DigimatCoupled.bdf` is the name of the MSC Nastran input deck created by Digimat-RP after coupling the structural model with one or more Digimat materials.

I.4.10 Digimat-CAE/OptiStruct

The objective of this section is to explain how to install the interface between Digimat and OptiStruct which uses Digimat-RP.

Installation procedure

When not using the plug-in, Digimat and OptiStruct can be coupled together without the need for installing anything in particular on top of the classical OptiStruct and Digimat installations.

Supported versions

Digimat 2021.2 officially supports the following releases of OptiStruct software:

- OptiStruct 13.0
- OptiStruct 14.0

Digimat should also work with older versions of OptiStruct. However, these other versions have not been fully tested and, therefore, are not officially supported.

Digimat 2021.2 supports the same platforms as the above versions of OptiStruct.

Executing a job

Once coupled with one or more Digimat materials, the OptiStruct model can be run with OptiStruct under Windows 64-bit or Linux 64-bit environments like any other OptiStruct model, without taking any specific action. Please refer to the OptiStruct documentation for more information.

For example, to execute a sequential job under Windows 64-bit using the command line, the user needs to type:

```
ALTAIR_INSTALL_DIR\14.0\hwsolvers\scripts\optistruct.bat model_DigimatCoupled.fem
```

where `ALTAIR_INSTALL_DIR` is the Altair installation directory and `model_DigimatCoupled.fem` is the name of the OptiStruct model created by Digimat-RP after coupling the structural model with one or more Digimat materials.

I.4.11 Digimat-CAE/PERMAS

The objective of this section is to explain how to install the interface between Digimat and PERMAS.

Supported versions

Digimat 2021.2 officially supports the following releases of PERMAS:

- PERMAS V17

Digimat should also work with older versions of PERMAS. However, these other versions have not been fully tested and, therefore, are not officially supported.

Digimat 2021.2 supports the same platforms as the above version of PERMAS.

Installation procedure

Digimat and PERMAS can be coupled together without the need for installing anything in particular on top of the classical PERMAS and Digimat installations.

Executing a job

Once coupled with one or more Digimat materials, the PERMAS model can be run with PERMAS under Windows 64-bit or Linux 64-bit environments like any other PERMAS model, without taking any specific action. Please refer to the PERMAS documentation for more information.

For example, to execute a sequential job under Windows 64-bit using the command line, the user needs to type:

```
INTES_INSTALL_DIR\V17\bin\permas.bat model_DigimatCoupled.uci
```

where `INTES_INSTALL_DIR` is the INTES installation directory and `model_DigimatCoupled.uci` is the name of the PERMAS model created by Digimat-RP after coupling the structural model with one or more Digimat materials.

I.4.12 Digimat-CAE/nCode DesignLife

The objective of this section is to explain how to install the interface between Digimat and nCode DesignLife. For more information concerning supported nCode DesignLife releases and platforms, please refer to the below section I.4.12.

Supported versions

Digimat 2021.2 supports the following releases of nCode DesignLife software:

- nCode DesignLife 2020.0, which supports Abaqus 2017/2018/2019 and ANSYS 2019R3 FE results files as long as the Digimat-CAE/nCode DesignLife interface is concerned;
- nCode DesignLife 2020.1, which supports Abaqus 2017/2018/2019/2020 and ANSYS 2020R1 FE results files as long as the Digimat-CAE/nCode DesignLife interface is concerned.

Digimat 2021.2 supports the following platforms:

- Windows 10 (64-bit)

Parallelization is not supported.

Installation procedure

Within the Digimat installation, the dynamic library `digi2ncode.dll` is located in the directory

INSTALL_DIR\2021.2\DigimatCAE\exec\digi2ncode

where `INSTALL_DIR` is the Digimat installation directory.

To be able to use Digimat to nCode DesignLife interface, `DIGIMAT2NCODE_SHARED_LIBS` environment variable needs to be defined. This variable enables nCode DesignLife to locate Digimat/nCode DesignLife library, to load it and to run coupled Digimat-CAE/nCode DesignLife analyses.

Path to third-party libraries

- `boost_chrono-mt-x64.dll`
- `boost_filesystem-mt-x64.dll`
- `boost_iostreams-mt-x64.dll`
- `boost_regex-mt-x64.dll`
- `boost_system-mt-x64.dll`
- `boost_thread-mt-x64.dll`
- `boost_zlib-mt-x64.dll`
- `digimathdf5.dll`
- `digimathdf5_cpp.dll`
- `digimathdf5_hl.dll`
- `digimatMathTools.dll`
- `digimatPocoFoundation.dll`
- `impi.dll`
- `lapi.dll`
- `libfabric.dll`
- `tinyxmlSTL.dll`
- `VMAP.dll`

must also be added to the PATH environment variable. If these libraries are moved to another directory, PATH variable has to be updated according to this new directory.

Remark: FLEXLM_TIMEOUT environment variable can be needed if using geographically distant license server to avoid failing of license checkout if answer of network is too slow. A meaningful value for FLEXLM_TIMEOUT is 5000000.

I.4.13 Digimat-CAE/ANSYS Fluent

The objective of this section is to explain how to install the interface between Digimat and ANSYS Fluent.

Supported versions

Digimat 2021.2 supports the following releases of ANSYS Fluent software:

- ANSYS Fluent 17.0
- ANSYS Fluent 17.2
- ANSYS Fluent 18.0
- ANSYS Fluent 18.1

Digimat 2021.2 supports the following platforms:

- Windows 10 (64-bit)

Installation procedure

Digimat-CAE/ANSYS Fluent is provided as a set of dynamic libraries. These libraries contain Digimat capabilities allowing to use Digimat materials in ANSYS Fluent analyses.

For more information concerning supported ANSYS Fluent releases and platforms, please refer to the section I.4.13.

Digimat-CAE/ANSYS Fluent for Windows

The Digimat-CAE/ANSYS Fluent interface for the Windows operating system is distributed in two parts. The first part contains third-party components as listed in the following:

- `boost_chrono-mt-x64.dll`
- `boost_filesystem-mt-x64.dll`
- `boost_iostreams-mt-x64.dll`
- `boost_regex-mt-x64.dll`
- `boost_system-mt-x64.dll`
- `boost_thread-mt-x64.dll`
- `boost_zlib-mt-x64.dll`
- `digimathdf5.dll`
- `digimathdf5_cpp.dll`
- `digimathdf5_hl.dll`
- `digimatMathTools.dll`
- `digimatPocoFoundation.dll`
- `impi.dll`
- `lapi.dll`
- `libfabric.dll`
- `tinyxmlSTL.dll`
- `VMAP.dll`

These files are found in the

```
DigimatCAE\exec\digi2Fluent
```

folder of the Digimat installation. The second part are dynamic libraries which are crucial for the installation process of the Digimat-CAE/ANSYS Fluent interface. These dynamic libraries depend on the ANSYS Fluent release and on the parallelization that will be used (Serial, MSMPI or PCMPI). They can be found in three different folders, related to a parallelization method, for each ANSYS Fluent release:

```
DigimatCAE\exec\digi2Fluent\18.1\Serial
DigimatCAE\exec\digi2Fluent\18.1\MSMPI
DigimatCAE\exec\digi2Fluent\18.1\PCMPI
```

In order to enable the Digimat-CAE/ANSYS Fluent interface for a specific calculation, three manual operations are needed:

1. The third-party components listed hereinbefore must be copied in ANSYS Fluent working directory (see afterwards, for a definition of ANSYS Fluent working directory).
2. The folder matching the ANSYS Fluent release number and parallelization method must be copied in ANSYS Fluent working directory. For the sake of simplicity, this folder can then be renamed, e.g. "digi2Fluent".
3. The Digimat-CAE/ANSYS Fluent interface dynamic library must be loaded into ANSYS Fluent. Access the UDF Library Manager (see figure I.4.12) and **Load** the library using the copied folder name, e.g. "digi2Fluent" if renamed as in the previous operation (see figure I.4.13).

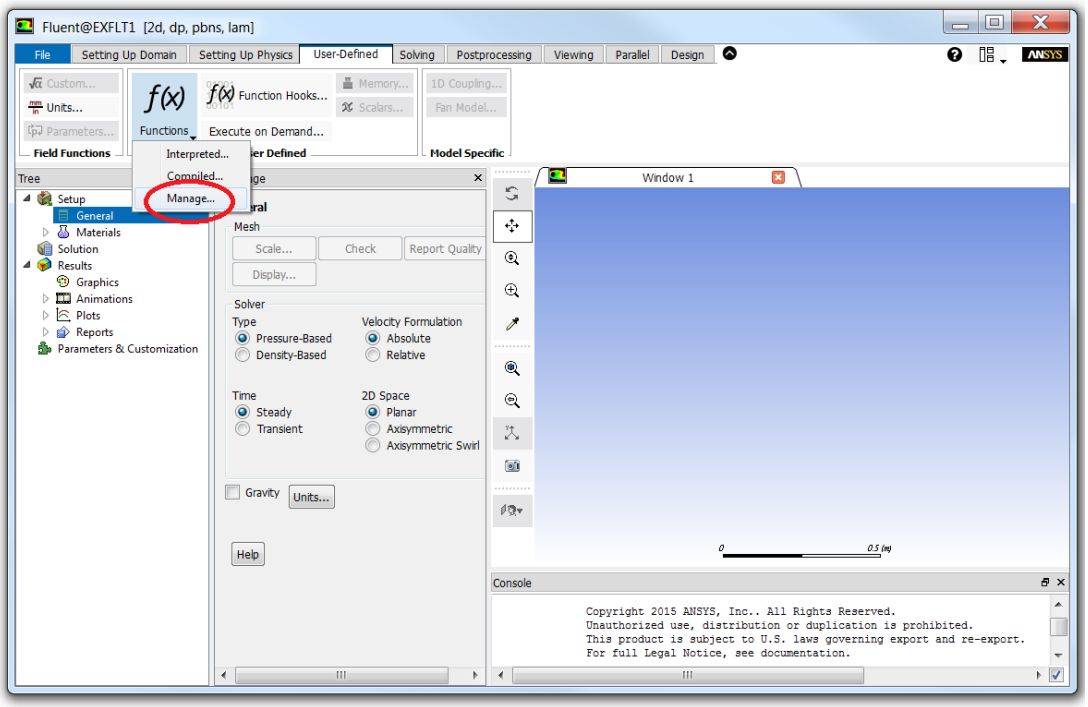


Figure I.4.12: Library manager opening

The ANSYS Fluent working directory depends on Fluent launch method. If ANSYS Fluent is launched from **ANSYS Workbench**, this directory is in the ANSYS Workbench project directory tree. For example, for the FluentHeat ANSYS Workbench project, the ANSYS Fluent working directory is:

```
\dir\FluentHeat_files\dp0\FFF\Fluent
```

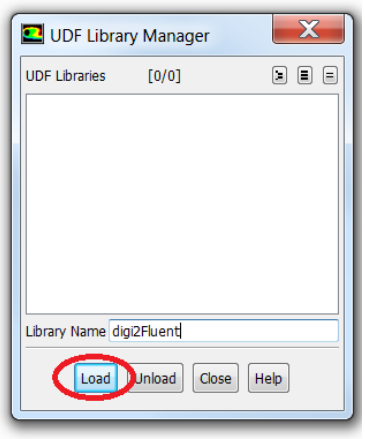


Figure I.4.13: Digimat-CAE/ANSYS Fluent interface dynamic library loading

If **ANSYS Fluent** is launched as a standalone software, it is defined from ANSYS Fluent launcher window (see figure I.4.14).

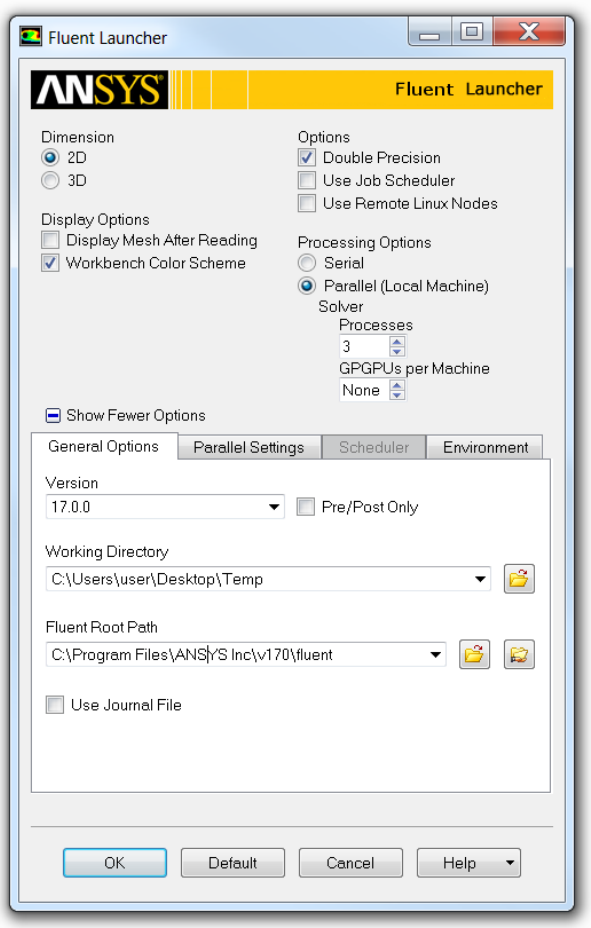


Figure I.4.14: ANSYS Fluent Launcher

It is worth noting that MSMPI and PCMPI Digimat-CAE/ANSYS Fluent interface folders can be used to run Serial calculations.

Part II

Software

Software II.1

New capabilities & changes in the software

II.1.1 Digimat 2021.1

Licensing, installation, and transversal functionalities

- Digimat 2021.1 installer automatically defines two environment variables, namely `MSC_LICENSE_FILE` and `DIGIMAT_BIN_20211`, at the end of the installation procedure. These definitions aim at easing the usage of Digimat products in command line or through scripts.
- A new class of functionalities, named *Specific Features*, regroups all features that are lacking maturity, or still require industrialization activities before being officially supported. Such Specific Features are not accessible by default in a pristine Digimat installation but requires the definition of specific keys in the Digimat settings. Please refer to the dedicated section in Digimat documentation for more information.
- A new feature, named `EX_DIGIMAT_FE_SOLVER_FFT`, is now necessary to use the FFT solver embedded in Digimat-FE. If Digimat-FE solver related features are already purchased, and the FFT solver has to be used, then license file has to be updated. This concerns both MSC One and Seat Based license files.

Known defect

Pasting data to input tables in Digimat platform, Digimat-MF, Digimat-FE, Digimat-MAP, Digimat-MX, Digimat-CAE and Digimat-HC graphical user interfaces may lead to abnormal termination of these products.

Digimat-MF

New capability

Addition of a temperature and strain-rate dependent elastoplastic model. This elastoplastic material model can have parameters that depend over strain-rate and temperature. In Digimat-MX elastoplastic material models with parameters calibrated at different temperatures and strain-rates can be combined in such a single temperature and strain-rate dependent elastoplastic model. This material model can be used in Digimat-MF but is limited to analysis using loading at constant strain-rate. For structural analysis, this model can be translated in a Thermo-Viscoelastic-Viscoplastic material model when using the hybrid solution procedure.

Improvement

Clean analysis job log file : Digimat-MF log files (.log) are now containing less warning and info messages that are general, and so not fully meaningful, for the analysis under consideration.

Known defect

When using a multilayer microstructure containing a layer modelled as a homogeneous material, the results in the results file associated with the matrix of the corresponding layer are not correct. A possible workaround is to define a fake reinforcing inclusion with a negligible volume fraction.

Digimat-FE

New capabilities

- Support of the FFT solver on GPU: the FFT solver is taking advantage of the CUDA libraries from nVIDIA to unleash the computational power of nVidia GPUs. Please note that this capability requires a specific license feature.
- FFT solver for new material performance predictions:
  - Support of thermo-mechanical and creep analysis.
  - Support of viscoelastic-viscoplastic, pressure sensitive elastoplastic (Drucker-Prager model), thermo-elastic, thermo-elastoplastic, thermo-elastoviscoplastic, and some hyperelastic material models.
  - Support of per phase failure indicator computation.
- RAW 3D image file can be imported as microstructure description:
  - Microstructure can be directly imported from RAW image file. Currently the image must be segregated such that two-phases, and only 2 for the moment, are existing in the image.
  - The FFT solver is the only solver that can be used to solve the sub-sequent analysis.

Improvements

- Efficiency related improvements in the FFT solver:
  - Addition of a single precision computation mode allowing to largely reduce the memory consumption. Single precision is activated by default in the current release.
  - CPU performance improvements leading to 30
- Widen cemented metal modeling capabilities:inter-grain failure prediction, using cohesive material model together with the finite element solver.
- Improvement of the FFT solver when used for crystal plasticity computation: the convergence rate was improved and so the computation time for a given analysis is reduced.
- Extension of the support of STL file for microstructure definition: STL file were supported when defining a microstructure made of two-phases materials. In the current version, STL files can also be used to define single-phase materials like foams, lattices and other cellular materials.
- Improvements in the polycrystal microstructure generation when modeling metals: the improvements aim at increasing the smallest edge length which exists in the polycrystal microstructure so to ease its meshing and increase the characteristic length of the smallest element.

Digimat-MX

New capabilities

- Automatic reverse-engineering of material model parameters for SFRP from data-sheet information: nonlinear (e.g., elastoplastic with failure) and anisotropic material model parameters can be reverse engineered from data-sheet information thus relying on a single tensile stress-strain curve (e.g., a tensile stress-strain curve obtained for an ISO527 dumbbell).
- Validation of calibrated material model parameters using finite elements models of dumbbells: after having calibrated the parameters of a material model, an additional step allows users to trigger the automatic creation, submission, and post-processing of finite element analysis over dumbbells.
- New way to contact Material Supplier.
- New material data in public database:
  - New models from the following suppliers
    - RadiciGroup High Performance Polymers: Add Heramid A GF030. Product made with raw material from post-industrial selected plant and from textile polymerization and compounding.
    - DOMO Engineering Plastics: Update Technyl MMI database. Add a new materials (TECHNYL AFX218VP50, SINTERLINE PA6 XP 1670 Natural).
    - DSM: Add new models for existing materials.
    - Dupont Transportation and Industrial: Add 2 new materials (Zytel NVH70G35HSLA2 BK416, Zytel NVH70G35HSLA BK152), remove Zytel 73G40T and new models for existing materials.
    - LGChem: Add 3 new materials (LUMID GP2400AW, LUMID GP2600B, LUSED GP2400CD).
    - Stratays: Add a new material (Ultem 9085 resin CG).
    - SABIC Specialties: Add new models for existing materials.

    * Trinseo: Add new models to existing materials.
    * EVONIK: Remove 2 materials (VESTAMId HTplus M1035 and VESTAMId HTplus M1063).
    * Asahi: Remove 3 materials (Leona 92G60, Leona EG135 and Leona EG150).
  - New material suppliers
    * HANKUK Carbon: Add a CFRP material (T700-4545S).
    * MISUI: Add a CFRP material (TAFNEX).
    * Avient: PolyOne becomes Avient.

Improvements

- Improvement in the reverse-engineering of viscoelastic material model parameters when targeting NVH analysis: the reverse-engineering process is re-structured in a step-by-step procedure, relying on DMA and tensile stress-strain curves, easing the obtention of a good match between predicted and measured material behavior. In addition, new visualization of elastic modulli evolutions as function of frequency are added.
- Additional tag about material card Pedigree: every material model file inserted in the Digimat-MX database has received a Pedigree tag to inform the user if it is considered as made for quantitative or semi-quantitative predictions, or only to be considered as generic.
- Addition of a dedicated button to ask the material supplier for additional data for a given material grade.
- Finite element solver improvements that may lead to CPU time reduction.

Digimat-MAP

Known defect

Digimat-MAP doesn't support weld line files that are exported from Moldflow software using other language than English (file must contain the keyword 'Time').

Digimat-CAE

New capabilities

- Updated support of the existing interfaces with CAE software:
  - Marc 020
  - ANSYS 2020R2
  - PERMAS 18
  - nCode DesignLife 2020.1
  - Abaqus 2019 HF10 & 2020 HF4 (available on-demand)
- Addition of a temperature and strain-rate dependent elastoplastic model: Elastoplastic material model can have parameters that depend over strain-rate and temperature. In Digimat-MX elastoplastic material models with parameters calibrated at different temperatures and strain-rates can be combined in such a single temperature and strain-rate dependent elastoplastic model. In Digimat-CAE, for structural analysis, such model can be translated in a Thermo-Viscoelastic-Viscoplastic material model when using the hybrid solution procedure.

Improvement

Clean analysis job log file: Digimat-CAE log files (.log) are now containing less warning and info messages that are general, and so not fully meaningful, for the analysis under consideration.

Known defects

- When the path to orientation or weld line files are too long, Digimat-CAE displays the following error message: `DIGIMAT ERROR: No Analysis section is defined in .mat file.`

- Using LS-DYNA/Implicit with woven microstructure can lead to very slow convergence of LS-DYNA solver.

Important notice

Red Hat support: Red Hat 6 is supported for the interfaces to Abaqus prior to 2020, LS-DYNA and PAM-CRASH. Dedicated installers are available on demand.

Digimat-RP

New Capabilities

- ICME workflow for fiber reinforced polymer printed by SLS: fiber orientation tensor can be defined and visualized over the part, next to the printing and recoating directions. Homogenization methods can then be used to compute equivalent material properties for the fiber reinforced polymer and later perform structural FEA analysis.
- Additional capability in Digimat-RP/Moldex3D allowing to load material rheology from external file.

Improvements

- Extended SFRP fatigue post-processing capabilities: additional visualization capabilities (e.g., cut views, element set selection and highlighting...).
- Extended macro solution capabilities: Abaqus macro solution is extended to elastoplastic and thermo-elastoplastic material performances.
- Digimat-RP/Moldex3D solver update to 2020 version.

Known defects

- Digimat-RP doesn't support weld line data that are exported from Moldflow software using other language than English (file must contain the keyword 'Time').
- Orientation files in .dof format, larger than 2Gb, are not supported by Digimat-RP
- When using 3D TIMON injection files with shell elements, there is a discrepancy between strong coupling and macro solution:
  - When using strong coupling solution, thicknesses of shell elements will be the one of structural mesh.
  - When using macro solution, thicknesses of shell elements will be the one of injection mesh.

  This can lead to differences in results in case of important differences between thicknesses defined for injection mesh and thicknesses defined for structural mesh.

Digimat-VA

New Capability

Parametric study of effects of defects: prediction of effect of defects over material stiffness and strength can be used in conjunction with parametric studies. Statistical distributions of defects key characteristics can be defined so to predict the corresponding range of variation of material performances.

Improvements

- Smart time stepping strategy for advanced progressive failure model: it allows to reduce the number of time steps, and so the CPU time, by a factor 2 (factor measured on a representative test campaign made of UNT, UNC, OHT and OHC tests).
- Finite element solver improvements that may lead to CPU time reduction.

Known defect

- In case of errors during the porous material properties calibration process (using Digimat-FE from Digimat-VA, when performing defect study with intraply or interply porosities), all errors are not correctly reported in the Digimat-VA log file.
- When saving a `.vaf` file from the Digimat-VA UI, then reloading that .vaf in Digimat-VA UI and resaving again as `.vaf`, that second `.vaf` file contains an error in each `FEA_SETTINGS` section (`test_type` key is wrong) which will lead to a crash when reloading that `.vaf` file and generating the coupons.

Digimat-AM

New capabilities

- Explicit modeling of supports and brims: in addition to the previously existing ways to implicitly model the effects of supports over part warpage, explicit modeling is now available. Explicit models allow to define the supports and brims geometries and material models, so to later discretize them and model their behavior within the AM process simulation.
- Batch mode: analysis file can be exported in an editable and readable ASCII file and run in command-line.
- Costing model: new post-processing module allowing to input material, printer, energy, labor... costs and compute the resulting printed part cost accounting for the number of printing batches and parts per batch.
- Database update: new material models
  - Stratasys UltemTM 9085 resin CG
  - Domo Engineering Plastics Sinterline PA6 XP 1670

Improvements

- Full SLS build simulation enhancements:
  - Thermo-mechanical analysis is now supported.
  - Dedicated workflow for printer qualification not requiring the import of a part geometry.
  - New post-processing output: isochrone plot.
  - New result output: state of matter.
- Finite element solver improvements that may lead to CPU time reduction.

Known defect

Remote job submission is not functional for input files larger than 4Go.

II.1.2 Digimat 2020 FP1

In this section of the documentation, you can find all major changes that are in Digimat 2020 FP1.

Digimat-MF

Consolidation of multi-component 3D failure indicator.

Digimat-FE

- Electrical analysis of woven with Abaqus solver is now supported
- Consolidation of STL geometry import: Mesh of imported geometry

Digimat-MX

None for this release.

Digimat-MAP

Support of Eiger (Markforged) toolpath encrypted file format (Encryption available on request to Markforged).

Digimat-CAE

Corrected SFRP failure indicator output in MSC Nastran SOL400.

Digimat-RP

- Support of Eiger (Markforged) toolpath encrypted file format (Encryption available on request to Markforged).
- Updated solver for Digimat-RP/Moldex3D solver: upgrade from Moldex3D R16.2 to R16.3
- Corrected shell thickness for Nastran mesh mapping
- Corrected orientation tensor for ANSYS macro coupling

Digimat-VA

None for this release.

Digimat-AM

- Support of Eiger (Markforged) toolpath encrypted file format (Encryption available on request to Markforged).

- Loading of crystallinity model is now supported
- Consolidation of meshing symmetry (for single part print only)

II.1.3 Digimat 2020.0

In this section of the documentation, you can find all major changes that are in Digimat 2020.0.

Digimat-MF

Consolidation of transversally isotropic fiber response with thermo-dependent and viscous matrix

- Corrected phase results with TE matrix model (without impact on composite response)
- Corrected response with TEP matrix model
- Extended TE matrix model to orientation tensor and thermo-dependent transversally isotropic fiber
- Supported with TVE matrix model

Digimat-FE

- New external geometry microstructure definition: supported .stl geometry import to distinguish two phases
- More robust and efficient modeling workflow for UD stiffness and strength prediction
  - Accumulated plastic strain failure indicator with thermo-mechanical analysis
  - Element deletion post failure and damage
  - Pressure dependent matrix hardening behavior
  - Friction post-debonding for breaking glue
- Widen cemented metal modeling capabilities
  - New phases are inclusion, void, prismatic grain and core-rim inclusion : binder instead of matrix (labeling only)
  - Enriched microstructure post-processing
    - Intercept distribution
    - Equivalent diameter distribution
  - Available with FE/Solver (FEA and FFT approach)
- Consolidation of the FFT solver
  - Supported EVP matrix model
  - Supported curved sphero-cylinder inclusions
  - Supported theta and phi input for loading

Digimat-MX

- New filtering experience
  - New interface highlighting material supplier's presence
  - Efficient browsing capabilities relying material type, manufacturing, microstructure, part performance or process, model behavior and conditioning
  - Import to grade and eased navigation capabilities
- Material card information export: on export, material cards now contain numerous valuable information
  - Digimat-MX database version it comes from
  - Performance tags
  - When applicable, conditioning and dependent information such as moisture, temperature, strain rate, frequency, load ration, etc.
- New material data in public database
  - New models
    - Ascend Performance Materials
    - SOLVAY engineering Plastics is now DOMO Engineering Plastics
    - DSM
    - Dupont Transportation and Industrial
    - KOLON PLASTICS
    - Kuraray co. Ltd.
    - LG Chemicals
    - MarkForged
    - PolyOne
    - SABIC Specialties
    - SABIC Petrochemicals
    - Solvay Specialty Polymers
    - SUMIKA Polymer Compounds
    - Toray
  - New material suppliers
    - Ascend Performance Materials
    - DOMO Engineering Plastics
    - KOLON PLASTICS
    - LG Chemicals
    - PolyOne
    - Toray
  - Leaving material suppliers
    - Lanxess

Digimat-MAP

- New mesh extrusion capability
  - Post mapping, possibility to extrude receiver mesh
  - Supported for Aniform donor and Abaqus receiver meshes
- New partial infill field mapping
  - For FFF and FDM based on toolpath input
  - For solid receiver mesh only
  - Local infill per element or average partial infill over domain
- Supported CFF process
  - Support of Markforged toolpath format
  - Save element sets of Onyx and CFF materials
- Extended data support for existing interfaces: PAM-Form orientation .erfh5 format

Digimat-CAE

- Updated support of the existing interfaces for user subroutines for Windows (7 and 10) & Linux (Red Hat 7 and Suse 12)
  - Abaqus (GA release only): 2018 / 2019 / 2020
  - ANSYS: 2019R1 / 2019R3 / 2020R1
  - LS-DYNA: R9.3 / R10.2 / R11.1
  - Marc: 2018.1 / 2019 / 2019 FP1
  - PAM-CRASH: 2017 / 2018 / 2019
  - Samcef: V16.3 / V17.2
  - nCode DesignLife: 2018.1 / 2020
- Supported thermo-mechanical analysis for LS-DYNA/Implicit
- Supported advance PFA for structural analysis
  - Available for UD material only using Camanho model failure indicator
  - Supported for Abaqus/Explicit, LS-DYNA/Explicit and Marc
- Supported structural curing analysis
  - Available for UD material only
  - Prescribed temperature field only
  - Supported for Abaqus/Standard, ANSYS, LS-DYNA/Implicit and Marc

Digimat-RP

- Extended Digimat-RP/Moldex3D solver to valve gate control
  - Accessible from orientation tensor process settings with multiple gates
  - Available for shell and solid mesh
- Supported in command-line
  - Accessible once analysis is ready to run (very last step prior submission)
  - Compatible with orientation tensor mapping, Digimat-RP/Moldex3D estimator and new valve gate control feature
- Extended SFRP fatigue post-processing capabilities: FEA support extended to PERMAS on top of Marc, Abaqus and ANSYS
- Supported partial infill
  - For FFF and FDM manufacturing process, based on toolpath input
  - For solid receiver mesh only
  - Local infill per element or average partial infill over domain
- Supported CFF process
  - New manufacturing process for continuous fiber fabrication (CFF) and associated material type for continuous fiber-reinforced polymer
  - Support of Markforged toolpath format
- Extended macro solution capabilities
  - FEA support extended to ANSYS for E, TE, EP and TEP models
  - Restricted encryption to encrypted Digimat material cards
- Updated solver for Digimat-RP/Moldex3D solver: Upgrade from Moldex3D R16.1 to R16.2

Digimat-VA

- Extended effect of defects workflow: New defect (AFP gaps)
- Extended usage of advanced PFA to effect of defect workflow

Digimat-AM

- Improved usability for results post-processing
  - Automated superposition and reference plane positioning for warpage evaluation
  - Scan dimensional comparison
  - New post-processing output: Shape tolerance
  - Per part post-processing for multi-part build
- Supported FFF and FDM partial infill
  - Thermo-mechanical solver only
  - Unfilled and reinforced materials
  - New result output: Porosity
- Supported full SLS build simulation: thermal solver only
- Printer database update for FFF
  - New Roboze Argo 500
  - New MarkForged X7
- Support of Stratasys toolpath v2.2 : available from Insight 14.2 or GrabCAD Print 1.41
- Support of TVE material with transverse isotropic fibers

II.1.4 Digimat 2019.1

In this section of the documentation, you can find all major changes that are in Digimat 2019.1.

Digimat-MF

- Revised default failure models for SFRP and CFRP
  - Tsai-Hill 3D Transversely isotropic, strain based, for microstructures with matrix + inclusion (SFRP)
  - Multicomponent 2D for microstructures with continuous fibers (UD and woven 2D)
- New Tsai-Wu 3D orthotropic failure model improving failure modeling for FFF/FDM materials

Digimat-FE

- New additional solver within Digimat-FE/Solver, based on FFT technology
  - Reduced run time vs Finite Element Analysis based solver
  - Reduced memory consumption vs Finite Element Analysis based solver
  - Supported for mechanical analysis of RVE involving
    - Elasticity, elastoplasticity
    - Viscoelasticity, Elastoviscoplasticity
    - Hyperelasticity, crystal plasticity
- Improved SFRP geometry generation algorithm, enabling higher volume fraction and more accurate fiber orientation distribution
- More robust and efficient modeling workflow for UD stiffness and strength prediction

  - Improved microstructure generation for better randomness and high volume fraction
  - Extruded periodic meshing for robust and efficient run
  - New waviness definition for compression case simulation
  - New initial thermal loadcase to account for manufacturing stresses
  - Phase strength distribution
  - New Turon cohesive law to model fiber/matrix interface with more physics and better convergence (available with FE/Solver only)
- Improved RVE generation algorithm for strands enabling higher out-of-plane orientation distribution
- New crystal plasticity constitutive model available for polycrystal microstructures
  - Dedicated Metal microstructure definition through Polycrystal
  - Texture import & post-processing from Digimat-FE results
  - Supported for
    * Single phase polycrystal microstructure
    * FCC, BCC, HCP crystal symmetries
  - Available with FE/Solver (FEA and FFT approach)
  - Requires dedicated add-on licenses to Digimat-FE

Digimat-MX

- Extended reverse engineering method, now supporting
  - Viscoelasticity models
  - Thermo-viscoelasticity models
- New Coefficient of Thermal Expansion reverse engineering
- New Poisson's ratio reverse engineering
- Through thickness plot of fiber orientation tensor
- New material suppliers
  - MarkForged
  - Sintratec
- New material data in public database
  - DSM
    * Updated models for:
      · Akulon Ultraflow K-FHG12
    * Additional models (fatigue, thermoplasticty) for several grades:
      · Akulon K224-HG7
      · Akulon S223-HG0
      · ForTii Ace MX53T
    * Additional Elastic models for all grades
  - DuPont Transportation and Industrial
    * Addition of new grades:
      · Zytel 73G50HSLA BK416
      · Zytel 73G40T BK416
      · Zytel 73G60HSLA BK416
  - Solvay Specialty Polymers
    * Updated models for:
      · Ixef 1022 at 23°C
      · Ketaspire KT-880 GF30 at 23°C
      · Ryton R-4-200
    * Addition of new grades:
      · Amodel A-4145HH BK311
      · Ketaspire KT-820 GF30
      · Ryton R-4-220

    - Addition of new grades for Additive Manufacturing (FFF):
        - NovaSpire PEKK AM Powder
  - Sumika Polymer Compounds
    - Addition of new models(fatigue, creep...) for existing grades:
        - Thermofil HP F610X99
        - Thermofil HP F611X99
        - Thermofil HP F711X99
        - Thermofil HP F811X99
        - Thermofil HP F911X99
  - Asahi-Kasei Corporation
    - Addition of new nodels(fatigue, creep...) for existing grades:
        - Leona 14G30
        - Leona 14G35
        - Leona 14G50
    - Addition of new a grade:
        - Leona SG104
  - Sintratec (new AM printer supplier)
    - Addition a grade:
        - Sintratec PA12 Powder
  - Solvay Engineering Plastics
    - Addition of new grades:
        - TECHNYL Red J V35 Black 21N
        - TECHNYL Red S V50 Black 21N
  - RadiciGroup
    - Addition of new grades:
        - Radiflam A RV250HF 333 BK
        - Raditeck P ERV400K 1700 NT
        - Raditer B RV300 333 BK
        - Radilon DT RV300RKC2 306 BK
        - Radilon Aestus T1 RV300RKC 306 BK
        - Radilon Aestus T1 RV400RKC 306 BK

Digimat-MAP

- New weld line angle filtering method
- New manufacturing data formats supported: Hexagon VISI Flow
- Extended data support for existing interfaces
  - Moldflow 3D / Microcellular analysis: support of varying bubble density
  - 3D TIMON Light 3D
- Extended mapping : 1D mapping for porosity now available

Digimat-CAE

- Updated support of the existing interfaces for user subroutines for Windows & Linux (Red Hat 7 & Suse 11)
  - Abaqus 2017 / 2018 / 2019
  - ANSYS 19.2 / 2019R1
  - LS-DYNA R9.3 / R10.1 / R10.2
  - Marc 2018 / 2018.1
  - PAM-CRASH 2016 / 2017 / 2018
  - Samcef V16.3 / V17.2
  - nCode DesignLife 2018.1
- Improved robustness of Hybrid solution for strain-rate dependent j2-plasticity
- Simplified installation of Digimat with other user subroutines for Marc
- Full harmonic analysis now supported with ANSYS
- Support of RH6 OS for Abaqus, LS-DYNA and PAM-CRASH

Digimat-RP

- Improved superposition visualization for more confident mapping
- Simplified solution settings management
  - Settings are split between
    - Solution settings (application oriented, not requiring Hybrid parameters re-generation)
    - Advanced solver settings (solver oriented, requiring Hybrid parameters re-generation)
  - Previous templates are deprecated
- Updated solver for Digimat-RP/Moldex3D solver: upgrade from Moldex3D R16 to R16.1
- Extended SFRP fatigue post-processing capabilities
  - New plasticity correction method
  - FEA support extended to Marc on top of Abaqus and ANSYS
- New SMC solution
  - New material type for compression molding
  - Support of SMC type of material model
    - Elasticity
    - Viscoelasticity
    - Failure and damage
  - Support of fiber orientation and weld line manufacturing data

Digimat-VA

- New Advanced PFA model
  - Providing more physics and accuracy through
    - LaRC failure criteria
    - Elastoplasticity behavior for shear
    - In-situ strength
    - Intralaminar fracture toughness
    - Effect of manufacturing stresses

        * Dedicated meshing approach
    - Available for
        * UD materials
        * Unnotched and open hole tests
- New delamination modeling
    - Available for UD and woven materials
    - Available with Standard and Advanced PFA
- New effect of defects workflow
    - Enabling study of the effect of
        * Interply porosity
        * Intraply porosity
        * Out-of-plane waviness
    - Available with Standard PFA
- Enhanced allowables computation
    - Outliers check
    - Normalization on stiffness/strength
    - Revised allowable formula
- Command line available for batch mode
- Improved boundary condition for unnotched test
    - New option to define free length
    - Reduced mesh sensitivity

Digimat-AM

- Improved usability for results post-processing
    - Cut view
    - Custom reference plane definition for warpage evaluation
    - Pick node/element values
    - Manage user-defined views
    - Larger visualization window
    - Color scale exported with animation (GIF export)
- Enhanced computational performance
    - Thermal analysis
        * -90% result file size
        * -35% run time
    - Thermomechanical analysis
        * -85% result file size
        * -15% run time
    - Specific improvements with encrypted material models
        * -50% run time
        * -40% peak memory usage
- New remote job submission
    - Pre/post-processing with user interface on Windows only
    - Job run on Windows or Linux
    - Job submission: direct or via queuing system (PBS or LSF)
- Printer database update
    - FDM: New Stratasys Fortus 450mc
    - SLS
        * Sintratec Kit
        * Sintratec S1
        * Sintratec S2
- Support of Stratasys toolpath v2.2 : available from Insight 13.9 or GrabCAD Print 1.34

- Various enhancements
  - Improved physics in inherent strain preprocessing for FFF/FDM (energy conservation is ensured)
  - Project management
    - Save at exit when run completed / inherent strains have been computed
    - Working directory saved in the project
  - Licensing: user interface can be closed once job in launched, enabling the post-processing of another simulation result

II.1.5 Digimat 2019.0

In this section of the documentation, you can find all major changes that are in Digimat 2019.0.

Digimat-MF

- New strain rate dependent J_2-plasticity model
  - Straightforward piecewise-linear dependency function definition for J_2-plasticity model
  - First and second order homogenization are both supported
- Revised default settings for microstructures with matrix + inclusion
  - Number of angle increment = 12
  - Store pseudo-grain stress-strain history = on
  - Homogenization order = second
  - Default orientation type for inclusion phase = orientation tensor
  - Aspect ratio for inclusion = 20
- Engineering constants naming change: naming now follows the numerical notation for computed engineering constants
- Enhanced FPGF fatigue failure model
  - New FPGF fatigue multilayer failure trigger
  - New flexible FPGF fatigue failure indicator enabling full control of X, Y and S strength

Remark: Caution: legacy FPGF fatigue models created with Digimat 2018.1 or previous versions are not supported starting from Digimat 2019.0. If a material model is to be used with Digimat 2019.0, then it has to be created using Digimat 2019.0.

Digimat-FE

- Filament decohesion modeling for Fused Filament Fabrication RVE
  - Definition of interface/interphase between filament
  - Unit cell duplication in X, Y and Z direction
- New foam microstructure
  - Open cell and closed cell foam types
  - Random, Kelvin and custom foam topologies
  - Applicable for small strain applications
- New geometry controls for more robust mesh generation
  - "Minimum distance to RVE face" to avoid inclusions too close to RVE face
  - "Minimum angle to RVE face" to avoid partial inclusions difficult to mesh

  - Non-geometrical 2nd order elements
- General improvements
  - Confirmation message upon loading large .t16 result files
  - Warning message for finite strain definition if applied strain is larger than 0.05
  - New default chordal ratio value = 0.1
  - Updated FE/Solver version

Digimat-MX

- Enhanced SFRP fatigue reverse engineering
  - Support of multilayer failure trigger for improved accuracy
  - Support of any loading angle
  - Enhanced fatigue reverse engineering workflow enabling full user control of fatigue failure indicator parameters (previous identification method is not available anymore)
- SFRP stress localization factor for improved fatigue accuracy
  - Specimen geometry definition
  - Automated dumbbell FEA to compute stress localization
- New material data in public database
  - DSM
    - Additional conditions for several grades:
      - Akulon K224 (PG6,PG8)
      - Stanyl TW241F10
      - Stanyl TW200F6
      - Arnite AV2 390 XT
    - Addition of new grades for injection:
      - Akulon Ultraflow K-FHG12
      - ForTii Ace MX53T
      - Akulon K224-HG7
      - Akulon Ultraflow K-FHG0
    - Addition of new grades for Additive Manufacturing (FFF):
      - Novamid ID 1070
      - Novamid ID 1030
      - Novamid ID 1030-CF
      - Arnite ID 3040
  - SABIC
    - Addition of new grades:
      - Noryl FE1520PW
      - Noryl GFN2F
      - Noryl GFN3F
      - Thermocomp EC004APQ
      - Thercomcomp EC008APQ
  - DuPont Performance Materials
    - Addition of new grades:
      - Zytel 70G60HSLA BK099
      - Zytel 74G33W BK416
      - Crastin FR684NH NC010
      - Crastin SK605 NC010
  - Solvay Specialty Polymers
    - Additional conditions for several grades:
      - Ixef 1022

        - Ketaspire KT-880 GF30
        - Ryton R-4-200
    - Addition of new grades:
        - Amodel A-8950 HS
        - Ixef 1032
        - Ketaspire KT-820 GF30
        - Ryton BR42B
        - Ryton R-4-270
    - Addition of new grades for Additive Manufacturing (FFF):
        - KetaSpire PEEK-CF AM Filament
        - Radel PPSU AM Filament
- Borealis (New material supplier)
    - Addition grades for injection:
        - Fibremod GB307HP
        - Fibremod GB402HP
        - Fibremod GB477HP
        - Fibremod GD577SF
- Sumika Polymer Compounds(New material supplier)
    - Addition grades for injection:
        - Thermofil F610X99
        - Thermofil F611X99
        - Thermofil F711X99
        - Thermofil F811X99
        - Thermofil F911X99
- Asahi-Kasei Corporation
    - Addition of new grades:
        - Leona 92G60
        - Leona SG105
        - Leona SG106
- Kuraray Co. Ltd.
    - Additional conditions for existing grades:
        - Genestar G1300A
        - Genestar G1301A
        - Genestar G1350A
        - Genestar G1500A
    - Addition of new grades:
        - Genestar G1352A
        - Genestar GN2330
        - Genestar G1300H
- Stratasys Inc.
    - Addition a new grade:
        - Nylon 12 CF
- Solvay Engineering Plastics
    - MMI database updated, new grades and new models.
    - 68 grades for injection.
    - 1 grade for AM process

Digimat-MAP

- Support of porosity data from Volume Graphics
  - Support of macro porosity input (export to element set)
  - Support of diffuse porosity input (export to porosity file)
- Support 3D to 2D weld line mapping
- More robust weld line mapping procedure
  - Enhanced robustness of weld line mapping algorithm to reduce mesh sensitivity
  - New weld line radius option to control width of weld line area
- Enhanced support of symmetric Moldflow mid-plane data: data between [0, 1] are automatically extended to [-1, 1]

Digimat-CAE

- Updated support of the existing interfaces for user subroutines
  - Abaqus: 6.14-1 / 2016 / 2017 / 2018
  - ANSYS: 18.2 / 19.0 / 19.1 / 19.2
  - LS-DYNA: R9.1 / R9.2 / R9.3
  - Marc: 2017.1 / 2018
  - PAM-CRASH: 2015 / 2016 / 2017 / 2018
  - Samcef: V16.3 / V17.2
  - nCode DesignLife: 2018.1
- Automatic Fiber Placement enhancements
  - Local thickness export to Samcef
  - New output for UD: stress in the material frame
- Simplified installation of Digimat with other user subroutines: available for Abaqus
- Improved accuracy of Hybrid solution for accumulated plastic strain failure indicator

Digimat-RP

- Extended Digimat-RP/Moldex3D microstructure estimation
  - Weld line location now available for 3D mesh
  - Fiber orientation now available for 2D mesh
- Updated solver for Digimat-RP/Moldex3D solver
  - Upgrade from Moldex3D R14 to R16
  - New BLM meshing strategy requiring no mesh control
- New SFRP fatigue post-processing capabilities
  - Lifetime computation for constant amplitude loading
  - Various post-processing methods available
  - Support of Abaqus and ANSYS FEA results
- Composite output management: control of output for indicator of alignment, achieved potential stiffness and first eigenvalue for orientation tensor
- New default settings
  - Hybrid solution template set by default: enforced for models using EP strain rate, TEP, EVP, VEVP and TVEP with interaction law and failure (except if Macro solution is available)
  - Micro + Hybrid failure template is not available anymore

- Nonlinear macro solution for LS-DYNA
  - Direct input of macroscopic EP and EVP LS-DYNA material cards based on Digimat material model
  - Max/min principal strain failure indicator
  - Support of LS-DYNA/Explicit only
  - Support of both shell and solid elements
- Support of fiber reinforced polymer for FFF and FDM processes: fiber orientation distribution defined through toolpath file

Digimat-VA

- New parametric study workflow
  - Available for material, layups and some test parameters
  - Dedicated post-processing and 2D plots
- New in-plane shear test
  - V-notch or $+/-\ 45°$ tests
  - Matrix shear strength now available as model parameter
- Extended CLT analysis
  - Direct analysis of unnotched laminates for
    - Stiffness
    - Strength (1st ply failure)
    - Coefficient of thermal expansion
    - Coefficient of moisture expansion
  - Available for variability and parametric studies
- Interface to MaterialCenter
  - Import of ply properties stored in MaterialCenter for material model calibration
  - Export of laminate virtual allowables from Digimat-VA to store in MaterialCenter for data management at the enterprise level
- General enhancements
  - Mean values, standard deviation and coefficient of variations are now reported at batch level
  - Export variability for the carpet plot
  - Automatic rerun of analysis with increased applied strain when failure is not reached in carpet plot workflow

Digimat-AM

- Thermo-viscoelasticity model for thermomechanical analysis to simulate relaxation effect
  - Available for FFF, FDM and SLS
  - New cooling time process parameter
- Support remote database
  - Access to remote database is enabled to load and save data
  - Configuration of remote database is accessible
- Support remote database
  - Access to remote database is enabled to load and save data
  - Configuration of remote database is accessible
- Support of Stratasys toolpath v2.1 for FDM: now includes geometrical transformation information (scaling and rotations) to ensure workflow consistency between physical and virtual print
- -40% reduced file size for thermomechanical analysis
- Enhanced thermomechanical solver robustness
- Improved temperature modeling for FFF/FDM application using thermal or thermomechanical analysis

II.1.6 Digimat 2018.1

In this section of the documentation, you can find all major changes that are in Digimat 2018.1.

Digimat-MF

- Fabric fatigue modeling
  - Extension of UD fatigue model to fabric microstructures
  - Support of basic woven 2D only

Digimat-FE

- Improved workflow efficiency
  - Fabric generation geometry time is reduced by a factor 10
  - RVE with spherical inclusions can now reach up to 70
- Extended range of fabrics: support of Non-Crimp Fabrics (NCF)
  - Definition of UD and stitching yarn
  - Conformal and voxel meshing
- Support of wavy continuous fiber for UD microstructures
  - New type of inclusion shape: curved cylinders
  - Dedicated meshing algorithm (mesh-cutting)
- Multi-material yarns
  - Definition of different materials for different yarns in fabric RVE
  - Support of woven 2D and woven 3D microstructures
- Support of batch workflow under Linux
  - Geometry generation
  - Meshing and job creation
  - Job launch
  - Post-processing

Digimat-MX

- DMA reverse engineering
  - Support of DMA experimental data (tensile or torsional)
  - Dedicated reverse engineering method for viscoelastic model
- Automatic reverse engineering enhancements: switch to 2nd order homogenization for non-linear stiffness performance
- SFRP failure localization evaluation for improved failure accuracy
  - Specimen geometry definition
  - Automated dumbbell FEA to compute failure localization
- Generic MXDB maintenance
  - Elastoplastic and thermo-elastoplastic SFRP models now use 2nd order homogenization
  - Elastoplastic and thermo-elastoplastic SFRP models now propose a FPGF failure model

- New material data in public database
  - Asahi Kasei: 4 new grades (available on request)
  - DSM
    - 3 new grades
    - 11 new models (some available on request)
  - Dupont
    - 3 new grades (available on request)
    - 1 new model (available on request)
  - Radici:
    - 4 new grades
    - 3 new models (available on request)
  - Solvay Engineering Plastics:
    - 2 new grades
    - 86 new models (some available on request)
  - Solvay Specialty Polymers: 1 new grade (available on request)
  - Stratasys: 1 new grade (available on request)

Digimat-MAP

- Support of Cadmould data for injection molding
  - Support of binary and ASCII Cadmould formats
  - Support of solid receiving mesh
- Support of Marc export for element set mapping for microstructure submodeling : export of nodes, element, node sets and element sets data
- Support of nodal thickness in LS-DYNA
  - Visualization of local thickness
  - New mapping method to support various shell integration methods: Lobatto, Gauss and uniform

Digimat-CAE

- Progressive failure of reinforced plastics
  - Improved convergence with shell elements and implicit FEA
  - Additional damage law: power law
  - Smart time stepping for implicit FEA
- Updated support of the existing interfaces for user subroutines
  - Abaqus: 6.13-4 / 6.14-1 / 2016 / 2017 / 2018
  - ANSYS: 18.2 / 19.0 / 19.1
  - LS-DYNA: R7.1.2 / R8.1.0 / R9.0.1 / R9.1.0 / R9.2.0
  - Marc: 2016.0 / 2017.0 / 2017.1
  - PAM-CRASH: 2015 / 2016 / 2017
  - Samcef: V16.3 / V17.2
  - nCode DesignLife: 12 / 13

Digimat-RP

- Embedded superposition for efficient mapping of manufacturing simulation results
  - Visualization of manufacturing and component mesh superposition
  - Automatic or interactive superposition
  - Management of transformation tasks: reset, undo, reset, export and import transformation file
- More robust gate definition in Digimat-RP/Moldex3D: gate location is now defined based on closest node from point pick
- Support of Cadmould data for injection molding
  - Support of fiber orientation data
  - Support of solid component mesh only
- Advanced density definition for SMC NVH using MSC Nastran SOL400
  - Composite density is varying spatially due to the fiber volume fraction variation
  - Support of elastic and viscoelastic material models
- Support of nodal thickness in LS-DYNA
  - Visualization of local thickness for structural model
  - New mapping method to support various shell integration methods: Lobatto, Gauss and uniform
- Support of membrane sections in MSC Nastran SOL1XX & OptiStruct (Linear solution): automatic assignment of microstructure and material properties to membrane sections based on adjacent solid data
- Enhanced efficiency for Abaqus Linear solution
  - Improved material properties discretization for shell elements
  - Improved preprocessing time
  - Improved post-processing robustness

Digimat-VA

- Support of unbalanced woven for PFA
  - New material type: woven unbalanced (based on warp and weft rates)
  - Dedicated Digimat model calibration procedure
- Identification of ply shear properties from stress-strain curve
  - Import of shear stress-strain curve when defining ply properties for calibration
  - Automatic identification of $F_{12,0.2\%}$ and F_{12} values needed for Digimat model calibration

Digimat-AM

- Thermal and thermo-mechanical analysis with advanced solver
  - Available for FFF, FDM and SLS
  - Local material temperature can be predicted and analyzed
  - Local impact of printing process (strategy, speed) can be directly taken into account
  - Warpage and residual stresses predictions are improved
  - Additional field post-processing: temperature, crystallinity
  - New history plot for temperature and crystallinity evolution over printing time

II.1.7 Digimat 2018.0

In this section of the documentation, you can find all major changes that are in Digimat 2018.0.

Digimat-MF

- Accumulated plastic strain failure indicator
  - Critical accumulated plasticity as a function of stress triaxiality
  - Also available for structural analysis with Digimat-CAE and Digimat-RP
- Improved workflow for microstructure definition of fabrics: dedicated microstructure type
- New lattice microstructure type
  - Applicable to model Fused Filament Fabrication dense microstructures
    - Filament cross section definition and visualization
    - Filament orientation
  - Supports Standard failure definition (Composite level)

Digimat-FE

- More efficient post-processing through automatic computation of engineering stress-strain curve. Available for all RVE applications, including void phases and/or cohesive elements
- Custom weave pattern definition for woven 3D materials
  - Available for 3D interlock
  - Graphical editor for weave pattern definition
- Improved workflow for microstructure definition of fabrics: dedicated microstructure type
- New lattice microstructure type
  - Flexible infill definition
    - Aligned (Fused Filament Fabrication application)
    - Sparse (Fused Filament Fabrication application)
    - Double dense sparse (Fused Filament Fabrication application)
    - Hexagonal (Fused Filament Fabrication application)
    - Custom 2D (Fused Filament Fabrication application): custom definition of microstructure via beams and junctions
    - Custom 3D (All applications): custom definition of microstructure via beams and junctions
  - Available for non-reinforced and reinforced materials
  - Available for elasticity and plasticity constitutive models
- User defined failure indicator (only available with Digimat-FE/Solver)
  - Custom failure library to be built by user
  - Instantaneous stiffness reduction is available
- Enhancements for microstructures including curved sphero-cylindrical inclusions
  - Phase definition now available based on inclusion size, diameter and number of inclusions (leading to inclusion volume fraction computation)
  - More robust geometry and mesh visualization for very large microstructures. Geometry visualization through 1D beams and manual mesh generation if estimated mesh size is higher than 1.7M elements
  - Cohesive element definition now possible between matrix and inclusion phase. Available for Abaqus, Marc and FE/Solver
- New visco-hyperelasticity model. Available for Abaqus, Marc and FE/Solver

  - Abaqus models
    - Neo-Hookean
    - Mooney-Rivlin
    - Ogden
    - Storakers
  - Marc and FE/Solver models
    - Neo-Hookean
    - Mooney-Rivlin
    - Ogden

Digimat-MX

- Naming update: the reverse engineering method "Tensile" is now named "Static and dynamic".
- Handle shear data
  - New experimental data loading: shear
  - Experimental data usable for reverse engineering with Static and dynamic method as well as for failure indicator reverse engineering
- Data ordering filtering: new filtering possibilities in Digimat-MX tables (Grades, Digimat Analysis Files, ...) accessible via direct right-click.
- Reverse engineering for LFRP: new through-thickness definition of fiber aspect ratio and fiber volume fraction in multilayer microstructure definition.
- Reverse engineering for multiple multilayer
  - Enhanced flexibility for microstructure definition associated to each experimental curve used during reverse engineering
  - Each experimental data can be associated to a different multilayer microstructure
- Update of public database
  - Asahi Kasei: new material supplier
  - DSM: 11 new grades
  - Dupont:
    - 15 new grades
    - 20 new models for existing grades
  - Radici Performance Plastics: 4 new grades
  - Sabic: 2 new models for existing grades
  - Solvay Specialty Polymers: 8 new grades
  - Stratasys Inc: New supplier for additive manufacturing

Digimat-MAP

- Manufacturing data support update
  - Molding
    - Moldflow 3D results
      - Weld line and weld surface data
      - Fiber length
      - Porosity
    - 3D TIMON results: fiber length
    - Moldflow UDM mesh format
    - Residual stresses. Export extended to LS-DYNA and Marc

  - Additive manufacturing: Stratasys Insight results (toolpath in text format)
- Weld line mapping: export of Digimat weld line file now available in addition to element set export
- Automatic Fiber Placement
  - Loading and visualization of IGES files from AFP manufacturing software
  - Mapping to shell receiver meshes to account for defects (gaps)
    - Thickness modification (soft tooling)
    - Fiber volume fraction (hard tooling)
    - Fiber orientation
  - Export of mapped results
    - Thickness: Abaqus only
    - Fiber volume fraction and fiber orientation: all FEA
- Air gaps mapping from toolpath files
  - Identification of local air gaps present in a toolpath on a receiving mesh
  - Export of element set corresponding to mapped gaps location. Available for Abaqus, ANSYS, LS-DYNA, Marc, PAM-CRASH and Radioss.
- Support of degenerated SOL186 elements (ANSYS) for receiving mesh

Digimat-CAE

- CAE maintenance: supported version update
  - Abaqus: 6.13-4, 6.14-1, 2016, 2017
  - ANSYS, 17, 17.2, 18
  - LS-DYNA, R7.1.2, R8.1, R9.0.1, R9.1
  - Marc: 2015, 2016
  - MSC Nastran SOL1XX: 2016 or older, 2016.1, 2017.0, 2018.0
  - OptiStruct: V13, V14
  - PAM-CRASH: 2014, 2015, 2016
  - PERMAS: 16
  - Samcef: V16, V17
  - nCode DesignLife: 12, 13
- Initial stresses extension
  - Now supported with the Hybrid solution
  - Extended supported of FEA software
    - LS-DYNA
    - Marc
- Weld line strength. Definition of a strength degradation factor when using a weld line mapped file in the manufacturing data.
- Strain rate filtering
  - New parameter to filter spurious oscillations of strain rate values during strain rate dependent FEA runs
  - Available with the Hybrid solution only
  - Applicable to failure models using a (V-)EVP material model
- Stiffness reduction extension
  - Revised formulation to remove time step sensitivity
  - Control on linear softening behavior. Definition of equivalent strain from failure initiation to final stiffness reduction
  - Available for
    - Implicit & explicit FEA
    - Solid & shell elements
- Fused Filament Fabrication failure modeling
  - Available for unfilled polymer materials
  - Available with the Hybrid solution

- Support of encrypted files in ACT. Encrypted material models now supported via direct assignment method
- Bug fix: Teading of orientation file during FEA run:
  - Erroneous behavior: when using an orientation file which does not contain information for all integration points and using the Hybrid solution (using the default keyword hybrid_minimize_memory = on), orientation data used for integration points beyond first integration point could be erroneous
  - Fix: orientation file data are now read correctly for any integration point even if orientation file does not contain data for each integration point
- Notice
  - Digi2marc libraries are now directly available from the Digimat installer. No linking operation is required anymore
  - Fluent interface is now available on-request. Contact digimat.support@mscsoftware.com to obtain the installer.
  - Virtual.lab interface maintenance is dropped. Users willing to access the Virtual.lab interface are advised to use Digimat 2017.1 or previous versions.

Digimat-RP

- New user interface
  - New look and feel
  - Revised workflow
    - Structural model / Digimat material / Manufacturing data / Solution settings
    - User guidance from component definition
      - Manufacturing data type
      - Material type
- Extended support of molding manufacturing data
  - Weld line data (SFRP/LFRP)
  - Fiber length distribution (LFRP)
  - Fiber volume fraction distribution (LFRP)
  - Residual stresses (SFRP/LFRP)
- Support of additive manufacturing
  - FFF
    - Material: unfilled polymer
      - From Digimat-MX
      - From file
    - Performance (Hybrid solution only)
      - Linear stiffness
      - Elastoplasticity
      - Elastoplasticity + failure
    - Manufacturing data
      - Toolpath (gcode)
      - Residual stresses
  - FDM
    - Material: unfilled polymer
      - From Digimat-MX (Stratasys materials only)
      - From file (Stratasys materials only)
    - Performance (Hybrid solution only)
      - Linear stiffness
      - Elastoplasticity
      - Elastoplasticity + failure
    - Manufacturing data

            - Toolpath (Insight)
            - Residual stresses
        - SLS
            - Material: unfilled polymer, bead reinforced polymer
                - From Digimat-MX
                - From file
            - Performance (Hybrid solution only)
                - Linear stiffness
                - Elastoplasticity
                - Elastoplasticity + failure
            - Manufacturing data
                - Global printing direction definition
                - Residual stresses
- Extension of linear solution
    - Abaqus now available on top of MSC Nastran Sol1XX, OptiStruct and PERMAS
    - Support of thermoelasticity
- Control of number of material cards: new linear template in Solution settings to control maximum number of material cards: reduction level.

Digimat-VA

- PFA formulation enhancement for Unidirectional materials. Available for filled hole and bearing tests
- User defined material model
    - Custom material model library to be built by user (full procedure described in Digimat documentation)
    - Definition of input parameters and outputs results in Digimat-VA user interface
    - Applicable to variability scenarios
- First ply failure material model
    - Available for Unidirectional composites
    - Based on Tsai-Hill 3D Transversely Isotropic failure indicator
    - Dedicated post-processing
        - Failure indicator output
        - Critical ply identification
        - Driving failure mode output
- Additional process-related variability : ply misalignment (angle standard deviation definition)
    - Aligned plies
    - Non-aligned plies

Digimat-AM

- New FDM manufacturing type: provides access to Stratasys applications
    - Fortus 900mc printer
    - ULTEM 9085 material (available on-request)
- Support failure modeling (FFF/FDM)
    - Visualization of support location
    - Definition of interface strength in Material model definition
    - Definition of failure modeling approach

        * Failure index
        * Decohesion
    - Output of failure index value in Results
- Chamber temperature definition (FFF/FDM/SLS)
    - Enhanced definition of chamber temperature
        * Constant
        * Variable
    - Variable temperature definition via two interpolation models
        * Linear
        * Exponential
    - Inherent strain computation based on extrema chamber temperatures
    - Visualization of part temperature in results
- Data management
    - Support of encrypted material models for Digimat-AM
    - Inherent strain management
        * Can now be saved in Digimat-MX. Characterized via user-defined comments
        * Can now be loaded from Digimat-MX
- Anchor pin definition for warpage minimization (FFF/FDM): in Manufacturing step, definition of anchor pin location and diameter

II.1.8 Digimat 2017.1

In this section of the documentation, you can find all major changes that are in Digimat 2017.1.

Digimat-MF

- Improved robustness and accuracy of advanced material models
    - Crash: viscoelastic-viscoplastic model (VEVP): improved accuracy when using large Plastic Strain Multiplier value
    - Creep: (Thermo-)elastoviscoplastic model ((T-)EVP)
        * Improved convergence with Interaction law
        * Improved convergence at very low strain rate
    - Effect of porosity for crash of short fiber reinforced polymers: new default for elastoviscoplastic model including void phase: Incremental instead of discrete affine
- Extension of Short Fiber Reinforced Plastic failure model (FPGF) to microstructures including spherical void phase

Digimat-FE

- New grain inclusion type for polycrystalline materials: specific algorithm for high volume fraction of polyhedral inclusions
- New algorithm for long wavy fiber reinforced matrix RVE
    - Available for 2-phase microstructures defined as

        * Matrix phase
        * Curved sphero-cylindrical inclusion
    - Associated to new meshing technique: mesh cutting (tetra)
- New random fiber perturbation algorithm to reach high volume fraction of inclusions in unidirectional microstructure
    - Up to 90% volume fraction
    - Available for unidirectional reinforced material microstructures
        * Continuous fiber inclusion
        * Sphero-cylindrical inclusion
- Direct definition workflow for unit cell geometries (available via random fiber perturbation option). Available for unidirectional reinforced material microstructures
    - Continuous fiber inclusion
    - Sphero-cylindrical inclusion
- Enhanced boundary condition definition for Marc and FE/Solver
    - Periodic: default tolerance is now loosened
    - Dirichlet: default tolerance is now tighter
- Extended material model for thermomechanical analysis of woven RVE
    - Yarn can now be modeled as thermo-elastoplastic if matrix is defined as thermo-elastoplastic. Available for Abaqus, Marc and FE/Solver
    - Yarn can now be modeled as thermoelastic if matrix is defined as thermoelastic. Available for Abaqus, ANSYS, Marc and FE/Solver
- Improved robustness for failure simulation including damage upon failure
    - Marc: elasticity only is available
    - FE/Solver: elasticity and elastoplasticity are available, with revised damage computation for faster simulation run time
- Extended loading definition: off-axis loadings can be defined for uniaxial1 testing. Theta / phi loading angles can now be fully user defined

Digimat-MX

- Extended support of interactive reverse engineering of material models
    - Crash: VEVP model
        * Easy step-by-step workflow for viscoelasticity and viscoplasticity parameters optimization
        * On-the-fly choice of viscous model
    - Creep: (T-)EVP model with new Creep submethod
        * Easy step-by-step workflow for elasticity, plasticity and creep parameters optimization
        * On-the-fly choice of viscous model
- New merge tool of isothermal models: enables easy creation of thermomechanical model from several mechanical models of a same grade at different temperatures. On-the-fly definition of per-phase coefficients of thermal expansion
- Update of MXDB
    - DSM
        * Additional conditions for several grades: Akulon K224 (HG0,HG6,PG6,PG8) and for Stanyl TW241F10
        * Addition of new grades: Akulon Ultraflow K-FHG0, Akulon S223-HG0, Akulon Diablo HDT 2500 and Stanyl Diablo HDT 2700
        * Models are available with hybrid parameters
    - Solvay Engineering Plastics
        * MMI database updated
        * Addition of new grade for SLS: TECHNYL Powders PA6 6300 HT 110 Natural
    - Radici
        * Models updated for Radilon A RV300W, ARV350W and S RV300W

    * Addition of new grade: Radilon A RV500RW
  - Kuraray Co. Ltd.
    * Addition of 3 new PA9T grades: Genestar N1001A-M41, N1006A-M41,N1006D-H31
    * 3 new PA9T reinforced glass fiber grades: Genestar G1350A-M42, GX1500A-M61, G1301A-M61
    * Experimental data for different temperature are available
  - Sumitomo Chemical Europe :
    * Addition of SUMIKASUPER E6007LHF grade
    * Several models are available on request
  - e-Xstream engineering
    * Addition of generic data for additive manufacturing

Digimat-MAP

- Mapping of toolpath information for structural analysis of additive manufactured parts (FFF)
  - Loading and visualization of .stl file
  - Loading and visualization of .gcode file
  - Superposition of geometry/toolpath with structural mesh
  - Mapping of toolpath to structural mesh
  - Export of an orientation file for further structural analysis with Digimat-CAE
- Mapping of residual stresses from Digimat-AM for structural analysis of additive manufactured parts (FFF/SLS)
  - Loading and visualization of Digimat-AM mesh (.dat)
  - Loading and visualization of Digimat-AM residual stresses (.xml)
  - Superposition of Digimat-AM mesh with structural mesh
  - Mapping of residual stresses
  - Export to FEA
    * Abaqus
    * ANSYS
- Support of fiber volume fraction data from 3D TIMON
  - 3D/3D mapping
  - 3D/2D mapping

Digimat-CAE

- Structural analysis of additive manufactured polymer parts
  - FFF
    * Unfilled polymer
    * Performance (Hybrid solution only): Linear and non-linear stiffness
    * Connection to manufacturing: Toolpath information from .gcode file
  - SLS
    * Unfilled & reinforced polymers (bead or fiber)
    * Performance: Linear and non-linear stiffness + failure
    * Connection to manufacturing: homogeneous printing direction defined in material model
- Extension of the Hybrid method
  - MuCell & metal casting: support of the effect of porosity volume fraction on material behavior
    * Unfilled & reinforced matrices (bead or fiber)

    * Performance: linear stiffness (elasticity), non-linear stiffness + failure (elastoplasticity) and crash (elastoviscoplasticity)
    * Failure model accessible with the Hybrid solution: linear function of porosity volume fraction on the strain at failure
    * Creep: Thermo-elastoviscoplasticity model is now supported
- Bug fix for stiffness reduction/element deletion in implicit FEA
    * PFP output (percentage of failed integration points) computation is now corrected when non-convergence can occur
    * Fix residual stiffness computation for specific configurations

Digimat-VA

- New countersunk fastener geometry: available for filled hole and bearing tests
- CPU time reduction & improved solver convergence: average 50% CPU time reduction for UNT/C & OHT/C tests

Digimat-AM

- Create printing project
    * Visualize and select printer
        · Generic SLS
        · Generic FFF
    * Define Component
        · Load geometry (.stl)
        · Define material: select from database or create new
- Define Manufacturing
    * Define part orientation (SLS only)
    * Define warpage compensation
        · Apply anisotropic scale factor
        · Load modified geometry (.stl)
    * Load and visualize toolpath (FFF only / .gcode format)
    * Define other process parameters
- Run simulation
    * Generate voxel mesh: coarse/medium/fine/user defined mesh size
    * Define material model settings: Warpage computation approach: inherent strain
        · On-the-fly computation of inherent strain via micromechanical modeling
        · Direct user input: mechanical and thermal or total
        · From previous project
    * Submit job
        · Review project definition
        · Prepare job: define working directory and number of CPUs
        · Launch job (local run only)
        · Monitor job
- Post-process
    * View results
        · Field visualization: displacement, stress and warpage indicator
        · Visualization format on voxel mesh or on stl

        - Warpage visualization tools: scale factor for deformed shape and superimpose undeformed shape
    - Export results
        - Warped shape (.stl file with user defined scaling factor)
        - Residual stresses (Digimat XML format for further usage in Digimat-MAP)
- Transversal aspects
    - Project management
        - New
        - Save
        - Load

II.1.9 Digimat 2017.0

In this section of the documentation, you can find all major changes that are in Digimat 2017.0.

Digimat-MF

- New SFRP fatigue model for improved lifetime predictions: Model extended to viscoelasticity
- Extended range of available woven 3D weave patterns
    - Weave depth definition in the case of 3D orthogonal woven materials
    - Automated definition of standard weave patterns : diagonal, plain, satin and twill
    - Irregular weave step through a vector
- Improved accuracy of Drucker-Prager model
    - Revised sensitivity to Plastic Strain Multiplier (PSM) ensures consistency with J2-plasticity model
    - Drucker-Prager material models from previous Digimat releases using modified spectral method, and PSM > 1 require a new calibration

Digimat-FE

- Improved microstructure generation for SFRP
    - Higher volume fraction can be reached for all types of fiber orientations
    - Microstructure is generated faster
    - Available for 2-phase microstructures defined as
        - Matrix phase
        - Sphero-cylindrical inclusions
- Failure model for Discontinuous Fiber Composites
    - Inter-strand delamination failure mode can be modeled to predict RVE ultimate strength
    - Available for
        - FE solver
        - Marc
        - Abaqus
- Extended range of available woven 3D weave patterns (similar to Digimat-MF)

  - Weave depth definition in the case of 3D orthogonal woven materials
  - Automated definition of standard weave patterns : diagonal, plain, satin and twill
  - Irregular weave step through a vector
- Improved weave pattern definition via additional control parameters
  - Yarn crimp to control tortuosity between warp and weft
  - Yarn spacing ratio to control matrix pocket size between yarns
- Conforming meshing for woven 2D geometries: Obtain detailed description of local stress & strain fields thanks to conforming approach
- Extended modeling of SFRP fiber tips
  - Coatings can now be applied only on lateral faces of cylindrical inclusions
  - Suppressed contact condition between fiber tips and matrix
- GUI improvements
  - Woven definition step has been reviewed to avoid the need to scroll to enter all parameters
  - Post-processing of orientation tensor of generated RVE: user now has access to tensor values with 4 decimal digits (was 2 in previous version)
  - "Generate geometry" button is now greyed out during geometry generation

Digimat-MX

- CFRP automatic reverse engineering to speed up and simplify material model creation
  - Import composite datasheet
  - Turn composite datasheet into Digimat material model in 1 click
  - Available for UD and woven 2D materials (Glass and carbon fibers)
  - Available performances
    - Linear elasticity
    - Progressive Failure Analysis
- Improved SFRP failure reverse engineering procedure: manual definition of strain localization factor
- IT
  - DAKOTA new version
  - Support of white space in working directory
- New material data in public database
  - DSM
    - Akulon Diablo HT-HG0
    - Akulon K224-HG6
    - Akulon K224-HG7
    - Akulon K224-HG8
    - Akulon K224-PG8
    - Akulon S223-HG6
    - Akulon S223-HG7
    - Arnite AV2 390 XT
    - Arnite TV4 261
    - Akulon K224-HG0
    - ForTii MX3
    - ForTii Ace MX53
    - Akulon S223-HG0
    - Akulon K224-PG6
    - Fortii MX1
    - Stanyl Diablo OCD2100
    - Akulon Diablo HT-HG0
    - Akulon Diablo HT-HG6

        * Stanyl TW241F10
    - Dupont
        * Crastin HR5315HFS NC010 (New Temperature and humidity levels available)
        * Crastin HR5330HFS NC010
        * Zytel 70G30HSLR BK099 (New Temperature and humidity levels available)
        * Zytel 70G35HSLRA4 BK267 (New Temperature and humidity levels available)
        * Zytel 70G35HSLX BK357
        * Zytel 70G35HSRX BK099
        * Zytel 70G50HSLA BK039B (New Temperature and humidity levels available)
        * Zytel FE270099 BK099
        * Zytel HTN51G35HSLR BK420
        * Zytel PLS95G35DH1 BK549
        * Zytel XT70G35HSL BK044A

Digimat-MAP

- Warpage mapping for injection molding
    - Mapping of displacement fields predicted by injection molding simulation
        * Moldflow mid-plane
        * Moldflow 3D
    - Export of boundary condition card for receiver mesh
        * Abaqus
        * PERMAS
        * Samcef
- Extended mesh support
    - OptiStruct (.fem)
    - PERMAS (.dat, .uci)
- New general mapping and data manipulation capabilities
    - FEA result files mapping
        * Load FEA results, select and visualize fields
        * Map to receiving mesh
        * Available for Abaqus
    - New data operation to easily perform manual correction of large files
        * Apply scale factor on data loaded on a given mesh
        * Perform any linear combination of 2 similar data type files loaded on a given mesh
    - Element set mapping
        * Map element sets from donor to receiver mesh
        * Supported for 3D/3D and 2D/2D mapping
- 2nd order elements are now supported for donor mesh

Digimat-CAE

- Progressive failure of SFRP for ultimate strength predictions
    - Evaluate consequences of failure initiation in quasi-static simulations
        * Isotropic damage (all implicit FEA solvers)

        * Element deletion (Abaqus, LS-DYNA/Implicit, Marc)
    - Available when using the Hybrid solution
    - Check documentation for best practices on achieving FEA convergence up to ultimate failure
- Additional default outputs for SFRP to ease post-processing
    - Triaxiality (if using material model including tension/compression differentiation)
    - Damage (if activating stiffness reduction upon failure)
    - Percentage of failed integration points (if considering failure model)
- Extension of viscoelastic-viscoplastic Hybrid solution for improved accuracy
    - Yield stress can now be strain rate dependent
    - Material support has been extended from SFRP to include UD and woven 2D
- Reduced CPU time for CFRP Progressive Failure Analysis with Explicit FEA and solid elements
    - 4-5x faster computation
    - Available for UD and woven 2D materials
    - Link to manufacturing data (draping) is not supported
    - LS-DYNA and MSC Nastran SOL700 are not supported, CPU time is only available when using shell elements for those FEA codes
- Extended PAM-CRASH interface
    - Support 3rd party user materials: Digimat now uses plug-in MAT85 and MAT185 approach to allow multiple user subroutines to be used in the same FEA analysis
    - Export of Digimat outputs in State Variables for solid & shell elements (only for hybrid method)
- Improved lifetime predictions for fatigue analysis
    - Material behavior can now be modeled as non-linear and frequency dependent (viscoelastic constitutive model)
    - Fatigue failure model response is now dependent on the local load ratio
- Updated support of the existing interfaces for user subroutines
    - Abaqus: 6.13-4 / 6.14-1 / 2016
    - ANSYS: 16.0 / 16.2 / 17.0 / 17.2
    - LS-DYNA: R7.1.2 / R8.1
    - Marc: 2015.0 / 2016.0
    - Radioss: 13.0 / 14.0
    - Samcef: 16.3 / 17.2
- Improved accuracy of Hybrid solution for very ductile materials: Micro/Hybrid consistency for non-linear response is now automatically ensured
- New progress bar and time estimation during Hybrid solution pre-processing
- Improved estimation of transverse shear stiffness: value is now computed on composite material instead of stiffest phase properties
- Bug fix in Hybrid strain based failure / shell: Failure criteria value is now computed correctly

Digimat-RP

- Extension of supported FEA interfaces
    - Radioss/ shell is added to support both solid & shell
    - OptiStruct/ solid & shell: Elastic material model only / weak coupling
    - PERMAS/ solid & shell: Elastic material model only / weak coupling
- Extended support of FEA input deck
    - Input decks with same identical assigned to solid and shell elements can now be loaded in Digimat-RP (no Digimat material model can be assigned for that specific material)
    - Input decks with multi-material definitions in composite section can now be loaded in Digimat-RP (no Digimat material model can be assigned for that specific composite section)
- Bug fix: Corrected visualization of ellipsoidal plot of orientation tensors

Digimat-VA

- New bearing test is available for a wide range of configurations
  - Single shear bearing: Two pieces, Single-fastener
  - Tension
    - Unstabilized
    - Stabilized
  - Compression (stabilized only): Double-fastener
  - Tension
    - Unstabilized
    - Stabilized
  - Compression (stabilized only): One piece (tension, unstabilized only)
  - Double shear bearing (tension, unstabilized only)
- CPU time reduction: New option to enable adaptive time stepping to minimize number of time steps and reduce overall CPU time. Available for unnotched and open-hole tests (i.e. tests which do not involve contact modeling)
- Remote job submission for efficient computation of large VA campaigns
  - Test matrix preparation and post-processing is performed on desktop application (Digimat-VA user interface), and FEA computations can now be sent to remote cluster
  - Job monitoring can be performed from desktop application
  - Type of job submission
    - No queuing system
    - LSF
    - PBS

Additional information

- Support of Windows 10
- New license format in accordance with MSC template to minimize license administration for paid-up schemes. Version ID in a feature line is now turned into a maintenance end date

II.1.10 Digimat 2016.1

In this section of the documentation, you can find all major changes that are in Digimat 2016.1.

Digimat-MF

- Improved robustness of Drucker-Prager model
  - Convergence improvement
  - Default value change: dilatation angle set to 0 by default

- New harmonic analysis
  - Definition of frequency dependent viscoelastic material properties
  - Definition of harmonic loadings
    - Harmonic strain
    - Harmonic stress
  - Homogenization and plot of frequency dependent properties
    - Real part
    - Imaginary part
- New relative tolerance for homogenization schemes to improve convergence
  - New default parameter
  - Independence of tolerance value regarding implicit/explicit CAE
- Revised pseudo-grain fatigue failure indicator definition
  - Migration of reverse engineering capability to Digimat-MX
  - Definition of failure indicator via pseudo-grain S-N curves
  - Retro-compatibility ensured for Digimat analysis files from previous versions: automatic reverse engineering still performed in Digimat-MF
- Improved SFRP fatigue analysis
  - Full equivalency of amplitude and cycle based loadings
  - Support of mean-stress sensitivity model with amplitude loadings
  - New default log-linear extrapolation between minimum and maximum number of cycles to improve robustness of reverse engineering

Digimat-FE

- Extension of Digimat-FE/Modeler
  - Internal mesher (conforming and voxel) now also available for
    - Abaqus/Standard
    - ANSYS
    - LS-DYNA/Implicit
  - Including support of fabrics and discontinuous fiber composites
  - Export of FEA model and job monitoring
  - Full workflow available in command line
  - Limitation: post-processing for LS-DYNA is not available inside Digimat-FE
- New failure capabilities to predict strength of RVE
  - Available for Marc and FE solver
  - Definition of stress based failure indicators at the material level
    - Component
    - Von Mises
    - Tsai-Hill 3D transversely isotropic
    - Tsai-Wu 3D transversely isotropic
    - Hashin 3D
  - Computation of damage based on failure indicator
  - New outputs post-processing
    - Failure indicator
    - Damage
  - Available for all microstructures, including fabrics
- User interface robustness improvement: enhanced stability
- Usability improvement
  - Centralization of all geometry parameters in a single screen to simplify successful geometry definition
  - New default geometry parameters to improve meshing step
    - Minimum relative distance between inclusion set to 5%

    - * Minimum inclusion relative volume set to 5%
  - Simplified workflow to define discontinuous fiber composites: definition of new type of phase: strand
- New plasticity model for yarn to model non-linear behavior of fabrics
  - Yarn plasticity model automatically defined based on matrix elastoplastic model, fiber elastic model and yarn microstructure
  - Available for Abaqus/Standard, ANSYS, FE solver and Marc
  - Available for all fabric types
- New auto-save of Digimat-FE session to ensure backup of model setup
  - Material definition
  - Geometry
  - Mesh
- Support of pressure dependent plasticity material model for Abaqus/Standard: definition of Drucker-Prager model
- New meshing option for improved mesh quality
  - Continuous meshing strategy (shared node) available for conforming mesh
  - Applicable to basic RVE geometry
  - Not available for RVE involving coatings and interfaces
- Support of SMP with FE solver (identical licensing as DMP)

Digimat-MX

- New automatic reverse engineering to speed up and simplify material model creation
  - Fully automatic reverse engineering methodology
  - Required input data required limited to experimental data (stress-strain curves). No need of a Digimat analysis file template
  - Available for experimental data associated to SFRP materials fibers ("chopped fibers (short)" type of grades)
  - Available performances and related models
    - * Linear stiffness / elasticity
    - * Non-linear stiffness / plasticity
    - * Non-linear stiffness + failure / plasticity + FPGF
  - Speed-up of reverse engineering via support of multiple CPUs
  - Review of model parameters with reverse engineering report
  - Previously existing reverse engineering methodology renamed as "interactive"
- Extension of interactive reverse engineering
  - Drucker-Prager model for calibration of pressure dependent plasticity model
    - * Optimization restricted to yield function coefficient
    - * Yield stress exponent and dilatation angle are set to recommended value to ensure model robustness
  - Speed-up of reverse engineering via support of multiple CPUs
- Simplification of local database installation and usage
  - Installation of local database when installing Digimat
  - Direct access to database content when opening Digimat-MX. Database management tools accessible inside the main Digimat-MX window
- New fatigue capabilities
  - Import and plot of S-N curves
  - Import and plot of SFRP pseudo-grain fatigue material model
  - Reverse engineering of SFRP pseudo-grain fatigue failure model: migration from Digimat-MF to Digimat-MX
- Extension of unit conversion tool: support of material models including Hybrid parameters
  - Non crypted
  - Encrypted
- Database content: Solvay Engineering Plastics (Material models now available every 5°C instead of 10°C)

Digimat-MAP

- Revised mapping algorithm to reduce mapping CPU time
  - 70-95% reduction of CPU time for mapping
  - Applicable to all type of elements and data
- New data merge tool to create a single file from multiple files of same type of data
- Improved graphical performance when displaying large models. Instabilities may be observed for graphical configurations using old driver versions that do not support OpenGL 3.3
- Support of new elements
  - Abaqus: C3D10I/C3D10HS (orientation data stored at element level in 2016.0, now stored at integration point level)
  - ANSYS: SOLID285
  - LS-DYNA
    - Type 16 and 17 (10 nodes tetrahedral with 5 integration points)
    - Type 16 (fully integrated shell elements)
- New draping capabilities
  - Extension of mapping to multilayer draping files & UD orientation files
  - Visualization of yarn shear angle when displaying orientation data for woven
  - New interface to Aniform
- Interface to PAM-RTM
  - Mapping of porosity data to receiver mesh
  - Available for 3D models only
    - PAM-RTM
    - receiving mesh
- Support of odd number of layers in shell models

Digimat-CAE

- Support of SMP parallelization scheme
  - Support of implicit FEA codes
    - Abaqus/Std
    - ANSYS
    - Marc
  - Reduced memory consumption
  - Support of mixed DMP/SMP parallelization scheme
  - Identical licensing as for DMP
- New pressure sensitive elastoplasticity model
  - Available with the Hybrid solution for efficient and robust coupling with FEA
  - Drucker-Prager model from Digimat-MF required as input
- New basic SFRP fatigue solution
  - Fatigue failure indicator (number of cycles to failure) available as output state variable in Digimat coupled analysis
  - Available for all implicit FEA codes
  - Available for solid and shell elements
- Reduced CPU time in explicit/shell/Hybrid configurations: 10% CPU time reduction
- Revised thermo-elastoplasticity model for the Hybrid solution
  - Improved accuracy of CTE (Coefficient of Thermal Expansion)
  - Constituent CTE used as input for the Hybrid solution must have been reverse engineered from a thermo-elastic model

- Extension of NVH capabilities with Marc: anisotropic and frequency dependent damping based on local microstructure
- Support of new versions of the existing interfaces
  - Abaqus 2016
  - ANSYS 16.2 and 17
  - PAM-CRASH 2015
  - Marc 2015.0
- Support of new elements
  - Abaqus: C3D10I/C3D10HS (orientation data stored at element level in 2016.0, now stored at integration point level)
  - ANSYS: SOLID285
  - LS-DYNA:
    - Type 16 and 17 (10 nodes tetrahedral with 5 integration points)
    - Type 16 (fully integrated shell elements)
- Interface to ANSYS Fluent
  - Computation of local SFRP thermal conductivities based on local microstructure
  - Available in command line only

Digimat-RP

- Automatic reverse engineering
  - Available for SFRP
  - Import of stress-strain data curves
    - Text file
    - Copy/paste
  - Available performances and related material models
    - Linear stiffness / elasticity
    - Non-linear stiffness / plasticity
    - Non-linear stiffness + failure / plasticity + FPGFμ
  - Speed up of reverse engineering via support of multiple CPUs
  - Review of material model parameters
- Orientation file merge tool available for mapped orientation files
- Extension of unit conversion tool: support of material models including Hybrid parameters
  - Non crypted
  - Encrypted
- Support of SOL108 and SOL111 for MSC Nastran 2016.1
  - 15% faster SOL108 solution compared to Digimat 2016.0 + MSC Nastran previous versions
  - 500-600% faster SOL111 solution compared to Digimat 2016.0 + MSC Nastran previous versions
- Support of SMP: choice between SMP and DMP scheme upon job submission
- Support of new SFRP fatigue capabilities
  - Loading and visualization of fatigue material model
  - Definition of fatigue related parameters for standalone Digimat fatigue analysis
- Updated Moldex3D API for Digimat-RP/Moldex3D: upgrade to Moldex3D R14

Digimat-VA

- New filled hole test
  - Bolt or countersunk fastener type
  - Tension and compression loading
- New smart analysis stop upon load drop
- New VADB migration tool: import data from previous VADB during Digimat installation

Additional information

Shift to new FlexLM version (v11.13) for license server (available under Linux and Windows)

II.1.11 Digimat 2016.0

In this section of the documentation, you can find all major changes that are in Digimat 2016.0.

Digimat-MF

- Multi-layer failure controls for SFRP
  - Multilayer RVE failure can be controlled based on
    - First layer failure
    - All layers failure
    - Given thickness fraction of failed layers
    - Average value of failure indicator across thickness
    - Specific layer failure
  - Improved failure description of skin/core microstructures
- Progressive failure of woven composites: available for 2D woven composites
- 3D woven
  - Available predefined weaving patterns
    - 3D orthogonal
    - Interlock woven
  - Material performance: elasticity
- Improved user workflow for woven and braided model creation
  - Single fabric item instead of woven or braided definition
  - Automatic creation of RVE if required
- Carpet plot generation
  - Available for UD and woven composites
  - Explore layup design space with
    - Stiffness carpet plot
    - First ply failure carpet plot
- Failure envelope generation
  - Visualization of the failure model predictions for biaxial loads
  - Stress or strain envelopes
  - Available for SFRP, UD and woven composites
- Fatigue mean-stress correction
  - Scope of application of the pseudo grain fatigue model enhanced to varying load ratios
  - Definition of Haigh like diagram at pseudo grain level to predict R-ratio sensitivity of SN curves of SFRP

Digimat-FE

- Support of thermo-elastoplastic material model
  - Analyze non-linear thermo-mechanical response of any microstructure
  - Capability available for FE solver, Marc, Abaqus
- Improved user workflow for woven/braided model creation
  - Single fabric item instead of woven or braided definition
  - Automatic creation of fabric RVE if required
- Definition of multi-layer 2D woven microstructure
  - Periodic RVE implies restrictions on
    - Layer dimensions
    - Yarn orientation
  - Support of multimaterial for multilayer definition: Homogeneous material, UD, woven, SFRP,
- Definition of multi-phase microstructures involving woven: Support of inclusions in matrix phase of woven microstructure
- New periodic boundary conditions
  - In-plane periodic boundary conditions with stress free boundary conditions through thickness
  - Recommended for multilayer microstructures
- 3D woven: Available predefined weaving patterns
  - 3D orthogonal
  - Interlock woven

Digimat-MX

- Automatic update of MXDB: 1-clic update of MXDB to 2016.0 database structure
- Addition of NCAMP and AGATE data in public database
  - Ready-to-use progressive failure model
    - Tensile calibrated stiffness with asymmetric failure
    - Compression calibrated stiffness with asymmetric failure
    - Available for various conditions: CTD, RTD, ETW...
  - AGATE
    - NCT321 G150 / Unidirectional
    - G30-500 7740 / Unidirectional
    - T700GC 2510 / Unidirectional
    - T700 E765 / Unidirectional
    - 7781GF-8HS 2515 / Woven
    - T650-8H 7740 / Woven
    - T650-PW 7740 / Woven
    - T700-PW 2510 / Woven
    - T300-5HS E765 / Woven
  - NCAMP
    - AS4 8552 / Unidirectional
    - 6781 S2 MTM45-1 /Unidirectional
    - IM7 8552 / Unidirectional
    - AS4 8552 / Woven
    - T650 5320-1 / Woven
    - NCT4708 MR60H / Woven
    - G30-500 MTM45-1 / Woven

Digimat-MAP

- Support of FEA input files including include commands
  - Available for all FEA codes supported by Digimat
  - Transformation commands (translation, rotation) are supported for Abaqus and LS-DYNA
- Iterative mapping for 1-clic mapping
  - Improved efficiency of mapping process for dissimilar meshes
  - Automatic progressive increase of mapping tolerance
- Support of 3D TIMON/shell data
  - Fiber orientation only
  - 3D TIMON/shell 3 layers data structure requires usage of a 3 layers shell definition
  - 1D mapping available for FEA codes which require 5 layers
    - PAM-CRASH
    - Radioss
- Support of Moldflow 3D weld line
- Support of ProCAST porosity file

Digimat-CAE

- Improved Hybrid solution accuracy
  - Plasticity model is closer to Micro solution (affects EP model and EVP)
  - Improved stress based failure surface
- Reduced Hybrid solution memory consumption in implicit FEA. Gain is proportional to orientation file size and number of processors used for parallel computation
- Improved user workflow for Hybrid parameters generation: No user interaction (settings definition) required to generate Hybrid parameters
  - Automatic temperature discretization for thermo-mechanical models
  - Improved discretization for strain-rate dependent models
- Progressive failure analysis of 2D woven
  - Support of basic and advanced 2D woven (Orthogonal woven only)
  - Link to draping process is not supported
  - Support of optimized algorithm for explicit FEA/shell elements configurations
- 3D woven
  - Elastic model only
  - Link to the draping process is not supported
- NVH analysis: Improve predictivity of composite NVH analysis with frequency dependent stiffness and frequency dependent anisotropic damping
  - Supported materials: SFRP, UD, woven
  - Support of mechanical small strain models: E, EP, EVP, VEVP, VE
  - Available for Marc and Abaqus
    - Marc: Frequency dependent stiffness
    - Abaqus 6.14: Frequency dependent stiffness for every integration point and Anisotropic and frequency dependent damping tensor
    - Abaqus 6.13 and previous: Frequency dependent stiffness
- Support of 3D TIMON/shell data
  - 3 layers data by default
  - 5 layers data available with 1D mapping in Digimat-MAP for the required FEA codes
    - PAM-CRASH
    - Radioss
- FEA interface maintenance
  - PAM-CRASH 2014.0
  - Radioss/OptiStruct/HyperMesh 13.0

Digimat-RP

- Support of FEA input files including include commands
  - Available for all FEA codes supported by Digimat
  - Transformation commands (translation, rotation) are supported for Abaqus and LS-DYNA
- Access to NVH analysis with Abaqus and Marc
- NVH analysis with MSC Nastran SOL1XX
  - Dynamic analysis (MSC Nastran SOL108 and SOL111) with Digimat viscoelastic model
    - Perform MSC Nastran computations with anisotropic elastic and damping properties corresponding to VE properties at a given frequency
    - Perform MSC Nastran computation accounting for full frequency dependency of VE properties
  - Static analysis (MSC Nastran SOL101 and SOL 103) with Digimat viscoelastic model: Perform MSC Nastran computations with elastic properties corresponding to VE properties at a given frequency.
- Support of 3D TIMON/shell orientation file

Digimat-VA

- Support of 2D woven material
  - Definition of woven material
  - On-the-fly Digimat model calibration based on datasheet input
  - Progressive failure analysis of UNT/C and OHT/C tests
- Effect of environmental conditions
  - Predict ply properties at a given environmental conditions (temperature, humidity) based on existing data at another environmental condition
  - Available for UD material
- Carpet plot generation
  - Available for UD and woven composites
  - Explore layup design space with
    - Stiffness carpet plot
    - Strength carpet plot
- Per-layer visualization of FEA results

Additional information

- Support of Windows 8.1
  - Graphical user interfaces in Tools and Solutions
  - Solvers (Except for LS-DYNA 7 interface)
- Support of MSC One licensing
  - Token based licensing scheme providing access to MSC Software's simulation portfolio
    - Based on pool of tokens
    - Each individual feature requires a certain number of tokens to run
    - Tokens are checked out once a feature is called
    - Tokens are returned to the pool after each feature use
  - All Digimat products are available in MSC One except Digimat-RP/Moldex3D
  - User can choose between classical licensing (EXLM) or MSC One
    - During installation of Digimat product
    - After installation, via the Digimat platform in Settings/License

II.1.12 Digimat 6.1.1

In this section of the documentation, you can find all major changes that are in Digimat 6.1.1.

Digimat-MF

Bug Fix: Corrected computation of failure criteria used in global axis and at phase level.

Digimat-CAE

- Support of ANSYS 16.0
  - Windows/Linux
  - ACT plug-in for ANSYS workbench
- Support of LS-DYNA R7.1.2 (Windows/Linux)

Digimat-RP

- Fiber orientation estimator powered by Moldex3D
  - Analysis setup in Digimat-RP:
    - Geometry extraction from mesh
    - Rheological model selection
    - Gate definition
    - Mesh level selection
    - Fiber orientation model definition
  - Mesh and model generation in Moldex3D OEM: eDesign mesh
  - Injection simulation solver
    - Local run
    - Parallel computation supported
  - Injection molding post-processing in Digimat-RP:
    - Fiber orientation
    - Melt front time
    - Melt front time animation
- Bug Fix: Support of hybrid solution for thermo-viscoelastic models

II.1.13 Digimat 6.0.1

In this section of the documentation, you can find all major changes that are in Digimat 6.0.1.

Digimat-MF

- Failure indicators: temperature dependent strengths in failure criteria:
  - Similar capabilities to strain rate dependencies
  - Thermo-elastic and thermo-elastoplastic models
- Progressive failure
  - New multi-component 2D failure indicator
  - Independent damage law per sub-failure indicator
- Drucker-Prager: new formulation of isotropization for enhanced robustness
- Curing:
  - Johnston-Hubert model for UD materials
  - Access to curing state allowing to define specific dependences of material parameters for thermo-elastic and thermo-viscoelastic models
  - No chemical shrinkage
  - Constant CTE definition above and below glass transition temperature
- Outputs: new option allowing to select the number of digits in the output files

Digimat-FE

- Discontinuous long fiber composites: specific RVE generation algorithm allowing to generate DLF microstructures
- Automatic stiffness generation: new options allowing to automatically compute orthotropic engineering moduli (stiffness and conductivities)
- Curing:
  - Available with FE solver
  - Johnston-Hubert model
  - Computation of chemical shrinkage
  - Constant CTE definition above and below glass transition temperature
  - Access to curing state allowing to define specific dependences of material parameters for thermo-elastic and thermo-viscoelastic models
- Additional material models:
  - Thermo-viscoelastic in Marc and FE solver
  - Drucker-Prager in Abaqus
- CPU improvements when post-processing Marc and FE solver results files
- Interface to J-Octa: user definition of inclusions' positions and orientations
- Licensing: mesh generation and visualization now accessible with DIGIMAT_FE_MODELER

Digimat-MX

- Reverse engineering of Tsai-Wu 3D transversely isotropic failure criterion
- Improved algorithm for reverse engineering:
  - Local method
  - Global method
- New grades:
  - Radici:
    - RADILON A RV300W

    - RADILON A RV350W
    - RADILON S RV300W
  - Solvay Specialty Polymers
    - Veradel AG-330
    - Ryton R-4-200BL
    - Amodel AS-1145
    - Amodel A-6135
    - Amodel A-1133
    - Ixef 1622
    - Ixef 1521
    - Ixef 1022
    - Amodel AS-1933
    - Amodel FC-1150
    - Amodel FC-1140
    - Amodel AS-4145
    - Amodel AS-1945
  - Trinseo
    - PULSE 979
    - VELVEX 5250
    - PULSE 630GF
    - ENLITE PP LGF 6002 + 67
    - ENLITE PP LGF 6002 + 50
    - ENLITE PP LGF 6002 + 33
    - ENLITE ABS Alloy LGF 6001 + 42
  - SABIC
    - NORYL FE1630PW
    - STAMAX 20YK270E
    - STAMAX 30YK270E

Digimat-MAP

- New automatic mesh superposition algorithm with improved robustness (advanced method)

Digimat-CAE

- Progressive failure
  - Multiple damage laws with a single failure indicator
  - Significant CPU time reduction for UD/shell/explicit simulation configurations
- Hybrid Solution
  - Minimization of the number of state variables
  - Support of unbalanced woven
  - Thermally dependent failure strengths in TE and TEP
  - Support of thermo-viscoelastic models
  - Hybrid parameter reader and viewer allowing to compare hybrid and micro responses

  - Failure: strain based failure criterion allowing to differentiate tension and compression based on triaxiality
  - General CPU time reduction:
    * Significant for shell elements
    * Minor for solid elements
- New outputs for UD materials: fraction of failed/non-failed integration points through the thickness of shell elements
- Interfaces to FEA
  - MSC Nastran SOL400/SOL700: support of version 2016.0 (Windows / Linux 64 bits)
  - Abaqus: support of version 6.14 (Windows / Linux 64 bits)
  - LS-DYNA:
    * Support of version R6.1.2 (Linux 64 bits)
    * Support of version R7.1.1 (Windows / Linux 64 bits)
    * General robustness improvements
    * Correction of energy computation
  - ANSYS: ACT plugin for ANSYS Workbench

Digimat-RP

- Graphical engine:
  - Improved CPU and memory performance
  - Visualization of orientation using vector/ellipsoidal plots
- Mapping
  - New mesh superposition algorithm with improved robustness
  - 1D mapping to define the desired number of layers in shell structural mesh
  - Improved flexibility for loading of orientation files: each element must have at least one information defined
- Interfaces:
  - PAM-CRASH 2013
  - MSC Nastran SOL1XX: weak coupling for 2-phases elastic models
  - Marc: switch between Intel-MPI and MS-MPI in Settings Manager

Digimat-VA

- Prediction of allowables
  - UD materials
  - Unnotched tension/compression and open-hole tension/compression tests
- Test matrix preparation
  - Definition of materials, layups, tests, environment conditions
  - Definition of sampling (number of batches, panels and specimens)
- Simulation preparation:
  - Import of Digimat model including progressive failure
  - Calibration of Digimat model from datasheet
  - Definition of micro-level variability (Gaussian distributions)
  - Definition of FEA settings: mesh size, element type, meshing strategy, number of time steps
  - Generation of FEA models
    * Preview mesh
    * Preview random draws

- Simulation run:
  - Embedded solver for local run
  - Job management
    - Job prioritization
    - Monitoring
- Post-processing
  - Automatic extraction of stress-strain curve, stiffness and strength
  - Computation of A, B-basis and mean values for strength following CMH17 procedures
  - Strength and stiffness distribution plots
  - Visualization of stress, strain and damage fields on coupon model
  - Creation of a customized report
  - Export of raw results to Excel
- Additional functionalities
  - Save Digimat-VA project: light or complete
  - Management of working database: materials, layups, tests, conditions and FEA settings

II.1.14 Digimat 5.1.2

In this section of the documentation, you can find all major changes that are in Digimat 5.1.2.

Digimat-MF

- Corrected failure criteria formulation
  - Shear terms in strain based criteria
    - Tsai-Hill 3D Transversely Isotropic
    - Tsai-Wu 3D Transversely Isotropic
  - Hashin 3D linear expression
  - Tsai-Wu 3D linear expression
- Corrected phase homogenization order when using the multi-level method
  - Affects elastic and visco-elastic UD material models including voids
- Corrected specific heat capacity computation
- Improved robustness with custom output for clustering with failure model
- Improved robustness for woven/braided
  - More robust when switching from FE to MF
  - Improved reporting for incorrect inlays definition
  - Improved error messages
- Improved robustness for second order homogenization

Digimat-FE

- Improved Marc interface robustness
  - Corrected periodic boundary conditions formulation
  - Corrected shear13 periodic loading boundary condition
  - Corrected user thermal loading definition
- Improved GUI robustness
  - Affects only intensive GUI browsing
- Initial seed size taken into account when exporting to Abaqus
- Corrected handling of continuous fibers with diameter larger than 0.5
- Upgraded WiseTex engine for woven
  - Improved robustness for braided and inlay geometry generation

Digimat-MX

- Upgrade to Postgresql 9.3
  - Requires an upgrade of database (See Section **??**)
- Corrected unit system conversion of strain rate dependent failure models

Digimat-MAP

- Improved robustness
  - Weld line mapping
    - Only hexa 20 elements were concerned
  - Automatic scaling
    - Removal of negative bounding box size ratios
  - Donor meshes with wedges
  - Porosity mapping procedure
    - Volume fraction now results from mapped size and mapped pore density

Digimat-CAE

- Digimat to Radioss:
  - Support of Radioss v12
  - Support of Radioss for UD and Woven
  - Support of 1 layer draping file
  - Hypermesh/OptiStruct plugin v12
- Digimat to PAM-CRASH
  - Support of UD and woven with Micro and Hybrid solution
- Improved robustness when using
  - Porosity and variable aspect ratio files
  - Volume fraction files

- Element deletion triggering
  - All integration points must fail to trigger element deletion
  - Concerns LS-DYNA, MSC Nastran/SOL700 and PAM-CRASH
- Digimat to Abaqus
  - Corrected computation of transverse shear stiffness for composites with transversely isotropic fibers
  - Corrected handling of multiple integration point elements when using Digimat Orientation File (.dof)
    - Each integration point has its actual orientation instead of the orientation of the first integration point
- Hybrid:
  - Convergence improvement on Current yield Norton law for implicit solver
  - Improved robustness:
    - Identification of hybrid parameters for TE and TEP materials
      - Correct non-linear behavior of TEP material for every temperature
      - Identification possible for 0°
    - Identification of hybrid parameters for EVP materials with failure criteria
- Porosity (Mucell)
  - Corrected license usage for 3 phases involving voids and porosity distribution file.

Digimat-RP

- Support of aspect ratio distribution
- Support of all formats of 3D TIMON orientation files for solid elements
- Enhanced equivalence between material models output from RP and CAE
- Abaqus:
  - Value of transverse shear stiffness now depends on thickness section
  - Density of materials now always written
  - Now supports Abaqus input files with the following keywords (without spaces):
    - `*SOLIDSECTION`, `*SHELLSECTION`, `*ENDSTEP`, `*ELEMENTOUTPUT`, `*TRANSVERSESHEARSTIFFNESS`
- ANSYS
  - Corrected SVAR output request
    - Respect of user defined output frequency
  - Improve robustness for ANSYS models
    - For models containing several materials
    - For models with non-Digimat material preceding a Digimat material

II.1.15 Digimat 5.1.2 Student Edition

In this section of the documentation, you can find all major changes that are in Digimat 5.1.2 Student Edition. A Student Edition version

- can be used during two years after the release.
- is Windows only.
- only contains Digimat-MF and Digimat-FE.

Digimat-MF

- Analysis
  - Only mechanical isothermal analysis
- Materials
  - Only elastic materials
- Phases
  - Only two phases used in a microstructure
  - Only matrix, inclusion, void and continuous fiber phases
  - Coatings are available
  - Clustering is not available
- Microstructures
  - Only one microstructure used in the RVE
- RVE
  - Single and multi-layer analysis
  - Woven are not available
- Failure
  - Static and dynamic failure are available
    - Stress and strain based
    - All failure indicators are available
      - Component
      - Tsai-Hill 2D, 3D and 3D transversely isotropic
      - Azzi-Tsai-Hill 2D
      - Tsai-Wu 2D, 3D and 3D transversely isotropic
      - Hashin-Rotem 2D
      - Hashin 2D and 3D
      - SIFT
      - User defined
      - Outputs
  - All outputs are available

Digimat-FE

- Analysis
  - Only mechanical isothermal analysis
  - Materials
    - Only elastic materials
  - Phases
    - Only two phases used in a microstructure
    - Matrix, inclusion, void and continuous fiber phases
    - All inclusion shapes are available
      - Ellipsoid
      - Cylinder
      - Sphero-cylinder
      - Prism
      - Icosahedron
      - Beam
      - Curved beam

            - Platelet
            - From CAD file
        - Coatings are supported
        - Clustering is not supported
    - Microstructures
        - Only one microstructure used in the RVE
    - RVE
        - Single and multi-layer analysis
        - Woven are not available
    - Geometry
        - Maximum of 10 inclusions
    - Mesh
        - Conforming and voxel mesh
        - In-house mesher
        - Limited to 5000 nodes
- Solver
    - In-house solver
        - Computation on a single CPU
        - Limited to 5000 nodes
        - First order elements
    - Export to Marc, Abaqus and ANSYS
- Output
    - All outputs are available

II.1.16 Digimat 5.1.1

In this section of the documentation, you can find all major changes that are in Digimat 5.1.1.

Digimat-MF

- Advanced woven model: Enhanced modeling capabilities
    - $2^{1/2}$D Woven
    - 2D Braided

- Failure
    - Tension-Compression Differentiation based on the transversely isotropic Tsai-Wu model
    - Definition of user criteria, and link with Progressive Failure
    - SIFT (1st order formulation)

- Viscoelastic-Viscoplasticity (VEVP)
    - Material modeling solution for structural engineering to be used in combination with Hybrid solution technology
    - Reformulations in the homogenization engine: viscoelastic part of the VEVP model consistent with a pure viscoelastic formulation in tensile and shear tests and elastoplastic part of the VEVP model consistent with a pure elastoplastic formulation
    - Supported technology
        - Microstructure: Multi-Layer definition

        * Plasticity: Modified spectral method
        * Viscous models: Norton, Prandtl

- Clustering
  - Nonlinear stiffness: Elastoplastic
  - Robustness: Elastic matrix in clusters
  - Enhancement: Support of mass fraction
  - Material modeling solution for structural engineering to be used with the Hybrid solution technology

- Coating : Nonlinear elastoplastic stiffness

- Fatigue : Macroscopic fatigue model applicable to UD composites

- GUI
  - Woven visualization based on XFG
  - Display of unit system in use

Digimat-FE

- RVE
  - Generation based on Parasolid
    * Large Speed-Up
    * Improved Robustness
  - Import of custom inclusion shape: Parasolid & STEP
  - Export of generated geometries: Parasolid & STEP

- Meshing
  - Tetrahedral: 1st / 2nd order conforming meshes
  - Hexahedral: Mapping on voxelized RVE (specific license required)

- Solution
  - Analysis types
    * Mechanical
    * Thermo-mechanical: Isothermal material parameters
    * Thermal
    * Electrical
  - Internal solver
    * Speed-Up (Parallel computations supported)
    * Robustness (Choice between iterative & direct solvers)
  - Interfaces to external solvers
    * Marc: Support of version 2013.1
    * ANSYS: Support of version 15.0
    * Abaqus
      · Support of version 6.13
      · Support of version 6.14
      · Geometry import: STEP & Parasolid (specific Abaqus license required)

- Post-Processing
  - Field visualization of results over RVE: User friendliness
    * Cutting plane capability
    * Snapshot

  - Computation & visualization of result distributions over RVE
  - Computation of representative (mean) properties

- Woven materials
  - Support via voxel solution
  - Yarn definition
    - Elastic material (Properties computed from resin & fibers)
    - Local material axes follow yarn's waviness
  - Enhanced modeling capabilities
    - $2^{1/2}$D Woven
    - 2D Braided
  - Speed-up (Faster generation of woven geometries)

- GUI
  - Solver type to be chosen at the beginning of the analysis
  - New rendering library used

Digimat-MX

- Public Database
  - Lanxess
    - TEPEX dynalite 102-RG600(x)/47% - PA / GF47 elastoplastic
    - TEPEX dynalite 104-RG600(x)/47% - PP / GF47 elastoplastic
  - Victrex
    - Victrex 150GL30 - PEEK / GF30 elastic & elastoplastic
    - Victrex 150CA30 - PEEK / CF30 elastic & elastoplastic
    - Victrex 90HM40 - PEEK / CF40 elastic & elastoplastic
  - DuPont
    - Zytel HTN54G35HSLR BK031 - PA* / GF35 thermo-elastoplastic
    - Zytel PLS95G50DH2 BK261 - PA* / GF50 elastoplastic
    - Zytel 73G30HSL BK416 - PA6 / GF30 elastoplastic
    - Zytel 73G50HSLA BK416 - PA6 / GF50 elastoplastic
    - Zytel 70G30HSLR BK099 - PA66 / GF30 elastoplastic
    - Zytel 70G50HSLA BK039B - PA66 / GF35 elastoplastic
    - Zytel 70G35HSLRA4 BK267 - PA66 / GF35 elastoplastic
    - Zytel 80G33HSLR BK031 - PA66-I / GF33 elastoviscoplastic
    - Zytel FE5382 BK276 - PA612 / GF33 elastoplastic
    - Crastin HR5315HF NC010 - PBT / GF15 elastoviscplastic
  - Solvay: Database available on demand for local use:
    - Full content
    - Encrypted grades
  - e-Xstream engineering: GENERIC MATERIALS
    - SFRP - PEEK / GF30 elastic & elastoplastic
    - SFRP - PEEK / GF35 elastic & elastoplastic
    - SFRP - PEEK / GF40 elastic & elastoplastic
    - SFRP - PEEK / CF30 elastic & elastoplastic

    * SFRP - PEEK / CF35 elastic & elastoplastic
    * SFRP - PEEK / CF40 elastic & elastoplastic
    * SFRP - PEI / CF30 (thermo-) elastic
    * SFRP - PEI / CF35 (thermo-) elastic
    * UD - PEEK / CF55 elastic & elastoplastic
    * UD - PEEK / CF65 elastic & elastoplastic

- Unit System Management
  - MPa / Pa / SI / CGS / FPS / psi / ksi
  - 2 additional unit systems can be defined by the user
  - Capabilities
    * Import & assign unit system
    * Convert between unit systems
    * Store & export with new unit system

- Reverse Engineering
  - Upgrade of the optimization engine (use of Dakota 5.4)
  - Improved algorithm for progressive failure
- Encryption

  - Encrypt for groups
  - Encryption of hybrid parameters
  - Support of unit system management

Digimat-MAP

- Short Fiber Reinforced Plastics: Simpoe Molding (.xml format)

- Long Fiber Thermoplastics: Read & map additional data
  - Variable aspect ratio
    * Moldex3D (3D elements)
    * Molflow (Midplane)
  - Variable volume fraction: Moldex3D (3D elements)

- Woven
  - Read & map warp / weft
  - Interfaces to draping simulations
    * PAM-FORM
    * Digimat open format (.xml based)

- Micro computer tomography (μ-CT)
  - Read & map data from μ-CT
    * Fiber orientation
    * Fiber concentration
  - Interface to Volume Graphics (VGStudio MAX)

- Casting
  - Interface to MAGMASOFT
  - Read & map data from casting simulations (Local pore concentration)

- Initial Stresses: Export to ANSYS

Digimat-CAE

- Hybrid Solution
  - Speed-Up in the generation of Hybrid parameters: Parallelization of the Hybrid pre-processor
  - Support of material models
    - Viscoelasticity (with failure)
    - Viscoelastic-Viscoplasticity (with failure)
  - Support of failure models
    - Tension-Compression differentiation (Stress based)
    - Per-phase standard failure criteria (Multiple failure surfaces)
  - Reduced memory consumption

- Failure
  - Tension-Compression differentiation based on the transversely isotropic Tsai-Wu model
  - Progressive Failure
    - Speed-Up
    - Improved robustness
  - SIFT failure criteria
  - Usage of failure criteria: FPGF criteria (PGA/PGB/PGC) merged to one output

- SFRP: Simpoe-Molding (Support of .xml file format)

- Long Fiber Thermoplastics (LFT)
  - Fiber bundling / nonlinear supported with the Hybrid solution method
  - Moldflow Midplane: coupled analyses based on variable aspect ratio
  - Moldex3D: coupled analyses based on variable aspect ratio & volume fraction (3D)

- Woven / Draping
  - Support of the advanced woven model with the Micro solution
    - $2^{1/2}$D Woven
    - 2D Braided
  - Interface to PAM-FORM: coupled analyses based on local warp / weft data
  - Use data in the Digimat open format: ASCII based exchange format for local warp / weft information to be transferred from any type of draping analysis (e.g., internal user solutions based on explicit solvers)

- Computer Tomography (μ–CT): interface to Volume Graphics
  - Data export from VGStudio MAX – Fiber Composite interface (Greyscale image analysis of μ–CT data)
  - Coupled analyses based on local fiber orientation & volume fraction

- Casting: interface to MAGMASOFT. Coupled analyses based on distribution of porosity.

- FE solvers
  - Marc
    - Large rotations (Solid elements, isothermal analyses)
    - Support of version 2012 (Linux 64bit)
    - Support of version 2013.1 (Windows / Linux 64bit)
  - Abaqus Support of version 6.13 (Windows / Linux 64bit)
  - ANSYS Support of version 15.0 (Windows / Linux 64bit)
  - PAM-CRASH
    - Support of version 2013 (Windows / Linux 64bit)
    - Support of UD / Woven

- GUI
  - Display of unit system in use
  - Usage of failure criteria simplified

Digimat-RP

- Shell modeling
  - Templates for coupled analyses with SHELL
  - Visualization
    - Thickness
    - Layer-by-layer properties
- Unit System Management : MPa / Pa / SI / CGS / FPS / psi / ksi
- Stiffness & Failure
  - Parallel generation of Hybrid parameters
  - Tension – compression differentiation
- FEA solvers
  - Radioss (SOLID modeling)
  - Samcef
- Injection molding simulations
  - REM3D (support of .mtc file format)
  - SIMPOE (support of .xml file format)
  - Moldflow midplane (support of .xml and .ele file format)
  - Moldex midplane (support of .ele file format)
- GUI: New visualization engine

Bug fixes and minor improvements

- Digimat-MF
  - Second-order homogenization: bug fix
  - Woven: engineering moduli only computed for orthotropic stiffnesses
  - Fatigue: Improved parameter definition (number of cycles, Sa, GUI) and Reverse Engineering capabilities
  - Coating: Correct density computation with coated voids
  - Thermo-Elastoplasticity & Thermo-Elastoviscoplasticity: Poisson ratio correctly handled as a function of the temperature
- Digimat-MX
  - Database handling
    - Status of created DB (started/stopped, with or without service)
    - Improve delete grade process (interesting for very large DB)
    - Improve update of DB with the use of service
  - Import: reset loading angle during import process
  - Reverse Engineering: Keep the initial orientation after RE
- Digimat-CAE
  - SFRP - HYBRID solution / explicit: convergence issues fixed
  - Woven - HYBRID solution: Improvement in the generation of parameters for small angles (around 45°)
  - Viscoelasticity: fix for non-constant Poisson's ratios
  - Progressive failure: fix for element deletion trigger
  - MuCell®: Support of shell elements
  - Interface to Abaqus Standard: fix for shell composites
  - ANSYS PlugIn
    - Layer thickness correctly taken into account with .dof files
    - Improved management of layered sections

II.1.17 Digimat 5.0.1

In this section of the documentation, you can find all major changes that are in Digimat 5.0.1.

Digimat Platfrom & GUIs

- New platform design & structure
  - Tools
  - Solutions
  - eXpertise
- 2D plots - Improved Robustness
  - New GUI library

Digimat-MF

- Standard Failure
  - Unified treatment of all failure indicators
    - Linear formulation that can easily be linked to the security factor
  - Termination of analysis
    - Based on critical value
- First Pseudo Grain Failure
  - Consistent formulation for pseudo grain counting (PGA) and averaging (PGC)
    - PGA / PGC normalized based on critical values
    - User choice to enforce threshold when using PGC
  - Termination of analysis
    - Based on critical value
- Progressive Failure
  - Failure
    - Hashin 2D
    - Hashin 3D
    - Hashin-Rotem 2D
  - Damage
    - Matzenmiller/Lubliner/Taylor (MLT)
    - Individual damage evolution functions
    - Stabilization control using viscous regularization
- Thermal Analyses
  - Conductivity with temperature dependent parameters

Digimat-MX

- Reverse Engineering – Enhanced Capabilities & Robustness
  - Failure – FPGF / Tsai-Hill 3D transversely isotropic
    - Stress based
    - Strain based
  - Thermo-mechanical
    - Thermo-elastic
    - Thermo-elastoplastic
- Transversely isotropic materials
- Public Data
  - Generic grades
    - Glass fiber reinforced epoxy
    - Carbon fiber reinforced epoxy

Digimat-CAE

- Woven Composites – Robustness & Speed-Up
  - Support of Hybrid solution method
  - Material
    - Elastic
    - Elastoplastic
    - Elasto-Viscoplastic
  - Microstructure definition
    - Basic & homogeneous yarns
  - Failure definition
    - Per-phase (matrix & fibers)
- Failure
  - Solution control independent from physical failure parameters
    - Numerical flag set when physical threshold parameter exceeded (criteria $>$ critical value)
  - Actions initiated by numerical flag
    - Stop analysis - implicit (except for LS-DYNA)
    - Delete elements - explicit & implicit (LS-DYNA)
- Thermal & Thermo-Mechanical Analyses
  - Improved robustness – support of hybrid solution method
    - Thermo-elastic
    - Thermo-elastoplastic
  - FE solvers
    - Marc (thermo-mechanical analyses)
    - Abaqus Standard (thermal analyses)
- CAE software
  - MSC Nastran SOL 400
    - Support of version 2013.1 – delivered & licensed via MSC
  - MSC Nastran SOL 700
    - Support of version 2013.1 – delivered & licensed via MSC
  - LS-DYNA
    - Support of linear solution for shell elements
    - Support of version R6.1 – increased robustness

Digimat-RP

NEW MODULE ADDED

- Easy setup of 3D coupled analyses
- Processing
  - Types
    - Injection / Injection-Compression / Compression molding
  - Software
    - Moldflow3D
    - Moldex3D
    - Sigmasoft
    - 3D TIMON
- Material
  - 2-phase materials
  - Short & long fiber reinforced plastics
  - Input
    - Generic
    - From Digimat-MX
    - From Digimat-MF
    - From File (.daf & .mat)
  - Support of encryption
- FEM solvers
  - Marc
  - MSC Nastran (SOL400 & SOL700)
  - Abaqus (Standard & Explicit)
  - ANSYS
  - LS-DYNA (Implicit & Explicit)
- Solution methods
  - Macro, Micro, Hybrid
  - User defined templates
- Job management
  - Submission
  - Monitoring

Examples Manual

- Examples Manual
  - Overview over all ready-to-run examples
  - Platform
    - Delivered by a separated installer
    - Consistent between common browser types
  - Examples added for
    - Digimat-MF
    - Digimat-FE
    - Digimat-CAE
    - Digimat-MAP
    - Digimat-RP
    - Digimat-HC

II.1.18 Digimat 4.5.1

In this section of the documentation, you can find all major changes that are in Digimat 4.5.1.

Digimat-MF

- Improved application of loading conditions
  - Better prediction of experimental data for short fiber reinforced plastics and UD composites
    - Tension with off-axis oriented fiber
    - Shear

Digimat-MX

- Installation
  - MX database installed into Digimat working directory by default
- Public database
  - SOLVAY – new supplier, materials added
    - Ketaspire KT-880 GF30
    - Avaspire AV-651 GF30 BG20

Digimat-CAE

- Hybrid Solution
  - Improved accuracy for the anisotropic nonlinear hardening
    - Elastoplastic
    - Elasto-viscoplastic
- Post-Processing of short fiber reinforced plastics results as a function of the local fiber orientation
  - Micro & Hybrid solution procedures
  - Default output
    - First eigenvalue of orientation tensor a_{ij}
    - Ratio between apparent stiffness (computed from local orientation) & ideal stiffness (computed in fiber direction)
  - User choice
    - Scalar product between the first eigenvectors of the orientation a_{ij} and the stress tensor σ_{ij}
- Initial stresses
  - Support of ANSYS v14.5
- Support of FEA Software
  - Abaqus 6.12
    - Windows 32bit
    - Windows 64bit
    - Linux 64bit
  - Radioss v11

II.1.19 Digimat 4.4.1

In this section of the documentation, you can find all major changes that are in Digimat 4.4.1.

Digimat-MF

- Long Fiber Thermoplastics
  - Fiber bundling model: prediction of linear elastic stiffness
- Woven Composites
  - Advanced woven model: prediction of linear elastic stiffness based on weave pattern
  - Digimat GUI: advanced woven builder including
    - Yarn definition
    - Weave pattern definition
    - Visualization
- Creep
  - Digimat GUI: creep & relaxation loading
- Failure
  - Strain based Tsai-Hill-3D transversely isotropic failure criteria
  - Smoother behavior of FPGF model
    - Based on average failure criteria over all pseudo grains
  - Computation of 2D failure in the FPGF model performed in the most critical plane
  - Digimat GUI: improved & clarified workflow
- Fatigue
  - Pseudo grain based model: prediction of anisotropic S(N) curves enhanced to multilayered microstructures
  - Matrix based fatigue model: prediction of anisotropic S(N) curves dependent on fiber volumemass fraction
  - Digimat GUI: improved definition & display of S(N) curves
- Temperature dependencies
  - Plastic strain multipliers dependent on the temperature
- Time dependencies
  - General dependency of parameters in Digimat materials as a user defined function of time (e.g., to describe curing, crystallization...)
- Workflow & General Improvements
  - Loading: uniaxial direction defined via theta & phi angle
  - Microstructure: load layer definition from generic .csv formatted files
  - Export: isotropic material cards available for PAM-CRASH & Radioss

Digimat-FE

- RVE Generation
  - UD composites: periodic boundary conditions
- Interfaces
  - Support of ANSYS v14.5
- Workflow & General Improvements
  - Microstructure: load layer definition from generic .csv formatted files

Digimat-MX

- Public Database
  - Material suppliers: new data available
    - Evonik Industries
    - Sabic
  - Generic material models, (thermo-)elastic & (thermo-)elastoplastic
    - e-Xstream engineering
- Data import
  - Linear elastic: direct input of moduli
  - From Excel sheets: easy copy paste of general tabular data
- Reverse Engineering
  - Simplified procedures for non-material experts

Digimat-CAE

- Digimat LINEAR solution
  - Linear analyses based on
    - Direct engineering (input of matrixfiber properties)
    - Generic material data
    - Digimat analysis .daf files
  - No license blocked during coupled analysis runs
  - No license necessary to read local microstructure
- Micro Solution
  - Speed-Up: about 10 20 % gain in CPU for shell models
- Hybrid Solution
  - Speed-Up: about 30 - 50% gain in CPU
  - Memory consumption: decrease of about 40%
  - Improvements on failure modeling
    - Strain based failure
    - Full strain rate dependency

  - Input: support of 2nd order homogenization
  - Generation of Hybrid parameters
    - Multiple runs in the same folder
    - Re-running parameters by user choice

- Interfaces to FEA
  - MSC Nastran SOL400: new interface (single processor Windows)
  - Marc Mentat plug-in
  - Support of
    - ANSYS v14.5, Marc 2011, Marc 2012 (Win64bit), MSC Nastran 2013 (Win64bit)
  - Samcef
    - Support of 2nd order solid elements

- Interfaces to Processing Software
  - Injection molding
    - SIMPOE: new interface (via MAP)
    - Moldex3D: enhancements for 3D (temperature fields, weld lines, initial stresses)
    - Moldex3D: new interface for 2D (fiber orientations)
  - Compression molding
    - Moldflow (3D analyses)
    - Moldex3D (3D analyses)
  - Injection-compression molding
    - Moldflow (3D analyses)
    - Moldex3D (3D analyses)
  - MuCell™
    - Moldflow (2D analyses)
    - Moldex3D (3D analyses)

- Interfaces to Life Time Prediciton Software
  - nCode DesignLife (2D & 3D analyses)

- Automated procedures
  - Mesh superposition by gravity center & axes of inertia
  - 3D Mapping

Digimat-MAP

- Tools
  - Measurement of distance & angle between picked nodes
  - Mesh superposition by gravity center & axes of inertia

- Cross Mapping
  - From 3D volume to 2D shell meshes

- Meshes & Formats
  - MSC Nastran, Samcef: support of 2nd order solid elements, SIMPOE

- Fiber Related Post Processing
  - Visualization of material properties at an integration point

Digimat Documentation

- New section
  - Map module: description of batch mode

- New guidelines: Reverse Engineering
  - Creep of SFRP with the elasto-viscoplastic material model
  - Failure of SFRP with the Tsai-Hill 3D transversely isotropic stress or strain based failure indictor using FPGF

- Example manual Platform
  - Updated & new examples
  - Project: Semi-automated procedures for RE of failure of SFRP with the Tsai-Hill 3D transversely isotropic stress or strain based failure indictor using FPGF

II.1.20 Digimat 4.3.1

In this section of the documentation, you can find all major changes that are in Digimat 4.3.1.

Digimat-MF

- Creep
  - Interaction law: new linearization method
- Thermo-Viscoelastic Material Model
  - For high strain rate dependency & creep behavior of composites
  - Three time shift functions (Arrhenius, WLF, piecewise linear)
- Thermo-Elasto-Viscoplastic Material Model
  - Time law for creep behavior of composites
- Failure
  - Stress based Tsai-Hill-3D transversely isotropic failure criterion
- Fatigue
  - Pseudo-grain fatigue model enhanced to full 3D description
- GUI
  - Clear distinction for strain rate dependent material models
    - High strain rates
    - Creep
  - Improvements in tooltips

Digimat-FE

- Enhanced Flexibility in Phase Generation
- User Definition of Inclusion Positions
- Enhanced Clustering
- Interface to ANSYS
  - Support of v14.0
- GUI
  - New GUI structure
  - Improvements in tooltips

Digimat-MX

- New Database Tools
  - Advanced filter
  - Import data
- Enhanced Database Tools
  - Reverse Engineering
- GUI
  - New GUI structure

Digimat-CAE

- Failure
  - HYBRID failure available in combination with both solutions methods, MICRO and HYBRID
  - Recommended procedures for workflow between Tsai-Hill-3D transversely isotropic criterion and HYBRID failure
- HYBRID solution
  - Improvement in memory management leading to
    - Faster initialization of CAE analyses
    - Up to 50% decrease in memory consumption during CAE runs
- LMS Virtual.Lab Durability
  - Pseudo-grain based fatigue model available in interface to lifetime prediction software
- Samcef
  - HYBRID solution method available with Mecano solver
  - Support of Dynam method for vibrational analysis
- ANSYS
  - Support of v14.0
- GUI
  - Improvements in tooltips

Digimat-MAP

- Speed-Up
  - Increased mapping speed especially for large models (tetrahedral elements)
- Moldflow models
  - Automated scaling by factor 1000 (Dual view / superpose function)
- GUI
  - Improvements in tooltips

Digimat Installation

- New installation procedures
  - 3rd party products installed independently from Digimat core product
  - 2 archives to download, one installer to lead through the full installation workflow

Digimat Documentation

- Improved description of installation procedures
- Enhanced Example manual platform
- Recommended procedures for reverse engineering

II.1.21 Digimat 4.2.1

In this section of the documentation, you can find all major changes that are in Digimat 4.2.1.

Digimat-MF

- Fatigue model: prediction of orientation dependent SN curves for high cycle fatigue
  - 2 phase composite materials
  - Linear elastic material
  - Based on pseudo grain approach
- Improved description of FPGF failure criteria
  - Storage of full stress/strain data per pseudo grain
- Export of homogenization results as material cards ready to use with FEA solvers
  - Linear elastic / elastoplastic behavior (single curve)
  - Abaqus, ANSYS, Marc, LS-DYNA, PAM-CRASH and Radioss
- Improved user friendliness
  - Automated display of homogenization results per analysis (curve plot & stiffness)
  - Simplified input of special microstructures (short fibers, UD and woven composites)
  - Clear separation between static/dynamic and fatigue failure criteria
- General corrections:
  - Correction of the computation of shear elastic stiffness affecting linear behavior of small strain material models when using orthotropic closure.

Digimat-FE

- Full pre-/post processing workflow available for computations using ANSYS Workbench

Digimat-MX

- Redesign of database structure including
  - Handling data by user/ group permission
  - Sharing data between groups
- New GUI based reverse engineering tool including
  - Workflow user friendly oriented approach
  - Definition of one microstructure per experimental curve defined by an orientation tensor
  - Display of optimization progress
- Enhancements in the encryption technology

  - Encrypted data in MXDB
  - Multi selection of data to encrypt

- Interface to Materiality database (provided by DatapointLabs)

Digimat-CAE

- CPU Speedup through
  - New "HYBRID" solution method (focus on macroscopic material properties, available for elasto-plastic and elasto-viscoplastic material models)
  - Improvements in the handling of output data
- Macroscopic failure indicator taking advantage of the improvements in the FPGF failure description (available in combination with the new "HYBRID" solution method)
- Interface to LMS Virtual.Lab Durability for fatigue analysis
- Interface to Simulayt drapage technology
- Interface to LS-DYNA implicit
- Interface to Marc
- Enhancements in Samcef interface (multi-processor, 64-bit, Linux)
- Updated Sigmasoft interface (fiber orientation, residual stresses, weld lines)
- Enhancements in the encryption technology
  - Capability to add readable parameters to an encrypted file (e.g., failure indicators, analysis settings...)
- Support of Abaqus Part/Assembly data structure
- Support of ANSYS.inp data structure via the Workbench Plug-In

Digimat-MAP

- Improved handling of orientation tensors including
  - (Automated) re-mapping for element set without orientation tensors after mapping
  - Manual setting of orientation tensors for element sets without orientation information after mapping
  - Enhancements of automated checks of physicality of orientation data (upon reading and writing of orientation files)
- Improved graphical display of 2nd order meshes
- New display options of element sets:
  - By material ID (with ANSYS.cdb file)
  - By section and element type (with Patran .pat file)
- Support of Samcef mesh format

Digimat GUI

- Improved user friendliness: automated graphical display of user input for
  - Material properties (e.g., stress/strain curve)
  - Microstructure information (e.g., aspect ratio, orientation tensor)

Digimat Documentation

- New structure with focused improvements on
  - Dedicated chapter: Detailed description of installation procedures & workflow
  - Appendices: Overview over capabilities & limitations of the software

- Available as PDF document

II.1.22 Digimat 4.1.2

In this section of the documentation, you can find all major changes that are in Digimat 4.1.2.

Digimat-MF

- Temperature dependent models: consistency between Digimat material models and output.
  - Thermal strain in thermo-elasticity: the initial strains are assumed to be zero as when using thermo-elastoplasticity or thermo-elastoviscoplasticity.
  - Display stiffness matrices and engineering data outputs at initial or final temperature/time when working with thermal or time dependencies.
- Enhanced management of default parameters in analysis settings:
  - Linearization method: discrete affine method automatically chosen as default for elastoviscoplastic and viscoelastic-viscoplastic material models.
  - Multi-inclusion homogenization: coatings automatically correctly handled with multi-level scheme.
- General corrections:
  - Automated warning that classical failure cannot be mixed with FPGF in the same .mat file
  - CTE output is given in the .dsf and .stf files.
  - Improved output management.

Digimat-FE

- General corrections:
  - Restart analyses with modification in the analysis definition.

Digimat-MX

- Multiple selections of Material Explorer and Data Explorer entries for deletion, selection, export or plot.
- Improved behavior of the Material Information frame when displaying the grade definition for modification or at import.
- General corrections:
  - When importing a thermo-dependent Digimat analysis, extracted Digimat materials contain the thermo-dependency functions of the parameters.
  - A database cluster can be created in a folder with a path name containing blank space.
  - Large comment information field can be modified.
  - PDF datasheet generation possible for grades containing large comment field.
  - Stabilized behavior for stopping the server after a reverse engineering analysis.
  - Digimat analysis files containing reinforcement by rigid inclusions can be imported.
  - Improvement of MX messages to the user.
  - Possibility to delete material trees containing more than 20 experimental data entries.

Digimat-CAE

- CPU time reduction: general improvements in the code and convergence schemes.
- Stiffness update delay (SUD): improved formulation for combination of SUD with elasto-viscoplastic materials.
- Convergence stabilization: improvement in the algorithm enforcing plane stress condition for shell elements leading to a better convergence rate. These improvements are particularly effective when using elasto-viscoplastic materials.
- Multi-layer material: Digimat material (.daf) files defined as multi-layers can be used to set up coupled analyses via Digimat-CAE and the Digimat plugins.
- Failure indicators: Local axis system can be used to define failure criteria in both phases of two-phase composites as well as on the macroscopic level.
- Interface to ANSYS:
  - Stabilization of installation on single partition
  - Compatibility with ANSYS 13.0.
  - Compatibility of ANSYS wizard with Digimat material (.daf) files from older Digimat versions (4.0.2 and below).
  - WB wizard support of Digimat material (.daf) files containing blank spaces in the filename.
- General corrections:
  - Handling of orientation tensor defined in the Digimat material (.daf/.mat) files.
  - Output of failure criteria for homogeneous materials.
  - Applying failure criteria for element deletion even if not requested as output.
  - Handling of encrypted mat files in Digimat-CAE GUI
  - Radioss: Element deletion triggered when all integration points have failed.

Software II.2

Supported systems

II.2.1 Digimat GUI

Following platforms are supported:

- Windows 10 64 bits

II.2.2 Digimat-MF (batch mode, no GUI)

Following platforms are supported:

- Windows 10 64 bits
- Linux Red Hat7.3 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux Red Hat7.5 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux Red Hat7.7 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux Red Hat6.5 (GLIBC $\geq$ 2.12 and GLIBCXX $\geq$ 3.4.13)
- Linux SUSE12 SP1 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP2 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP4 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)

II.2.3 Digimat-FE (batch mode, no GUI)

Following platforms are supported:

- Windows 10 64 bits
- Linux Red Hat7.3 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux Red Hat7.5 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux Red Hat7.7 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP1 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP2 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP4 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)

II.2.4 Digimat-VA (for remote job submission, no GUI)

Following platforms are supported:

- Linux Red Hat7.3 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux Red Hat7.5 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux Red Hat7.7 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP1 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP2 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP4 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)

II.2.5 Digimat-AM (for remote job submission, no GUI)

Following platforms are supported:

- Linux Red Hat7.3 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux Red Hat7.5 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux Red Hat7.7 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP1 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP2 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)
- Linux SUSE12 SP4 (GLIBC $\geq$ 2.17 and GLIBCXX $\geq$ 3.4.19)

II.2.6 Digimat-CAE

For supported Operating system, refer to installation section of each CAE code.

Software II.3

Supported Digimat-MAP formats and data

II.3.1 File formats

FE software mesh files

- Abaqus (.inp) *
- ANSYS (.cdb / .inp / .dat / .ans)
- CADMOULD 3D-F (.cfe)
- I-DEAS (.unv)
- LS-DYNA (.key / .k / .dyn)
- Marc (.dat)
- Moldflow (.pat / .udm)
- MSC Nastran (.bdf / .dat / .nas)
- OptiStruct (.fem)
- PAM-CRASH (.pc)
- PAM-FORM (_M## / .erfh5)
- Patran (.pat)
- PERMAS (.uci, .dat)
- RADIOSS (.rad)
- REM3D (.t)
- Samcef (.dat)
- Simulayt (.layout)
- STL geometry (.stl)
- 3D TIMON (.msh)

* Please note that only flat models are supported in Digimat-MAP, assemblies are not.

FE software result files

- Abaqus (.odb)

Injection molding software results files

- CADMOULD 3D-F (.txt, .car)
- Moldex 3D (.o2d)
- Moldex midplane (.ele.*)
- Moldflow 3D (.nod, .xml)
- Moldflow midplane (.ele.*, .str, .nod, .xml)
- REM3D (.mtc)
- SigmaSoft (.txt)
- Simpoe (.xml)
- 3D TIMON (.bou, .hou, .fou)
- 3D TIMON midplane (.dat)
- 3D TIMON Light3D (.unv, .tdr)
- VISI Flow (.xml)

(Injection) Compression molding software results files

- Moldex 3D (.o2d)
- Moldflow 3D (.xml)

Liquid composite molding software results files

- PAM-RTM (.erfh5)

Casting software results files

- Magmasoft (.inp, .xml)
- ProCAST (.ntl)

Additive manufacturing data files

- G-code toolpaths (.gcode, .gco, .nc)
- Insight toolpaths (.txt): versions up to 2.3 are supported
- Markforged toolpaths (.mft)

Digimat internal file formats

- Digimat (.dof): format with an orientation tensor (or other type or data) defined at each integration point, instead of having an averaged orientation tensor per element as it is the case with all processing proprietary formats.
- Digimat (.dsf, .stf): formats with stiffness information, written out of coupled FEA, which can be visualized in Digimat-MAP.

Please note that the .dof and the .dsf formats are binary formats with better compression than plain text.

Digimat open file format for draping processes

- Digimat (.xml): open format containing mesh information (nodes and elements) and continuous fiber orientation for each element or integration point.

Other file formats

- VMAP (.h5): interoperability standard for material, mesh and data exchange, with limited availability only (see Section **??**).

II.3.2 Data types

Fiber orientation tensors

- CADMOULD 3D-F (surface mesh)
  - Data is typically provided on 5 layers of the surface mesh (external surface of the geometry).
  - Digimat-MAP layer numbering matches CADMOULD definition, e.g.: layer 5 is positioned on the surface of the model, and layer 1 is the inside-most. Typically, when considering two opposite and parallel faces of the geometry, layer 1 corresponds to the middle surface; consequently, orientation data is the same on both external faces for layer 1.
- Moldex 3D (solid and shell elements)
- Moldflow (solid and shell elements)
- REM3D (solid elements)
- SigmaSoft (solid elements)
- Simpoe (solid elements)
- 3D TIMON (solid and shell elements)
- 3D TIMON Light3D (3D TIMON solid mesh)
  - The full data set consists of an orientation data file (.unv) and a thickness direction file (.tdr, hidden file).
  - The orientation data file provides the components of the orientation tensor for 10 layers, distributed along the thickness direction. It is organized in `ML_ORIENTATION_TENSOR*T11T12T13` and `ML_ORIENTATION_TENSOR*T22T23T33` blocks (where * stands for the layer ID). Each block provides the following informations:
    - on the 3 first lines, the name of the orientation components;
    - on the 4 next lines, some description about the load case, which is ignored;
    - several pairs of lines, each giving (on the first line) the **original** element ID, the number of components, then (on the next line) the tensor component values;
    - an ending line containing -1.
  - The thickness direction file provides, for each element, the direction considered as the thickness direction. It is used by the mapping algorithm to determine, for each source tetrahedron element, which facet will be extruded to form the temporary 3D mesh. Note that for "bulk" elements, this direction corresponds to the normal to the free facet; for "edge" and "vertice" elements, we extrude the free facet whose normal is closest to the thickness direction, with an angular tolerance of 46° between these two vectors.
    The thickness direction file is organized similarly to the orientation file, but with a single `THICKNESS DIRECTION` block providing the three components of the thickness direction vector.
  - Digimat-MAP layer numbering follows this convention:
    - layer 1 corresponds to the `ML_ORIENTATION_TENSOR10*` blocks, and is positioned close to the external surface, e.g. at relative altitude $Z = -1 + 1/40$ w.r.t the source free facet;
    - layer 10 corresponds to the `ML_ORIENTATION_TENSOR1*` blocks, and is positioned close to the midsurface, e.g. at relative altitude $Z = -1/2 + 1/40$ w.r.t the source free facet;
    - layer 11 to 20 are the symmetric to layers 10 to 1 (respectively) w.r.t. the midsurface.
- VISI Flow (surface mesh)
  - Data file is organized in `<Element>` blocks, which provide the following informations:
    - a link between two elements of the surface mesh, e.g. a "source" element (`ID`) and a "target" element (`linkID`);
    - for "source" element, orientation data for 11 imaginary data point disposed uniformly along the line between the two linked elements centroids;
    - for "target" element, orientation data at the element centroid.

  - For sake of comprehensiveness, the distinction between "source" and "target" element is ignored by Digimat-MAP field visualization tools.
  - Digimat-MAP layer numbering follows this convention:
    * layer 1 corresponds to the last <Data> set in the <Element> block, and is positioned at the centroid of the source element (e.g. at relative altitude Z=0 w.r.t the source element);
    * layer 11 corresponds to the first <Data> set in the <Element> block, and is positioned at the centroid of the target element (e.g. at relative altitude Z=-1 w.r.t the source element).
- Volume Graphics (.csv, also contains volume fractions)

Initial stresses

- Digimat XML (solid elements)
- Digimat DOF
- Moldflow (solid and shell elements)
- Moldex3D (solid elements)
- SigmaSoft (solid elements)
- Simpoe (solid elements)
- Abaqus (export for CAE computation)
- ANSYS (export for CAE computation)
- LS-DYNA (export for CAE computation)

Initial temperatures

- Moldflow (solid and shell elements)
- Moldex3D (solid elements)
- Simpoe (solid elements)
- 3D TIMON (solid and shell elements)
- Abaqus (export for CAE computation)

Weld lines

- Moldflow (solid and shell elements)
- Moldex3D (solid elements)
- 3D TIMON (solid and shell elements)
- SigmaSoft (solid elements)

Porosity

- Moldflow (solid and shell elements)
- Moldex3D (solid elements)
- Magmasoft (.xml and .inp formats, solid elements and nodal data)
- ProCAST (solid elements and nodal data)
- PAM-RTM (solid elements and nodal data)

Volume fraction

- Moldex3D (solid elements, nodal data)
- Volume Graphics (.csv, also contains fiber orientation tensors)
- 3D TIMON (solid elements, nodal data)

Fiber length

- Moldflow (solid and shell elements)
- Moldex3D (solid elements)
- 3D TIMON (solid elements)

UD orientation

- Digimat XML (orientation vectors in global or local axis)
- PAM-FORM
- Aniform

Woven orientation

- Digimat XML (orientation vectors in global or local axis)
- PAM-FORM
- Aniform

II.3.3 Mesh formats

Abaqus

- Only 'flat' input files are supported, i.e., input files with neither assembly nor part instances definition.
- Element sets (*Elset) are supported (for mapping between subsets of elements).
- Included files (*Include) are supported as long as they are not encrypted.
- The following types of elements are supported:
  - Tri: S3(R,RS), STRI3
  - Quad: S4(R,RS,RSW), S4R5
  - Tetra: C3D4(H,T), C3D10(H,M,I,HS)
  - Hexa: C3D8(R,H,RH,I,IH), C3D20(R,H,RH)
  - Wedge: C3D6, C3D15
  - Pyra: C3D5

ANSYS (*.ans format)

- The following types of elements are supported:
  - Tri / Quad: type 43, 63, 143, 181 and 281
  - Tetra / Hexa: type 45, 64, 185, 186, 187 and 285

ANSYS (*.cdb, *.dat, *.inp format)

- Different element sets are created (for mapping between subsets of elements) based on the Real Id assigned to the elements.
- Included files are supported using the command `/input, <file>, <ext>, <folder path>, <n>`, or `/input, <file path>, <ext>, , <n>,`, where the file is read starting at line `n`. This last parameter is optional. Labels and `/eof` commands are not supported.
- The following types of elements are supported:
  - Tri / Quad: type 41, 43, 63, 143, 157, 163 and 181
  - Tetra / Wedge / Hexa: type 5, 45, 62, 64, 65, 70, 87, 90, 92, 95, 117, 122, 123, 164, 168, 185, 186, 187, 226, 227, 231, 232, 236, 237, 278, 279 and 285

  Hexahedra degenerated to tetrahedra, pyra and wedge elements are supported, other degenerations are not supported.

CADMOULD

- Only 3D-F (surface mesh) format is supported.
- The following types of elements are supported:
  - Tri: 3-nodes linear triangular elements

  Bar elements (2-nodes linear bar) are ignored.

I-DEAS

- The following types of elements are supported:
  - Tri:
    - Element types 41, 51, 61, 71, 91 (linear)
  - Quad:
    - Element types 44, 54, 64, 74, 94 (linear)
    - Element types 45, 55, 65, 75, 95 (quadratic)
  - Tetra:
    - Element type 111 (linear)
    - Element type 118 (quadratic)
  - Hexa:
    - Element type 115 (linear)
    - Element type 116 (quadratic)
  - Wedge:
    - Element type 112 (linear)

LS-DYNA

- Different element sets are created (for mapping between subsets of elements) based on the Part Id assigned to the elements.
- Included files are supported (*INCLUDE, *INCLUDE_PATH, *INCLUDE_PATH_RELATIVE cards).
- *INCLUDE_TRANSFORM cards are partially supported (only node id offset, element id offset, part id offset and transformation id are taken into account).
- Option POS6P is not supported for *DEFINE_TRANSFORMATION cards.
- The following types of elements are supported:
  - Triangular and quadrangular (with reduced integration scheme) linear shells
  - Linear and quadratic (10 nodes-definition) tetrahedron elements; linear hexahedron (with reduced integration scheme) and linear wedge elements

Marc

- Element sets ("define element set") are supported (for mapping between subsets of elements).
- Included files ("include") are supported.
- The following types of elements are supported:
  - Tri: Marc element type 6, 37, 49, 138, 155, 158, 200 (linear)
  - Quad: Marc element type 11, 18, 22, 30, 39, 72, 75, 80, 85, 86, 139, 140, 154, 186 (linear and quadratic)
  - Tetra: Marc element type 127, 130, 133, 134, 135, 157, 184 (linear and quadratic)
  - Hexa: Marc element type 7, 21, 43, 44, 57, 71, 84, 113, 117, 120, 123, 188 (linear and quadratic)
  - Wedge: Marc element type 136, 137, 192, 202, 203, 205, 238 (linear and quadratic)
  - Pyra: Marc element type 216, 217, 218, 219 (linear and quadratic)

Moldflow (*.udm format)

- The following types of elements are supported:
  - Tri: Element type TRI3 (linear)
  - Tetra: Element type TET4 (linear)

MSC Nastran

- Different element sets are created (for mapping between subsets of elements) based on the Property Id assigned to the elements.
- Included files using the simple `include 'file.dat'` command are supported. The file name/path must be explicit and be single-token (no `include 'file' '.dat'`). The quotes are optional only if the command is single-line. Other variants are not supported.
- The following types of elements are supported:
  - Tri: CTRIA3 (linear)
  - Quad: CQUAD4, CQUADR, CQUAD8 (linear and quadratic)
  - Tetra: CTETRA (linear and quadratic)
  - Hexa: CHEXA (linear and quadratic)
  - Wedge: CPENTA (linear)

OptiStruct

- Different element sets are created (for mapping between subsets of elements) based on the Property Id assigned to the elements.
- Included files using the simple `include 'file.fem'` command are supported. The file name/path must be explicit and be single-token (no `include 'file' '.fem'`). The quotes are optionnal only if the command is single-line. Other variants are not supported.

- The following types of elements are supported:
  - Tri: CTRIA3 (linear)
  - Quad: CQUAD4, CQUADR, CQUAD8 (linear and quadratic)
  - Tetra: CTETRA (linear and quadratic)
  - Hexa: CHEXA (linear and quadratic)
  - Wedge: CPENTA (linear)

PAM-CRASH

- Different element sets are created (for mapping between subsets of elements) based on the definition of Groups of elements.
- Included files are supported (INCLU / command).
- The following types of elements are supported:
  - Triangular and quadrangular linear shell elements
  - Linear and quadratic tetrahedron elements; linear hexahedron and wedge elements

Patran

- Different element sets are created (for mapping between subsets of elements) based on the element type and the cross section ID assigned of elements.
- The following types of elements are supported:
  - Tri: Patran element type 3 (linear)
  - Quad: Patran element type 4 (linear)
  - Tetra: Patran element type 5 (linear and quadratic)
  - Hexa: Patran element type 8 (linear and quadratic)
  - Wedge: Patran element type 7 (linear and quadratic)

PERMAS

- Element sets (ESET) are supported (for mapping between subsets of elements).
- The following types of elements are supported:
  - Tri: SHELL3, TRIA3, TRIA3K, TRIA3S, TRIM3, TRIMS3, TRIM6 and TRIMS6 elements (linear)
  - Quad: SHELL4, QUAD4, QUAD4S, QUAM4, QUAMS4, SHEAR4, QUAM8, QUAMS8, QUAM9 and QUAMS9 elements (linear)
  - Tetra: TET4 and TET10 elements (linear and quadratic)
  - Hexa: HEXE8, HEXFO8, HEXE20 and HEXE27 elements (linear and quadratic)
  - Wedge: PENTA6, PENTA15 and PENTA18 elements (linear)

RADIOSS

- Different element sets are created (for mapping between subsets of elements) based on the definition of parts ID.
- Included files (#include) are supported in the Starter file.
- The following types of elements are supported:
  - Tri: SH3N
  - Quad: SHELL
  - Tetra: TETRA4 (linear) & TETRA10 (quadratic)
  - Hexa: BRICK8 (linear) & BRIC20 (quadratic)

REM3D

- The following types of elements are supported:
  - Tetrahedral elements

Samcef

- Included files are supported using the simple `input "file.dat"` command. Other variants are not supported.
- The following types of elements are supported:
  - Tri: 1^{st} order shell element
  - Quad: 1^{st} order shell element
  - Tetra: 1^{st} order and 2^{nd} order 3D element
  - Hexa: 1^{st} order and 2^{nd} order 3D element
  - Wedge: 1^{st} order 3D element

STL geometry

- Both ASCII and binary STL formats are supported.
- The triangularization is loaded without remeshing, elements are assigned consecutive IDs starting from 1, in the same order as listed in the triangularization.
- Nodes are assigned consecutive IDs starting from 1, in the same order as listed in the triangularization, with two nodes considered as identical if they have exactly the same coordinates.

3D TIMON

- The following types of elements are supported:
  - Triangular and quadrangular linear shell elements
  - Tetrahedral, hexahedral and wedge linear elements

Part III

Windows Prerequisites

Windows Prerequisites III.1

Installation of prerequisites on Windows platforms

III.1.1 Installation of Microsoft Visual Studio Community 2017

Installation of Microsoft Visual Studio 2017 is needed to use Digimat to LS-DYNA interface in order to build LS-DYNA executables containing Digimat libraries. Several versions of Microsoft Visual Studio 2017 can be used: Professional, Enterprise or Community. Only Community version is available for free.

If Microsoft Visual Studio 2017 is already installed, user can skip this step. Microsoft Visual Studio Community 2017 can be downloaded from the Microsoft homepage. It may be needed to create a Microsoft account to be able to access this page.

Installation procedure is described below.

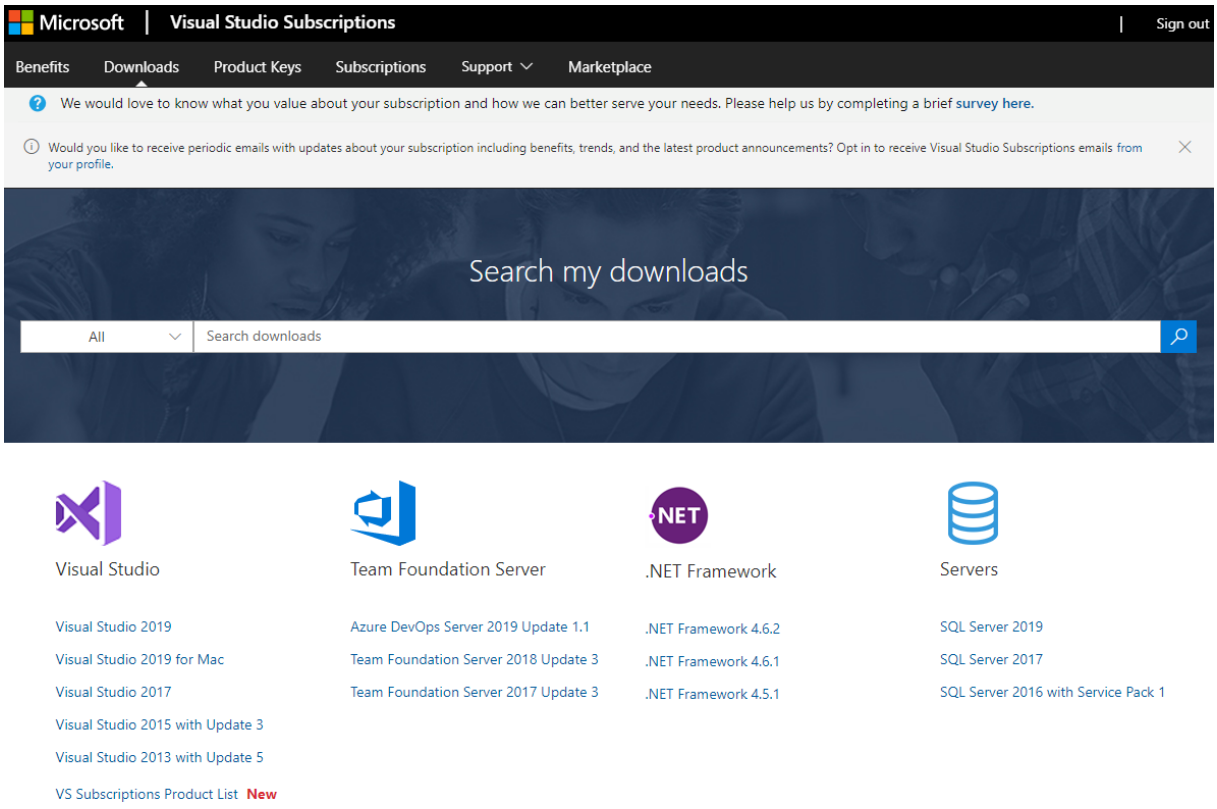


Figure III.1.1: Visual Studio download page.

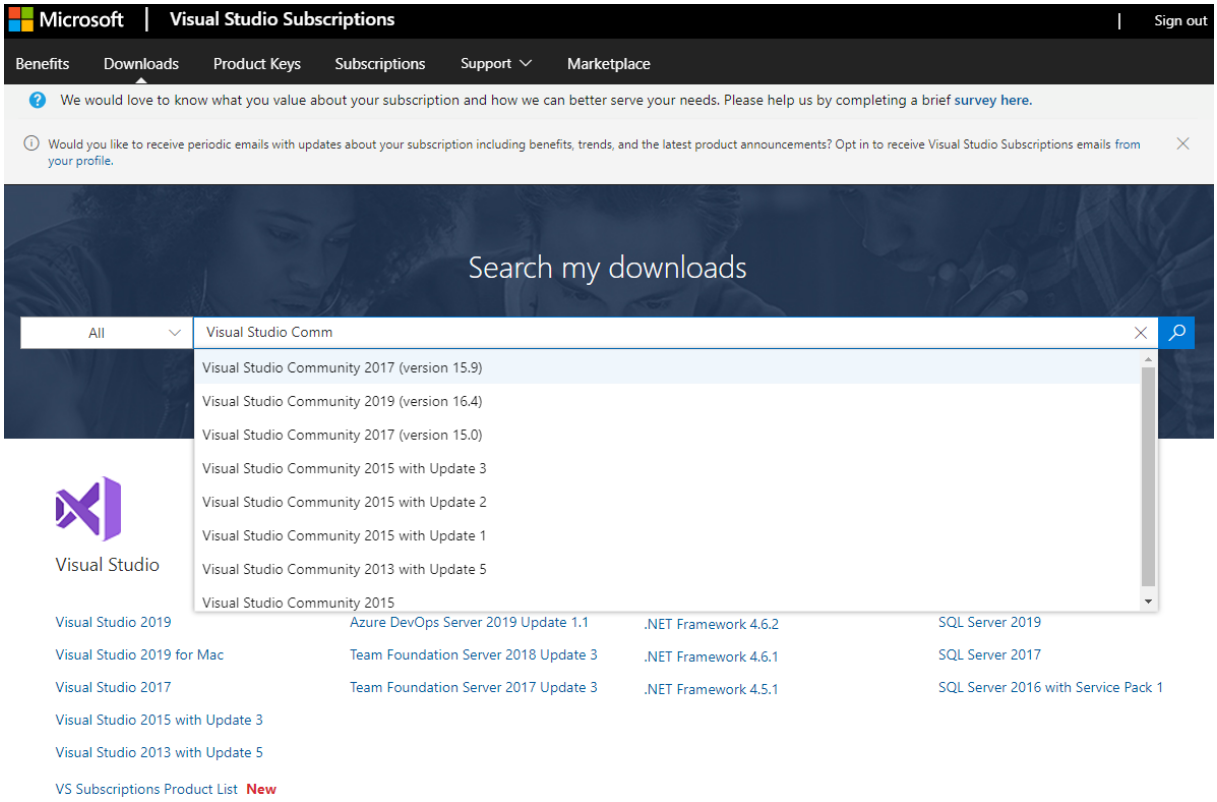


Figure III.1.2: Select Visual Studio Community 2017.

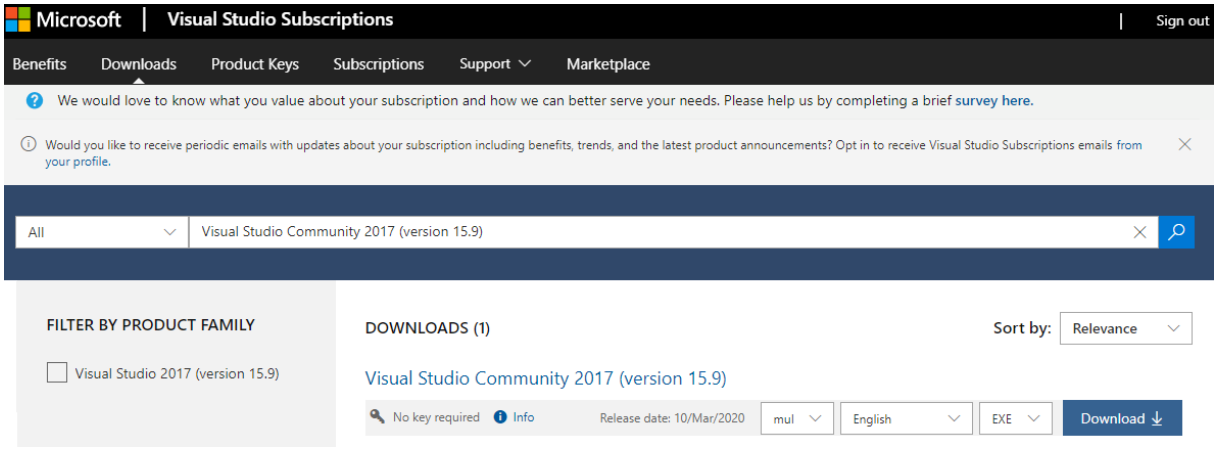


Figure III.1.3: Download Visual Studio Community 2017.

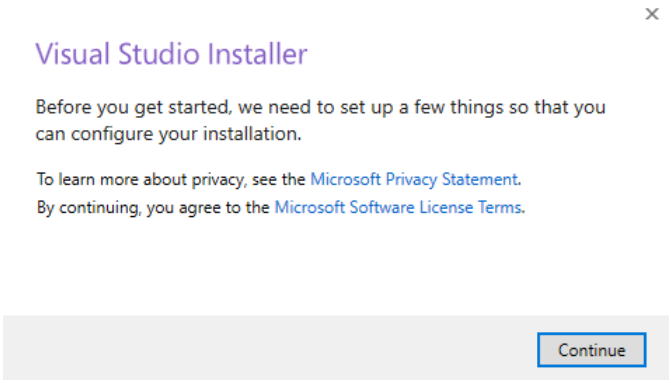


Figure III.1.4: Running Visual Studio Community 2017 installation.

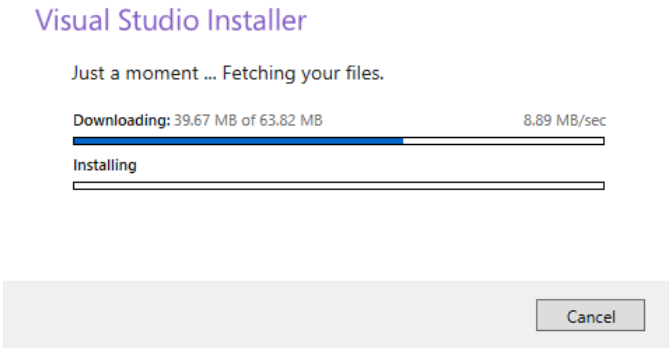


Figure III.1.5: Download Visual Studio Community 2017 installer.

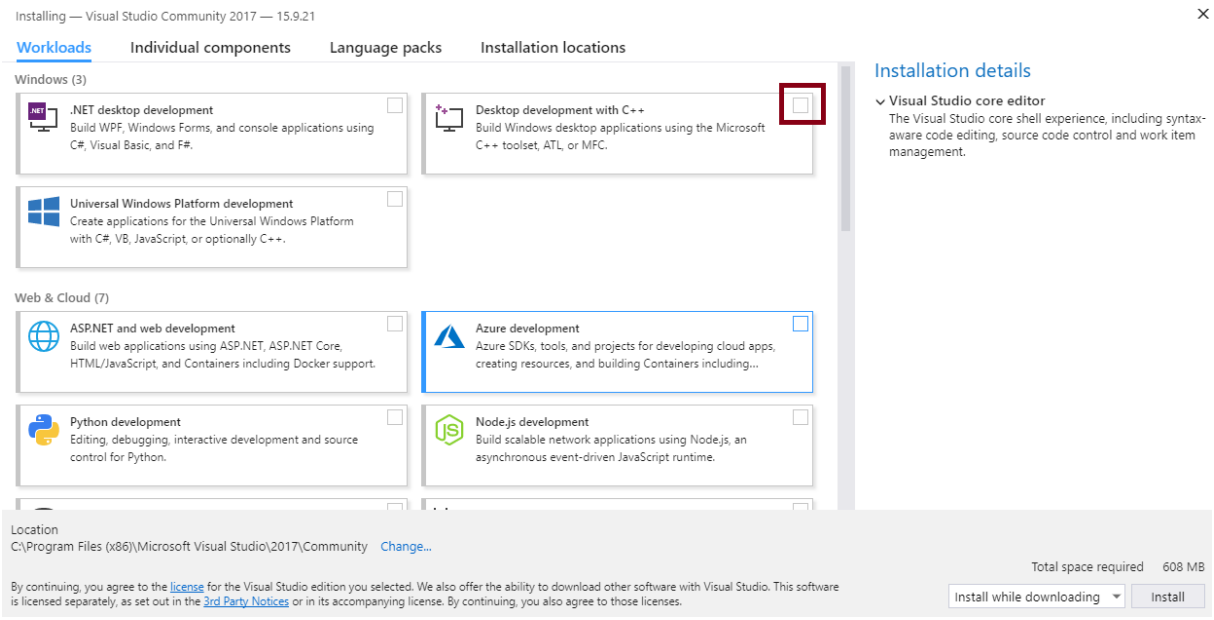


Figure III.1.6: Select the Desktop development with C++ component.

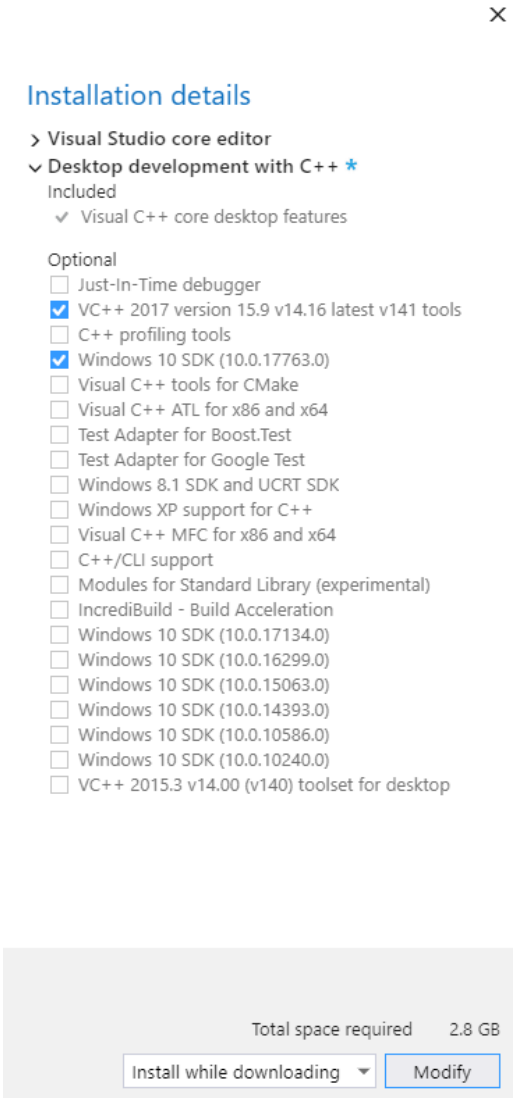


Figure III.1.7: Select the minimum optional components to be able to build Digimat-CAE/LS-DYNA executables.

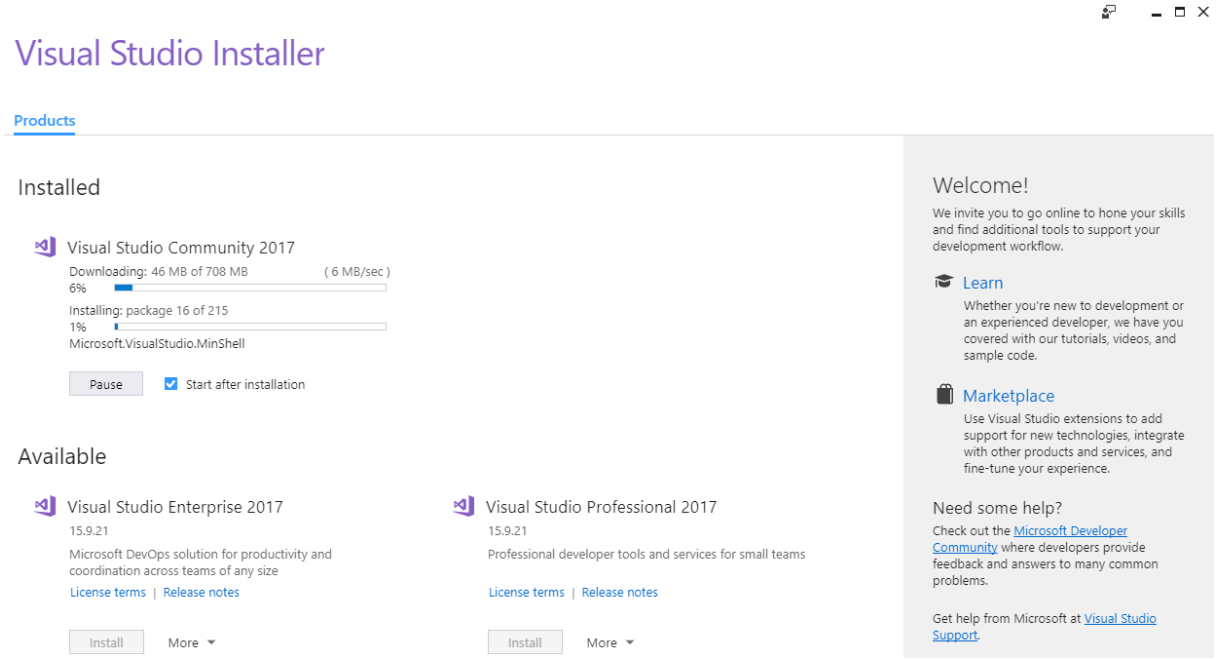


Figure III.1.8: Installation of selected Visual Studio Community 2017 components.

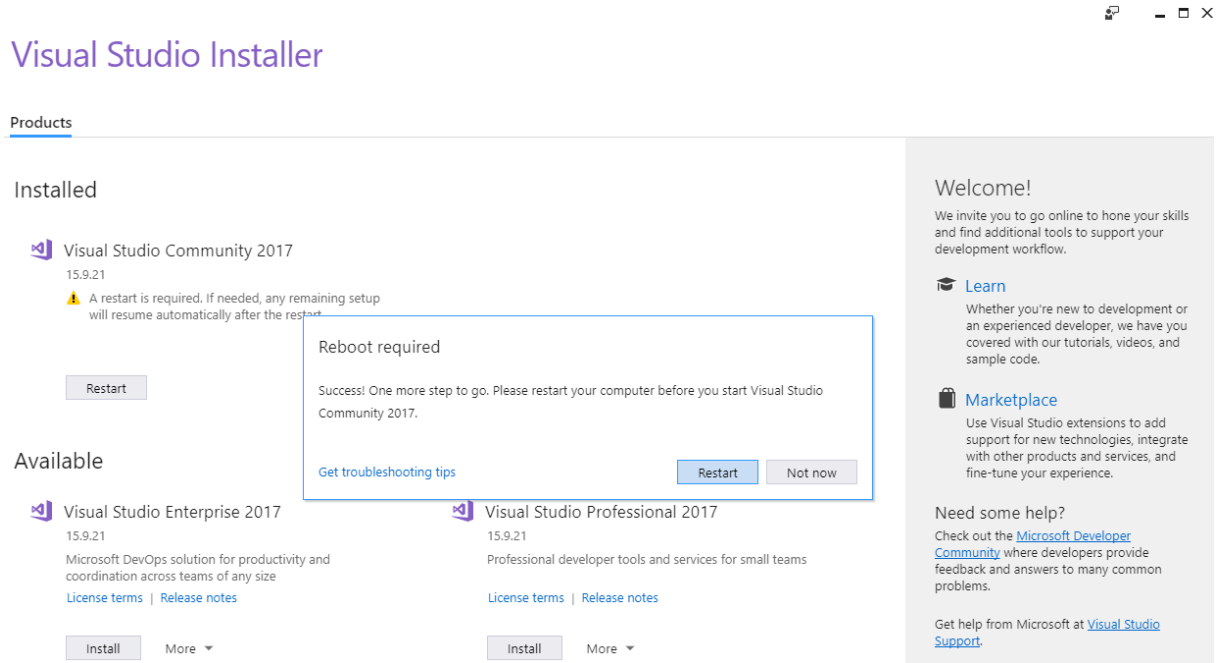


Figure III.1.9: Reboot computer if needed.

III.1.2 Microsoft Visual Studio Express 2012 for Windows Desktop

Installation of Microsoft Visual Studio Express 2012 for Windows Desktop is needed to use Digimat to Samcef interface in order to build Mecano and Dynam executables containing Digimat libraries.

Microsoft Visual Studio Express 2012 for Windows Desktop can be downloaded from the Microsoft homepage. It may be needed to create a Microsoft account to be able to access this page.

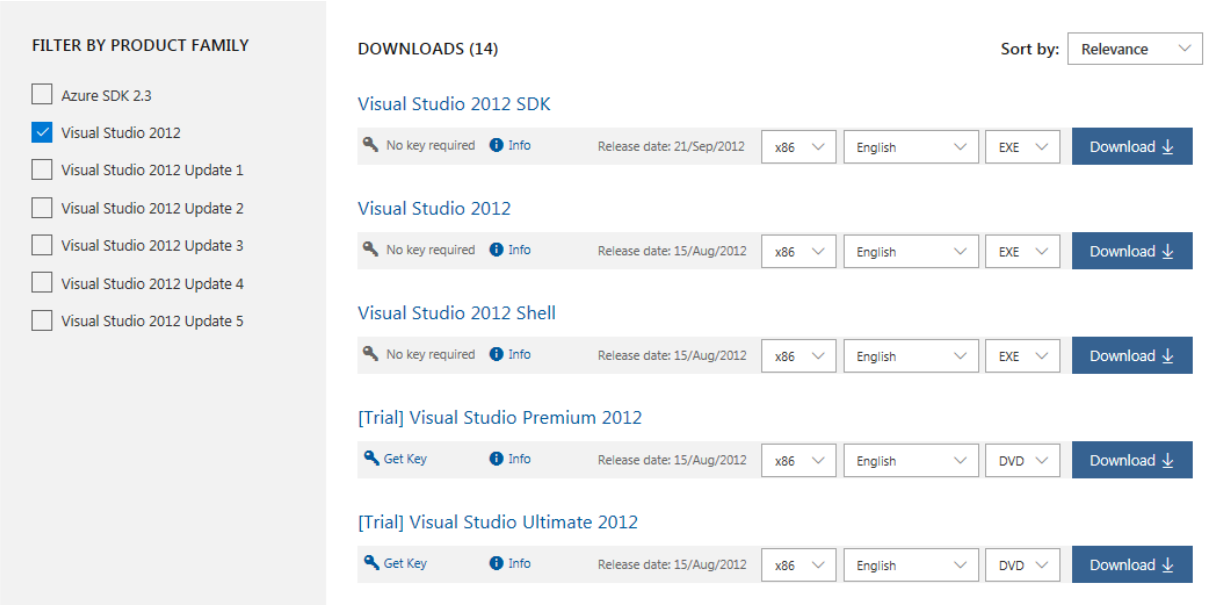


Figure III.1.10: Select Visual Studio 2012 in product family.

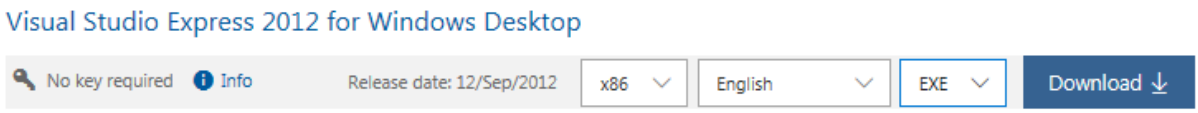


Figure III.1.11: Download exe file of Visual Studio Express 2012 for Windows Desktop.

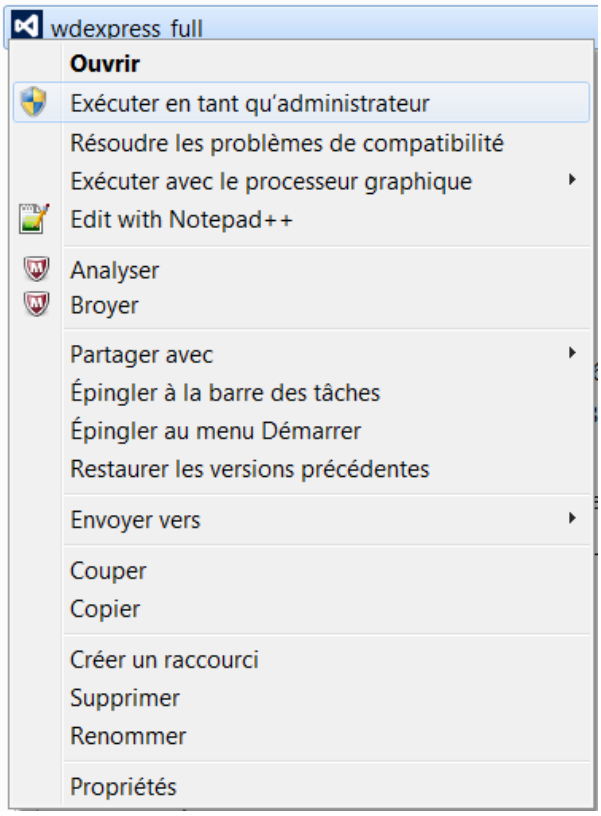


Figure III.1.12: Run the downloaded wdexpress_full.exe file as an administrator.

Figure III.1.13: Agree the license terms and conditions, then click on "INSTALL".

Figure III.1.14: Wait for the installation to be completed (can take a while).

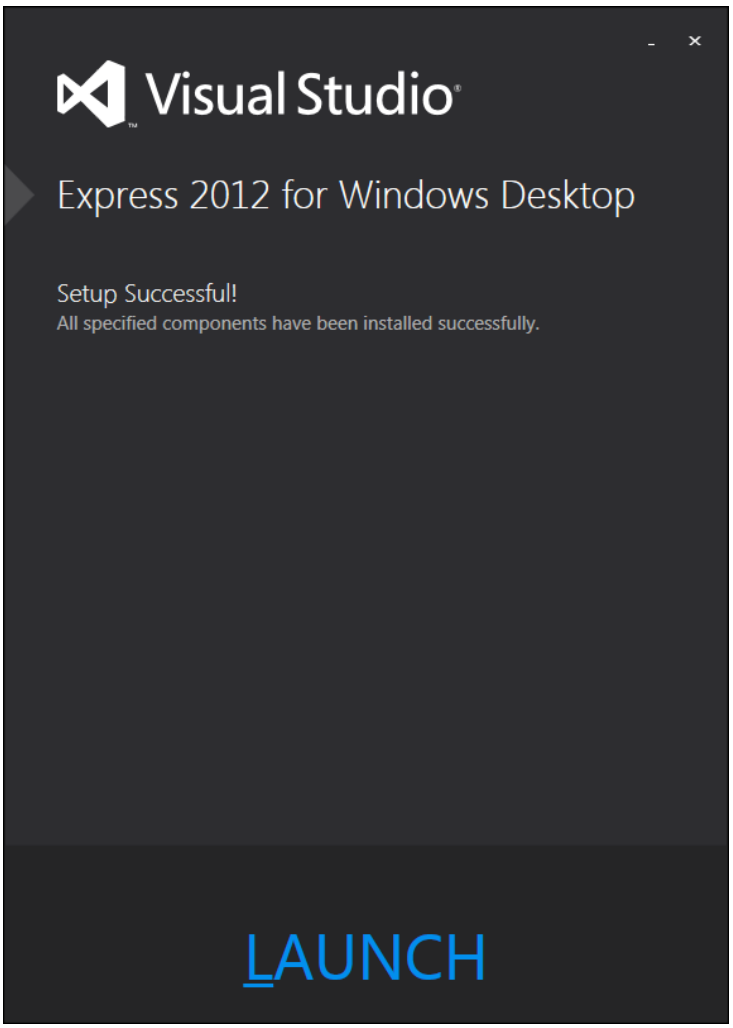


Figure III.1.15: Close the installation once it is completed.

III.1.3 Microsoft .NET Framework 4.6.2

Microsoft .NET Framework 4.6.2 or higher is required to use Digimat-RP, Digimat-VA and Digimat-AM.

The availability of the Microsoft .NET Framework 4.6.2 can be checked from the Windows Control panel (see III.1.16). If it is not installed, it must be downloaded from the Microsoft download page and installed before using Digimat-RP, Digimat-VA or Digimat-AM.

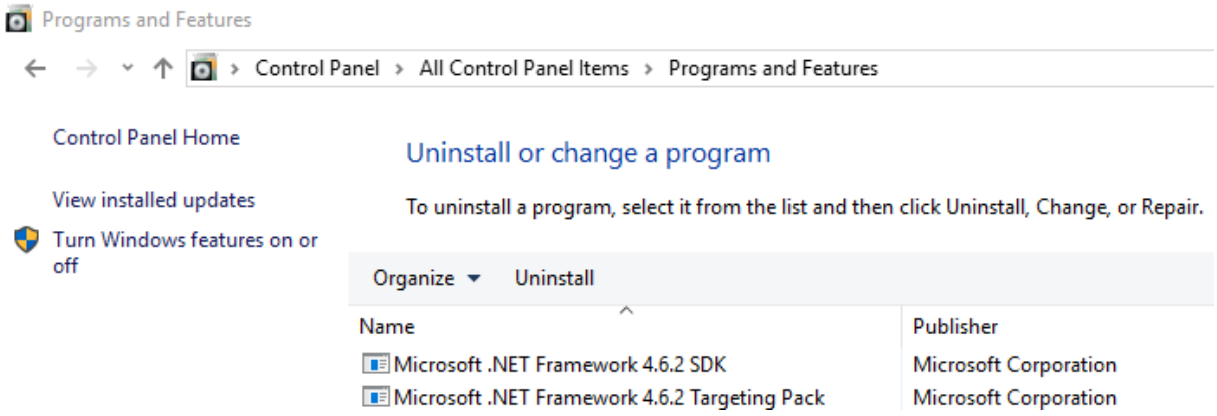


Figure III.1.16: Check if Microsoft .NET Framework 4.6.2 is installed