

## simufact additive Version 2020 FP1 What's new?

Soeren Hilbers Hamburg, August 7<sup>th</sup> 2020

#### What's new? – Highlights

- GUI automation by scripting
- New process type "Geometry inspection"
- New process type "Binder jetting" (Technical preview)
- Calibration usability improvements
- Many improvements in usability & stability
  - Implemented 96 features







- Automation is a big key topic when a various number of simulations should run with a minimum amount of user interaction
- For this reason **Simufact Additive can be automized** using script commands
- **Python allows to drive the GUI** by entering scripting commands manually or start the GUI and attach a script that should be executed by the GUI
- The workflow from creating a project to starting the simulation can be automized using scripting commands







- Using the scripting interface, it is possible to drive Simufact Additive from any other 3<sup>rd</sup> party software
- This allows e.g. PLM software to interact with Simufact Additive





The well structured and detailed documentation
 allows to write scripts easy and fast

 Reference Module simufact Functions Classes Table TableColumn TextStream UnitValueAcceleration UnitValueAngle UnitValueArea UnitValueCurrency UnitValueCurrencyPerTime UnitValueForce UnitValueForcePerLength UnitValueHtc UnitValueLength UnitValuePercent UnitValuePower UnitValueSpeed UnitValueTemperature UnitValueTime UnitValueTorquePerAngle UnitValueVolumePerTime Vector2D Vector3D Module simufact.additive Functions Classes AdvancedThermalBuildParameters BasePlate BuildStage CuttingStage DistributedInherentStrain HIPStage HatchingEstimation HatchingParameters HatchingStrategy HeatTreatmentStage ImmediateReleaseStage Machine MachineCosts Material MaterialiseBlockSupports MaterialiseLineSupports MechanicalScaling Part PostBuildParameters Process Project

6





- Geometry inspection is a new process type which only works on geometries without the usage of any simulation data
- This process types allows positioning, best fit, transformation and compensation of geometries based on surface deviation
- Geometry inspection does not require an additional license feature
- Every process can be changed into a geometry inspection process but not vice versa





- Reference geometries are now handled in the geometry widget under "Additional geometries" and not in the results widget anymore
- Simplifies workflow for geometry inspection process type as well as the handling of reference geometries for distortion compensation
- The GUI is cleaned up for geometry inspection to show just the needed commands and tools





- General workflow:
  - Import reference geometry (e.g. scanned geometry)
  - Import CAD geometry as part
  - Set transformation for geometry with respect to reference geometry using methods also available for result transformation
  - Compensate part











Before compensation



After compensation



Binder jetting (Technical preview)



- Binder jetting is a new and emerging additive manufacturing technology
- The manufacturing process is a **powder bed based process** where the part is build layer wise
- The geometry is formed by applying a binder on the powder which glues the powder particles
- The created geometry needs to be sintered in order to achieve a recent amount of strength
- Simufact Additive offers a technical preview on the new binder jetting process type
- The binder jetting process type is focused on the sintering where distortions and stresses occur due to large shrinkage of the powder
- For a technical preview not all features and functionalities have to work in all combinations without any problems





- Binder jetting requires an additional license feature
- The GUI is cleaned up for binder jetting to show just the needed commands and tools
- As the first and mandatory stage, the sintering stage is always present
- The sintering stage requires the thermal cycle as input as well as an initial relative density and the direction of the gravity vector





#### • Binder jetting does not require a voxel mesh

- The process is based on a tet or hex mesh whereas the tet mesh can be created using the Simufact Additive tet mesher
- Hex meshes as well as tet meshes can be imported when an external mesher was already used to create a finite element mesh





- Due to large shrinkage an iterative distortion compensation is required to print a larger geometry which has ideal dimensions after shrinkage
- The distortion compensation can be activated and defined identical to powder bed fusion processes







- Three additional result variables are added for post processing of binder jetting models
- These post values are:
  - Relative density
  - Grain size
  - Sinter stress
- The new post values can be used to have a deeper look into the sintering process







- All needed material data can be entered using Simufact Material
- A new page is added which contains the sintering material data
- The 316L powder data was extended and will be shipped with sintering data

Menu	Sintering							
General properties	Parameter	Туре	— C	Constant values		Tables		
Chemical composition	Surface energy	Constant \	~ 2	2.0	J/m² 🗸	Create table		
Powder characterization								
Thermal properties	Grain size		0	0.005	mm 🗸			
Mechanical properties	Grain size constant		e	5.65e-13	- ~			
Flow curves								
Anisotropy	Activation energy high temperature		2	21000.0	J/mol 🖂			
Damage								
Electromagnetic properties	Activation energy low temperature		3	315800.0	J/mol 🗸			
Nicrostructure	Pre-exponential constant		6	7.9e+8	Pa*s V			
Diffusion					14.5			
Creen	Activation energy viscous flow		2	20000.0	J/mol 🖂			
	Brief description (hold Ctrl key to lock)	) ———						
								C
							ок с	ancel





- The calibration is important to get the most accurate results for the build simulation
- The calibration workflow for mechanical simulations in Simufact Additive was improved to simplify the process setup
- The new default calibration for mechanical processes is defined as uniform orthotropic inherent strains using two cantilevers





- Depending on the strain distribution and strain type, all needed cantilevers will be created automatically by using the "Update cantilevers" button in the build dialog
- Cutting stages and measuring points will be adapted as well



HEXAGON

♥simufact

- The cantilevers will automatically be positioned in a way that the volume fraction is 100%
- No need for user interaction to position the cantilevers correctly









- Replaced icons in main widget
- More modern and cleaner look and feel



- Increased voxel mesher performance by up to factor of 13
- Performance improvement depends on model size, number of supports etc.
- Example shown on right side:
  - Voxel size: 0.5 mm
  - Meshing time V2020: 460s
  - Meshing time V2020 FP1: 35s
- Also improved error handling during voxel meshing





- More control for adaptive voxel meshing for base plate
- Elements can be kept coarse at the edges which reduces the element count and thus the simulation time









- Adaptive voxel mesh can be shown as a preview in the meshing dialog
- Allows to check the resulting mesh used in the simulation





- Number of layers for base plate voxel mesh cannot be smaller than two
- Allows to capture the bending behavior correctly with a minimum amount of elements





- Fast mode for mechanical manufacturing simulation saves up to 40% simulation time
- Can be used to get a fast distortion tendency
- Stresses can not be evaluated





- Configurable orientation assistant
- Criteria can be added or removed
- · Default set of criteria can be saved

	C					
Properties						
Resolution:		Middle			•	
Distance to base	e plate:	5.0		mm	•	
Criteria						
Name	Weight	Selected value				
Support area	1	l .	0.0	mm² /	4	Support area
Support volume	1		0.0	mm³ ▼	Ý	Support volume
Build costs	1 🖨		0.0	ś ▼	4	Build costs
Projected area	1		0.0	mm² 🔻		Build risk
rojectea area	-	•	0.0		<b>~</b>	Projected area
				Calulati		Local minima
Auto orientation						Design height
Auto select l	oest orien	tation			9	Set default
			ОК	Cance	el	



- Parameter configuration for each criterion can be done directly
- Clean and easy usage for each criterion and their parameters

	0	rientation assistar	ıt	<b>()</b>			
Properties							
Resolution:		Middle					
Distance to base	plate:	5.0		mm 🔻			
Criteria							
Name	Weight	Selected value		1			
Support area	1		0.0	mm² 🔻 🔯			
Support volume	1		0.0	mm³ 💌 🔯			
Projected area	1		0.0	mm² 🔽			
				Calculate			
Auto orientation							
Auto select best orientation							
			ОК	Cancel			







- Build risk analysis allows to identify the build risk of layers based on geometry and orientation
- The higher the area change from layer to layer the higher is the risk of issues during build process
- Such risks can be recoater contact, shrink lines etc.

![](_page_31_Picture_6.jpeg)

![](_page_32_Picture_1.jpeg)

![](_page_32_Figure_2.jpeg)

- Visual feedback by highlighting the selected geometry in the view
- Geometries also highlighted if hidden behind other geometry
- Geometries can be highlighted by clicking with the left mouse button in the view

![](_page_32_Picture_6.jpeg)

- Add advanced geometry modification options
- Allows faster and easier process setup

![](_page_33_Figure_3.jpeg)

![](_page_33_Picture_4.jpeg)

![](_page_34_Picture_1.jpeg)

Automatic

![](_page_34_Picture_3.jpeg)

Manual

- Multiple copies allow to set up an array of parts easy and fast
- Automatic mode uses base plate dimension to position each part
- Manual mode allows to enter the distance between two parts
- · Supports will automatically be copied

![](_page_35_Picture_1.jpeg)

- Mirror a part using the global coordinate planes
- Part can also be mirrored using user-defined planes by picking a facet on a geometry
- Supports will not be mirrored automatically

![](_page_35_Picture_5.jpeg)

![](_page_36_Picture_1.jpeg)

- Scaling can be used to reduce or enlarge the dimensions of a part
- Supports will not automatically be scaled

![](_page_36_Picture_4.jpeg)

- Easier and faster positioning by just picking a facet on the part
- Part is automatically rotated so that the normal vector of the facet shows in the same direction as the reference axis
- All geometries in the positioning view can be selected using the shortcut Ctrl+A

![](_page_37_Picture_4.jpeg)

![](_page_37_Picture_5.jpeg)

- Improved workflow for import of multiple parts
- Edit part name during import
- Use unit for all geometries during import
- Skip parts, import parts separately, import all parts with the same settings

S+ Geometry import - part			×
Import part			
🙀 Filename: 9.stl			
Geometry name: 9			
Build space			
Dimensions x: 500.0	<b>y:</b> 500.0	<b>z:</b> 250.0	mm 🔻
Geometry options			
Bounding box min. coordinates x:	0.066003	<b>y:</b> 0.095539	z: 0.01
Bounding box max. coordinates x:	0.183796	<b>y:</b> 0.173775	<b>z:</b> 0.041711
Dimensions x:		<b>y:</b> 0.078236	<b>z:</b> 0.031711
Unit:	Meter	Use unit for all impo	rted geometries
Positioning of geometries	nport		
Distance to left:		<b>?</b>	
Distance to front:		<i></i>	
Distance to bottom:			ALC: N
Brief description (hold Ctrl key to loc	k)		
			•
	α [ ]	Apply & Next Ski	p Cartel

![](_page_38_Picture_6.jpeg)

- Single shot distortion compensation performs only a single iteration
- Faster results of distortion compensation but not as accurate as when performing the iterative procedure

S+ Distortion compensation - Properties	$\times$
Distortion compensation Part Acceptable distortion Reference Part-Bearing Bracket 0.01 mm Tinitial shape T	
Maximum steps: Support generation Support group Number of supports Support origin No part selected Percents	
Results Export Results settings Save results for: All variants  Brief description (hold Ctrl key to lock)	
OK Canc	<ul> <li>Image: Constraint of the second sec</li></ul>

![](_page_39_Picture_4.jpeg)

- Allow to select the result saving strategy for distortion compensation
- Save only for the best variant
- Save for all variants
- Save for a specific number of best variants

S+ Distortion compensation - Properties			×
Distortion compensation			
Part Accepta	ble distortion	Reference	<b>X</b> .
Part-Bearing Bracket 0.01	mm 💌	Initial shape 🚬	
			<b>&gt;</b>
Maximum steps: 10 🚔 📃 Single shot			
Support generation			
Support group Number of supports Supp	ort origin		
No part selected			
Results Exercise			
Result settings			
Best variant All variant			
Brief description (hold Ctrl key to lock)			
			۲
			•
	Ok	Canc	el

![](_page_40_Picture_6.jpeg)

- Advanced thermal parameters for thermal build, post build, heat treatment and HIP stages
- Allows to cover the conditions in the build machine more accurately

S+ Heat treatment - Propert	ies						×
Menu Leat treatment	Database Name: 🔀 ThermalData		-	🜟 Library: 🕂		Comment	
HT parameters	HT parameters Part/Support				_		
	Emissivity:	Constant 🔻	0.6	] -	•		
	Heat transfer coefficient:	Table 🔻	Edit table				
	Base plate						
	Emissivity:	Table	Edit table	_			
	near dansier coefficient.	Table					
							Add timestamp
	Brief description (hold Ctrl ke	y to lock) —					
							OK Cancel

![](_page_41_Picture_4.jpeg)

- Improved calculation of exposure energy fraction automatic mode based on material data
- More accurate value calculation

Database				Comment	
Name: 🧏 BuildParameters		🖌 📩 Library:	┣ 陆	Add a comment.	
Parameters of single laser					
Power: 200.0 W 🔻	Speed: 1000.	0 mm/s	▼		
Efficiency: 25.0 %	Beam width: 0.1	mm	-		
Layer parameters					
Layer thickness: 0.03		mm 🔻			
Recoater time: 10.0		s 🔻			
Scan rate: Estimated 💌 2.1e-9		m³/s ▼ Est	timation		
Heat flux parameters					
Exposure time:			ms 🔻		
Exposure energy fraction: Automatic 💌	18.6477		% ▼		
Volumetric expansion factor, 1500 opic	0.0		- 🔻		
Predicted properties					
Estimated total build time: 12.2176	h 🔻				
Estimated build rate: 1.43586e-9	m³/s ▼				
Energy density: 2.38095e+10	J/m³ ▼				
Miscellaneous					
Gravity					Add times
Brief description (hold Ctrl key to lock)					

![](_page_42_Picture_4.jpeg)

New and more suitable default value for automatic exposure time

Database						Comment	
Name: 💥 BuildParameters			- \star	Library: 🗧	- 🖪	Add a comment.	
Parameters of single laser —							
Power: 200.0	W 🔻	Speed:	1000.0	mm/s	▼		
Efficiency: 25.0	% 🔻	Beam width:	0.1	mm	-		
Layer parameters							
Layer thickness: 0.03			mr	n 💌			
Recoater time: 10.0			S	•			
Scan rate: Estimated	▼ 2.1e-9		m³/s	▼ Esti	mation		
Heat Arm							
Exposure time:	Automatic 💌	0.1			ms 🔻		
Exposure energy macaon	-	10.6477			% 🔻		
Volumetric expansion factor:	Isotropic 🔻	0.6			- 🔻		
Predicted properties							
Estimated total build time: 12		h 🔻					
Estimated build rate: 1.	.43586e-9	m³/s ▼					
Energy density: 2.		J/m³ ▼					
Miscellaneous							
Gravity							Add timestam
Brief description (hold Ctrl key	to lock)						
							OK Cancel

![](_page_43_Picture_3.jpeg)

#### Easier machine definition

- Machine origin can be defined manually
- Previously machine origin was defined at lower left corner of the build space
- Now center of the build space can also be selected
- Base plate is always positioned in the center of the machine

	S+ Machine - Properties	×
	Database Comment	
	Name: 💿 Machine 🔽 🜟 Library: 🕂 🔚 🛛 Add a description for this machine.	
	General properties	
	Manufacturer: simufact engineering gmbh	
	Machine type: Generic	
	Image: Edit / show	
	But space Hixations	
1	Machine coordinate system	
	Origin: Lower left ▼	
	Build spa Center	
	X: 250.0 Y: 250.0 Z: 250.0 mm 💌	
	Base plate	
	Shape: Rounded corners 🔻 Corner radius: 24.0 mm 💌	
	Add timestar	np
	Brief description (hold Ctrl key to lock)	_
		9
		Ð
		D
	OK Cancel	

![](_page_44_Picture_7.jpeg)

- Surface deviation can be visualized during result transformation
- More precise positioning possible by using result transformation methods
- Best fit method can be used for result transformation
- Result transformation can be edited

![](_page_45_Picture_5.jpeg)

Origin

Show me

Origin

Preview

Y-axis p... 0.0

0.0

A

mm 🔻

Cancel

1000.0

Ok

![](_page_45_Picture_6.jpeg)

	Clipping plane properties	*
Plane	Position	+
🗹 Plane		
		×
✓ Advanced		
Position: 40.8673	% 🔻 🔤 Absolute position	
Rotation		
Theta:	•	-
Phi: •	•	
Center: 162.385	/ 156.42 / 23.3337 mm ▼	
LF 0	ete.	

![](_page_46_Picture_2.jpeg)

- Clipping dialog re-designed for more usability
- Interactive mode for free definition of clipping plane

![](_page_46_Picture_5.jpeg)

![](_page_47_Picture_1.jpeg)

- Display settings for all query points can be changed in the context menu on the query point
- Query points can be synchronized between views so that different processes use the same query point location

![](_page_47_Picture_4.jpeg)

![](_page_47_Picture_5.jpeg)

- Check volume and mass of geometries
- Mass can only be evaluated if a material is defined

s+

Part

Part-Bearing Bracket - P	roperties						×
u properties metry information	Geometry info Selection Imported file:						
	Dimension – x: 66.0026 y: 95.5393 z: 10		183.796 173.775 41.711	mm * mm *			
	Geometry —	31688 15450.3	d from CAD file.	mm² 🔻			
$\langle$	Physical prop Volume: Mass:	27506.7 0.122049		mm³ ▼	>		
	Brief descriptio	n (hold Ctrl key	r to lock)				•
						ок	Cancel

![](_page_48_Picture_4.jpeg)

Base plate properties now contain geometry information

Base plate - Properties				×
u e plate proputies metry information	Geometry inform	Base plate 💌 Geometry not imported fro	om file	
	x: 0 y: 0 z: -30	- 250 - 250 - 0	mm ▼ mm ▼	
	Geometry — ∑ Facets: ∑ Surface: ♀ Geometry	6300 152751.0 y not imported from CAD fil	mm² ▼ e.	
	Physical proper Volume: Mass:	ties 1.85989e+6 Material not yet defined	mm <sup>3</sup> 💌	
	Brief description	(hold Ctrl key to lock) —		•
				OK Cancel

s+

Mer Bas

![](_page_49_Picture_3.jpeg)

![](_page_50_Picture_1.jpeg)

 "Group by object type" is active per default to minimize the amount of information shown in the GUI

![](_page_50_Picture_3.jpeg)

![](_page_51_Picture_1.jpeg)

- Gravity vector can be defined for each stage separately using view interaction
- More flexible model definition

![](_page_51_Picture_4.jpeg)

![](_page_51_Picture_5.jpeg)

![](_page_52_Picture_1.jpeg)

- Issues during CAD export can be visualized on the CAD files directly
- More feedback and support to fix issues during CAD export

![](_page_52_Picture_4.jpeg)

![](_page_52_Picture_5.jpeg)

- Base plate can be meshed with tetrahedrals and exported using UNV export
- Improves interoperability with 3<sup>rd</sup> party software

![](_page_53_Picture_3.jpeg)

![](_page_53_Picture_4.jpeg)

- Added coarsening factor to advanced volume mesh control
- Allows to reduce the number of elements for volume mesh used for UNV export

![](_page_54_Picture_3.jpeg)

![](_page_54_Picture_4.jpeg)

Underscore is now supported in project name

S+ Create new project			
Project — Please en	ter the name of the project and choose a folder where the project shall be created.		
Name: P	Project_1	$\checkmark$	
Folder: [C	<u>C:\</u>		
Brief descr	iption (hold Ctrl key to lock)		
Name The name underse The proje	e of the project. The name may contain 1-40 of the following characters: <b>A-Z, a-z, 0-9</b> , an <b>core</b> , and a <b>hyphen</b> and should not start with an underscore or a hyphen. ect name will be used to create the project information file (*.amproj) and a subfolder where the co	mplete 💌	
	ОК	Cancel	

![](_page_55_Picture_3.jpeg)

![](_page_56_Picture_1.jpeg)

![](_page_56_Picture_2.jpeg)

![](_page_56_Picture_3.jpeg)

- Add further material parameters to user-defined result values
- · Allows more flexible result values
- Added:
  - Ultimate strain
  - Yield strength
  - Tensile strength

	MatSolidusTemp	Solidus temperature
-	MatSnFraction	Material tin fraction
	MatSiFraction	Material silicon fraction
	MatSeFraction	Material selenium fraction
-	MatSbFraction	Material antimony fraction
	MatSFraction	Material sulfur fraction
	MatPdFraction	Material palladium fraction
o user-defined	•	

🔆 Input value selection

![](_page_57_Picture_8.jpeg)

OK

Cancel

×

- Update Materialise API
- Update Adams SDK to latest version
- Update CT component to CT2019SP3
- Update the 3DReshaper SDK
- Update product icons and splash screens to Hexagon standard
- Update Trumpf machines
- Add Additive Industries machine and base plate
- Update Marc documentation
- Improve GUI performance for very large models
- Improve calculation speed for result value limits that are calculated on the fly
- Improve and harmonize geometry export and result export dialogs
- Reduce recycle due to "body to body" and "contact separation" during build load case
- Make the option "Restore imported mesh" available only if the surface mesh has been changed
- Lock domain decomposition method if adaptive meshing is used
- Add progressbar while deleting results in the result manager

- · Improve default names of video files
- Improve error message for densification curve dialog page
- Set relative density to 99% if sample point is added
- Add a visualization of the z-axis when fitting the normal direction of the current view
- Remove "Comment" area from tab order
- Unify message boxes where the deletion of a voxel mesh is asked
- Increase waiting time for license status "waiting for license" to 72 hours
- Max. creep strain rate parameter provided in the creep material data must be removed

![](_page_59_Picture_9.jpeg)

## Thank you

![](_page_60_Picture_1.jpeg)