First time right print of a swirler component

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In Laser Powder Bed Fusion (LPBF) of metal components, the additive layer-by-layer build-up process may incur component distortions due to the complex thermo-mechanical processes induced by the laser welding. The distortions can lead to out-of-tolerance geometric deviations and shrink lines in the component. This constitutes a considerable challenge in printing components first time right. Simcenter 3D Additive Manufacturing helps the user to identify these critical regions in a fully integrated Siemens Additive Manufacturing end-to-end workflow.

The computational set up and workflow of the LPBF process simulation are described using the example of the swirler component. Particular emphasis will be placed on the distortion prediction and the distortion compensation to achieve first time right printing of the swirler. The distortion compensation is carried out by inverting the distortion prediction and applying the inversion to the nominal target geometry.

The LPBF process simulation consists of the following steps.

1. Support generation and transfer to CAD-modelled supports for the computational meshing.
2. Meshing the component and supports. The supports will be meshed as solid components using material homogenization to account for anisotropies. The components will be meshed with boundary-fitted meshes to consider geometric details correctly.
3. Thermo-mechanical simulation of the build setup. The thermal history will be provided as well as the layer-by-layer distortion profile.
4. The distortion prediction will be used for compensation and pre-distortion of the component. The new geometry is available as BREP geometry. The supports will be re-attached. The updated build setup may be send to the printer directly or used for a second or third iteration of the LPBF process simulation to refine the quantitative compensation.