ON THE CREATION OF A NEW FINITE ELEMENT SIMULATION ENVIRONMENT FOR ADDITIVE MANUFACTURING

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ABSTRACT

This presentation provides an overview of the capabilities developed in a new commercial software, to offer a practical, industrial solution for predicting distortion, residual stress, microstructure and mechanical properties. The first release of this new software is focused on metals, while support for plastics will follow in a subsequent release.

Finite Element simulation of the additive manufacturing process requires special considerations for modelling, solving and results reviewing. For each of these stages, the challenges will be reviewed and solution approaches provided. Correlation of results to actual parts will be presented.

The modelling of the Finite Element simulation starts by connecting to a CAD file that contains the part to be produced. From the CAD geometry, a finite element mesh will be created. The finite element mesh is based on a voxel approach, to capture very intricate details

efficiently and quickly. Because of the high level of detail required, many millions of elements are used.

The influencing parameters to be defined as model inputs include the manufacturing method (powder bed, wire, laser, arc, etc.), energy input, speed, material deposition & melting rate, welding paths, material properties and supports.

Several solution approaches are available, based on the desired results. A macroscopic approach with the inherent strain method is used for fast simulations to predict overall distortion and residual stresses. To do a detailed study at the microscopic level, a full transient simulation with moving heat sources and metallurgical modelling is used. All the simulation methods are seamlessly integrated in the same environment, and can be used interchangeably.