Technische Universität Braunschweig

MUSEN

The Finite Cell Method for Simulations in Metal Additive Manufacturing

Lecture of

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Webex Meeting

https://bit.ly/2MZh5sQ
Zugriffscode: 137 648 9880
Passwort: e2vSQH3vJk2

The simulation of Additive Manufacturing processes and products for parts with complex geometries is an involving task. The challenges not only lie in the complex multi-physics that require local mesh refinements and bridging of different temporal scales but also in the generation of volumetric meshes, when boundary conforming finite element methods are employed.

Immersed finite element methods such as the Finite Cell Method [1] provide an efficient and flexible means of handling AM computations involving parts with complex geometries. These methods usually utilize a simple Cartesian mesh that embeds the artifact in a non-boundary conforming manner. The original geometry is then recovered through specialized integration techniques which are easy to automatize and do not result in additional unknowns. The scheme is combined with an *hp*-refinement scheme [2] for the simulation of laser powder bed fusion (LPBF). It will first be demonstrated how the FCM may be used to derive part properties of AM *products* based on CT scans.

Next, the *process* of LPBF will be investigated. Therein, a fundamental phenomena is melting and solidification. Thus, a special focus is placed on the verification and validation of those phenomena and the validity range of the model to compute the size of a melt pool of a single stroke will be presented [5]. After a quick validation of a thermo-mechanical coupling procedure, the FCM will be used for layer-wise simulations as an extension of the pragmatic approach [3]. It will be demonstrated how the growth of the computational domain can be modeled naturally within the FCM resulting in an algorithm similar to the EBM (Element-Birth Method) [4].

We will conclude that, although promising results are already available [6], the quest for bridging the vast scales involved in the computational analysis of the LPBF processes is far from over.