Development of a Simulation-Based Process Chain - Strategy for Different Levels of Detail for the Preprocessing Definitions

Toni A. Krol[1], Sebastian Westhäuser[1], Johannes Schilp[1]

[1]iwb Anwenderzentrum, Technische Universität München, Beim Glaspalast 5, 86153 Augsburg

Additive manufacturing processes fulfill the actual market demands with regard to a high individuality and complexity of products. Hence, these processes are used nowadays in different branches (e. g. aerospace, automotive, medical industry). Furthermore, a high process stability and reproducibility is requested by the user for an economic usage of this technology. Up to now, these targets are reached by numerous test rigs on the manufacturing system which causes high resource consumption.
For increasing the efficiency of metal-based additive manufacturing (AM), the employees of the iwb application center Augsburg in corporation with the CADFEM GmbH and four further partners develops a simulation-based process chain (founded by the Bavarian Research Foundation). Before the production process is started, an analysis of the structural part behavior as well as a process optimization should be performed using the finite element analysis (FEA). Due to the complexity of the thermally activated process it is necessary to select the appropriate FE-modeling strategy for enhancing the target figures calculation efficiency and accuracy. Hence, in this work a strategy will be presented, which can map different levels of detail for the preprocessing definitions. These local and global descriptions can be realized by using suitable contact definitions (contact elements) to link different element meshes. Additionally, the user can select different layers of the part geometry, which should be analyzed in detail within the simulation. Hence, also layer-specific distortions and residual stresses can be calculated while saving calculation time. Furthermore, with this approach the process history and therefore the whole part geometry can be considered in the structural calculations. A validation of the transient temperature field and the mechanical part properties is presented by the comparison with measured values.