An end to end platform for the industrialization of additive manufacturing

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Abstract. In the field of AM, and specifically metal Powder bed fusion, which is the subject of this presentation, a lot of progress has been made. Today, for example, AM allows us to have affordable low volume production, and new design methods allow for optimal designs that were not manufacturable before. But in order to make the next step and go to zero inventory or individualization of products, it is the view of Siemens that a more integrated and automated software process chain is needed. In general, todays' software chain, is too fragmented and does not allow updates in the design to move quickly through the entire production chain. In this presentation we will show our End-to-end platform applied to a combustion chamber from a Siemens Energy gas turbine. In this example we move from virtual product to virtual production to production planning to physical production, while the entire chain is integrated and managed in one unique environment. One of the main functionalities needed for AM is the ability to design for AM, which means CAD functionalities, topology optimization and the ability to integrate lattice structures. The designed part is then connected to production preparation and process simulation in an associative way, i.e. an update made to the design, at a later stage, will propagate through the chain automatically. One special point of focus is the possibility to remove support structures in an automated way, in order to fully automate the chain and to be able to scale up production to cost and quality. In the second part of the presentation we focus on process simulation, because in order to reach first time right printing, we need to predict problems like re-coater collision and part distortion. If these problems cannot be predicted accurately, they will have to be solved on the printer by printing the parts, and thus impeding industrialization of quick design updates. For the distortion analysis we use an enhanced inherent strain method using a full thermo-mechanical analysis. We initially focus on the thermal analysis, in order to tackle local overheating. Local overheating is closely linked to re-coater collision, together with global distortion. The quality of the global distortion is also important of itself, because it allows us to pre-distort the part before printing and obtain a geometry close to nominal geometry after printing.

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