Congreso de Métodos Numéricos en Ingeniería (CMN2021)
28-30 de junio de 2021, Las Palmas de Gran Canaria, España

MODELING OF METAL ADDITIVE MANUFACTURING PROCESSES

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Key words: Additive manufacturing, metals, process parameters, simulation..
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ABSTRACT

Additive Manufacturing (AM) of metals aims at the production of high-performance functional parts with mechanical properties comparable to processes such as casting, milling or forging. As compared to these classical processes, however, AM offers highest production flexibility and almost unlimited freedom of design, which enables the generation of highly complex geometries or substructures (e.g. lattice-based, honeycomb-like, biomimitec designs) that cannot be obtained by conventional manufacturing processes. However, a sub-optimal choice of process parameters often leads to high residual stresses, dimensional warping, porosity, undesirable microstructures or even catastrophic failure of the part during the production process. The complexity of these processes prohibits identification of optimal process parameters via trial and error, resulting in the inevitable need for predictive process simulation.

The purpose of this Thematic Session is to provide a forum for discussion in the modeling and simulation community as applied to AM of metals. Contributions on the modeling of any relevant process (e.g. selective laser melting / sintering, electron beam melting, directed energy deposition, binder jetting, material droplet printing) are welcome. Topics of interest include, but are not limited to:

- Part-scale process modeling to predict residual stresses / strains, part distortion etc.
- Mesoscale modeling of melt pool fluid dynamics to predict surface topology, porosity etc.
- Microscale modeling to predict the evolution of the metallurgical microstructure
- Multiscale approaches considering several of the relevant time / length scales
- Inverse approaches, e.g. for compensation of part distortion
- Coupled process-part optimization for the design of functionally tailored / lightweight parts
- Modeling of powder feedstock deposition / recoating processes
- Modeling of powder feedstock production processes (e.g. water / gas / plasma atomization)
- Modeling of novel materials and their behaviors (e.g. functionally graded materials, electrical circuits built in-situ)
- Modeling of non-standard processes, enabling 2D and 3D material activation beyond the point-by-point, line-by-line, layer-by-layer