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MULTI-PHYSICS AND MULTI-SCALE MODELLING APPROACHES IN ADDITIVE MANUFACTURING

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ABSTRACT

Additive manufacturing transforms the computer aided virtual design into the physical functioning part through adding layers of material to form the final 3D product. With the vast pool of methodologies, it has paved its way into several industrial applications. Currently the AM industry faces the challenge of predicting the quality of the final product based on the process parameters and foreseeing potential defects. An experimental trial and error approach is clearly extravagantly expensive. Therefore, simulation has been adopted as an effective, inexpensive and reliable tool to address this issue. Over and above that, using simulations and experimental data, we are able to develop digital twins that guide the AM process and determine the optimal process window in real-time. An AM process consists of many sub-processes that each have their own set of physical phenomena and operate at different temporal and spatial scales. Consequently, an AM digital twin is powered by a number of sub-models that represent different physics and scales. This multi-scale multi-physics approach poses a challenge to establish correlations between disparate models. This mini symposia gives the opportunity to bring together the researchers from diverse backgrounds working on different aspects of multi-physics and multi-scale modelling in AM process simulation. Moreover it also provides the platform to present and exchange the ideas in the framework of scale bridging techniques for AM Technology. The following topics are included but are not limited to:

- Model order reduction / Reduced order modelling
- Data-driven and physics-driven surrogate models
- Scale bridging techniques e.g. homogenization, projection, coarse-graining etc.
- Process-structure-property relationship
- Validation, verification and uncertainty quantification (VVUQ)
- Continuum-Discrete Coupling e.g. Lagrangian-Eulerian approaches
- Micro-macro coupling e.g. crystal plasticity and thermo-elastoplastics
- Arbitrary-Lagrangian-Eulerian (ALE) Scheme e.g. part deformation monitoring
- Homogenization of microscale material properties
- Industrial applications