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ADDITIVE MANUFACTURING MODELING USING LAGRANGIAN MODELS

S. ADAMI*, M.W. GEE†, N.A. ADAMS*

* Chair of Aerodynamics and Fluid Mechanics, Technical University of Munich
Boltzmannstr. 15, 85748 Garching
aerodynamik@tum.de, www.mw.tum.de/aer

† Mechanics & High Performance Computing Group, Technical University of Munich
Parkring 35, 85748 Garching
sekretariat@mhpc.mw.tum.de, https://www.mw.tum.de/mhpc

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ABSTRACT

Additive manufacturing (AM) dates back to 1980, when Hideo Kodama presented the first rapid prototyping system using photopolymer material with UV light to build up models layer-wise [1]. Within only four decades of research, development and experience, AM has become a serious alternative manufacturing process as compared to traditional subtractive machining. It's field of application ranges from quick prototyping to single and light-weight high-strength part production using complex alloy material systems.

The resulting quality of 3D printed parts (geometry, surface quality, internal microstructure) is mainly governed by the thermal treatment and resulting melt dynamics (pre-heating, melting, solidification, post-treatment). Therefore, detailed knowledge and control of the melt-pool is the key to successful fabrication. However, access to experimental measurements and visualizations of the production process are obviously limited due to the high-energetic environment and lack of non-invasive probing.

In the past, classical grid-based CFD methods have been applied to AM to investigate the process, see e.g. [2-4]. However, the complex powder structure, melt pool dynamics and phase-change phenomena challenge Eulerian-based approaches mainly for their need of geometric reconstruction. As a remedy, recently Lagrangian methods have gained strong interest in modelling AM processes showing great success so far [5,6].

In this session we want to discuss latest achievements of Lagrangian methods for additive manufacturing simulations. We invite both pure methodological developments (e.g. innovative splitting/merging/creation algorithms for vaporization models) and novel macroscopic process simulations exploiting the unique capabilities of particle dynamics.

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