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MODELLING AND SIMULATION FOR ADDITIVE MANUFACTURING

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ABSTRACT

Additive Manufacturing (AM) has become a key enabling technology for producing complex, high-performance components with controlled precision and tailored functionality. Metal AM processes such as Wire Arc Additive Manufacturing (WAAM), Directed Energy Deposition (DED), and Laser Powder Bed Fusion (LPBF) present unique multi-physics and multi-scale challenges that require advanced modelling and simulation tools for process optimization and part qualification.

The objective of this Thematic Session is to share recent advances in numerical simulation, experimental analysis, and data-driven modelling of AM processes at the component and part scales. The session aims to bring together experts from academia and industry to discuss predictive and efficient computational methods capable of capturing the coupled thermal, mechanical, and metallurgical phenomena inherent to AM.

Topics of interest may include:

- Process simulation and optimization at micro- and macro-scales.
- Novel space discretization and time-integration schemes for accurate and efficient part-scale analysis.
- Reduced-order and data-driven modelling for simulation acceleration.
- Multi-physics and multi-scale approaches for microstructure and defect prediction.
- Material modelling including thermo-mechanical–microstructural coupling.
- Prediction and mitigation of residual stresses, distortion, and warpage.
- Combined simulation and in-situ monitoring for calibration, validation, and qualification.
- Machine learning and feedback-control strategies for process optimization and quality assurance.
- Optimization of process windows and scanning strategies.

The Thematic Session welcomes contributions covering various AM technologies (LPBF, DED, WAAM, etc.) and materials. The session will serve as a forum for discussing the latest research trends and for fostering collaborations aimed at advancing predictive, high-fidelity simulation tools that accelerate the industrial adoption and certification of additive manufacturing technologies.