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PGD MODEL WITH DOMAIN MAPPING OF BEAD-ON-PLATE WELD SIMULATION FOR WIRE ARC ADDITIVE MANUFACTURING

Dominic Strobl[1]*, Annika Robens-Radermacher[1], Chady Ghnatios[2], Andreas Pittner[1], Michael Rethmeier[1] and Jörg F. Unger[1]

[1] Federal Institute for Material Research and Testing
Unter den Eichen 87, 12205 Berlin, Germany
dominic.strobl@bam.de, annika.robens-radermacher@bam.de,
Michael.Rethmeier@bam.de, Andreas.Pittner@bam.de and Joerg.Unger@bam.de,
https://www.bam.de

[2] Notre Dame University-Louaize
Zouk Mosbeh, PO Box 72, Keserwan, Lebanon
cghnatios@ndu.edu.lb, https://www.ndu.edu.lb

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Numerical simulations are essential in predicting the behavior of systems in many engineering fields and industrial sectors. The development of accurate virtual representations of actual physical products or processes allows huge savings in cost and resources. In fact, digital twins would allow reducing the number of real, physical prototypes, tests, and experiments, thus also increasing the sustainability of the production processes and products' lifetime. Standard numerical methods fail in providing real time simulations, especially for complex processes such as additive manufacturing applications.

This work aims to build up a reduced order model for efficient wire arc additive manufacturing simulations by using the proper generalized decomposition (PGD) [1,2] method. Model order reduction is a popular concept to decrease the computational effort, where each evaluation of the reduced forward model is faster than evaluations using classical methods, even for complex models. The simulation of a moving heat source leads to a hardly separable parametric problem, which is solved by a new mapping approach [3]. Using this procedure, it is possible to create a simple separated representation of the forward model.

In this contribution, a PGD model is derived for the first part of wire arc additive manufacturing: bead-on-plate weld. An excellent agreement with a standard finite element method is shown. The reduced model is further used in a model calibration set up, speeding up calibrations and ultimately leading to an optimized real-time simulation.

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