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INDUSTRIAL CHALLENGES FOR AM SIM

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ABSTRACT

It is not uncommon that *industrial* use of simulation lags years behind *academic* development of a new simulation capability. In the field of metal additive manufacturing, however, industrial adoption of certain simulation tools was exceptionally rapid. This rapid adoption provided a market for a considerable number of new software developments and –startups. AM simulation has certain characteristics that make it eminently suited for highly automated simulation workflows (e.g. fully automated finite element meshing by voxel approximation can be sufficient for AM distortion prediction) and many of the new software tools focused on user-friendliness and automation of the simulation workflow. It seems, however, that we have reached the limits of this: highly automated approaches entail the risk of not predicting key AM defects (e.g. buckling) and runtimes are sometimes unacceptably long for industrial use (e.g. microstructure and property prediction for an industrial part).

In this session we raise the following questions to the Sim AM community:

Question from Industry to Sim AM community	Description
Microstructure and property prediction: is it finally time for industrial use?	What are the holes left in the relevant ICME (e.g. grain-size effect on TTT, not in any public literature for Ti 6 4 --> usually ends up fudged?)
	How to conquer the scale & runtime challenge? (e.g. AMbench 2022: beautiful meld pool results, but for tiny volumes of matter only)
Microstructure and property prediction: what can already be done, *industrially*, with the maturity that we have?	What *is* already possible (in spite of the remarks above), on real industrial cases?
Was the thermal problem ever solved, really?	For distortion prediction, the inherent strain method has proven efficient and useful. Various simulation tools propose equally accessible thermal history prediction, but when one looks into the detail, application *at an industrial scale* is still very difficult. On top, we have new multi-laser machines, the influence of gas flow, wire-feed systems

	with the wire being fed from one side. If in the near future we want continuous power adaptation as function of the build geometry, there is a need for a next-gen thermal history prediction!
Digital continuity	The part is not ready after printing, there is a need for validated methods for chaining simulations of printing --> heat-treatment --> trimming --> machining etc. Also, in the near future there will be a need to adapt the power as function of the build geometry, based on thermal simulation results.
Industrial application of anti-distortion of the geometry before printing, and optimisation of support structure in response to simulation predicted residual stress and distortion	We know it can work in experimental iterations, who can make it industrial using simulated iterations?
Is there more to life than powder-bed?	DED and FFF are also very important for industry and they bring their own AM sim challenges, like, scale and optimisation of the order of deposition.
We propose a first set of benchmark problems that test AM sim approaches for *industrial* use	Invited talk by the NAFEMS Focus Group on a first set of benchmark problems that test AM sim approaches for *industrial* use: reliable buckling prediction, correct representation of build join-ups, …