Unified Finite Element Formulation to Improve Understanding of Materials Science

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ABSTRACT

Unified formulation to solve fluid-structure interaction and multi-fluids problems are gaining popularity in many engineering applications, in particular for material forming processes. Indeed, it simplifies different issues related to mesh generation and boundary conditions and increases the flexibility to deal with multiscale problems.

We propose in this work a monolithic formulation where the complete problem is written in a fully Eulerian framework and the phases (fluid, solid,…) are separated by a level set function. The obtained system is solved using stabilized finite element methods. We combine this approximation with time-dependent anisotropic mesh adaptation to ensure accurate capturing of the discontinuities at the interfaces [1].

Different use of the levelset function ranging from, grain growth models for the evolutions of microstructure [2]or void disclosure [3] induced by forming operations, to the heat treatment of immersed metallic-alloys inside three-dimensional industrial furnaces will be presented [1]. The advantages and the encountered numerical issues as well as the ongoing investigations related to these formulations will be discussed.

REFERENCES

[1] E. Hachem, H. Digonnet, E. Massoni, T. Coupez, *Immersed volume method for solving natural convection, conduction and radiation of a hat-shaped disk inside a 3D enclosure*, International Journal of Numerical Methods for Heat & Fluid Flow, Vol. 22 (6), pp.718 - 741, 2012

[2] A. Agnoli, N. Bozzolo, R. Logé, J.-M. Franchet, J. Laigo, M. Bernacki, *Development of a level set methodology to simulate grain growth in the presence of real secondary phase particles and stored energy-Application to a nickel-base superalloy*, Computational Materials Science,89(2014)233-24

[3] E. Roux, M. Bernacki, P.O. Bouchard, *A level-set and anisotropic adaptive remeshing strategy for the modelling of void growth under large plastic strain*, Computational Materials Science 68 (2013) 32-46