

ADVANCES IN PARTICLE FINITE ELEMENT METHOD FOR THE SIMULATION OF PHASE CHANGE PROBLEMS AND FLUID-STRUCTURE INTERACTIONS

JEAN-PHILIPPE PONTHOT^{*}, EDUARDO FERNANDEZ, SIMON FEVRIER,
MARTIN LACROIX, BILLY –JOE BOBACH, LUC PAPELEUX
AND ROMAIN BOMAN

^{*} Liège University, Aerospace and Mechanical Engineering Department
Allée de la découverte 13a, 4000 Liège, Belgium
JP.Ponthot@uliege.be and

ABSTRACT

Particle Finite Element Method (PFEM) is a still rather young method that tries to combine the advantages of classical methods such as FEM and more recent methods known as particle methods (SPH...) The method is quite versatile and can be applied to both solid and fluids material behavior. It is a Lagrangian method that combines computations over one time step using FEM with a fast remeshing algorithm trying to avoid mesh distortions consequent to very large deformations such as the ones encountered for fluid flow with free surfaces.

New developments will be presented here, such as the use of a level set function, instead of the traditional alpha-shape algorithm to determine the new boundaries of a body after remeshing, as well as the implementation of phase-change algorithm, including vaporization. The lecture will cover several applications including the simulation of the fluid behavior in a melt pool during LPBF (laser Powder Bed Fusion) where the initial powder is melted by the laser, and then solidifies again when the laser goes away. During this process, due to the high power density of the laser, some part of the material is not only melted but also vaporized. Other applications of the PFEM will illustrate fluid-structure interactions simulations including contact between different solid parts and plastic deformation of some components of the system.

REFERENCES

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