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AN EXPLICIT ENRICHED FINITE VOLUME SCHEME FOR THE SIMULATION OF DISCONTINUITIES INDUCED BY SPALLATION

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Spallation is a damage and failure process occurring under shock loading. During an impact experiment, a projectile hits a target: shock waves propagate in both materials and then reflect in rarefaction waves on material boundaries. Their interaction implies a brutal tension in the material and triggers damage process, leading to spallation. In this work, we only consider ductile metals. Since the shock loading induces strong compression in materials, their compressible behavior has to be considered through an equation of state.

The waves propagation is calculated by the explicit dynamics Von Neumann & Richtmyer (VNR) scheme [1], based on a Finite Volume (FV) discretization. The damage process leading to spallation is represented by a cohesive zone model. Failure is simulated by a displacement jump inside the material continuum. Hansbo & Hansbo approach [2] has been adapted to the FV method to treat the discontinuity induced by spall opening independently from mesh characteristics. Note that Hansbo & Hansbo approach is in fact equivalent to the Heaviside enrichment of the eXtended Finite Element Method [3] but with a different meaning of degrees of freedom as explained in [4].

The introduction of Hansbo & Hansbo method and cohesive zone model into VNR scheme are presented. Two mass lumping strategies are analyzed regarding the quality of thermodynamical representation around discontinuity and the stability condition of this scheme. Finally, results from simulation are compared with experimental free surfaces velocities.

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