Development of Generalized Interpolation Material Point Method for Fully-Coupled Thermo-mechanics with Applications to Model-Based Simulation of Failure Evolution

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Abstract

To better simulate structural responses to extreme loading conditions, FGIMP, a Fully coupled thermo-mechanical formulation is established within the framework of Generalized Interpolation Material Point (GIMP) method, with applications to model-based simulation of failure evolution. The FGIMP weak formulation is based on the strong coupling between conservation of momentum and conservation of energy, which is different from the weakly coupled GIMP [1]. The FGIMP method considers the effects of both the thermal state on the deformation and the deformation on the thermal state. A staggered solution scheme is designed to solve the coupled temperature-displacement equations. Several representative numerical examples with analytical solutions are presented to demonstrate and verify the proposed FGIMP procedure for coupled thermo-mechanical analyses. The material failure evolution in the landslide of a snowy mountain under an increasing temperature environment is then predicted with the use of a temperature-dependent von-Mises model in combination with a decision model via discontinuous bifurcation analysis. Future tasks will be discussed based on the obtained research findings.

Keywords: generalized interpolation material point method, coupled thermo-mechanics, material failure, landslide

References

[1] Tao, J., Zheng, Y. G., Chen, Z. and Zhang, H. W. (2016) Generalized interpolation material point method for coupled thermo-mechanical processes, *International Journal of Mechanics and Materials in Design* **12**, 577-595.