ADVANCES IN THE PARTICLE FINITE ELEMENT METHOD FOR MULTIDISCIPLINARY PROBLEMS IN COMPUTATIONAL MECHANICS

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ABSTRACT

The Particle Finite Element Method (PFEM) is a general numerical procedure for the analysis of problems in fluid and solid mechanics combining techniques from finite element and particle methods. The key feature of the PFEM is the use of a Lagrangian description to model the motion of the nodes in both the fluid and the solid domains. Surface nodes are viewed as particles which can freely move and separate from the main analysis domain representing, for instance, the effect of water drops or disgregated solid particles. The boundary of the analysis domain is defined at each step using the Alpha Shape method. A mesh connects the node defining the discretized analysis domain where the governing equations are solved using state of the art FEM. The PFEM is particularly suited for multidisciplinary problems in mechanics such as fluid-structure interaction situations accounting for large motions of the free surface and splashing of waves, heterogeneous fluid mixtures and non linear problems in solids accounting for large deformations with multiple frictional contacts, material fragmentation and thermal coupled effects.

In the presentation we will show a wide range of examples of application of the PFEM including the study of water streams on structures accounting for erosion of the foundation, the analysis of the failure of earth dams in overtopping scenarios, the stability of harbour structures under large waves, the analysis of mixing processes in fluids, the study of the melting and burning of objects in fire and the simulation of industrial forming processes.

References

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