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Partitioned Coupling Approaches for the Simulation of Natural Hazards Impacting Protective Structures

V. Singer Singer[1], K. Sautter, A. Larese[2], R. Wüchner Wüchner[1], K. Bletzinger

1 K.

2 International Center for Numerical Methods in Engineering (CIMNE), Technical University of Catalonia (UPC), Edificio C1, Campus Norte, c. Gran Capitán, s/n, 08034 Barcelona, Spain

Abstract

In recent years, the intensity and frequency of natural hazards such as landslides, debris flow and avalanches have increased significantly due to climate change and global warming. These catastrophic events are responsible for numerous destructions of infrastructures with high economic losses and, even worse, often claim human lives. Therefore, in addition to the prediction, the design and installation of protective structures are of tremendous importance. Due to its hybrid approach of an Eulerian background grid in combination with Lagrangian moving material points, the Material Point Method (MPM) is particularly suited to capture the flow process of those mass movement hazards. For the numerical simulation of protective structures, however, other numerical methods are often preferable. Considering highly flexible structures, which are often utilized due to their high energy absorption capacity classical Finite Element Method (FEM) is best suited to model cable, beam, and membrane elements, while a retaining wall consisting of a few discrete blocks may be preferable modeled by Discrete Element Method (DEM). Therefore, we are proposing partitioned coupling approaches to combine the advantages of different numerical methods so that the protective structures can be appropriately designed to withstand the impact of those mass movement hazards.

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