Abstract

This project focuses on particle methods, specifically on the Material Point Method (MPM). MPM is an hybrid mixed Lagrangian-Eulerian method which uses moving Lagrangian material points that store physical properties of a deforming continuum and a fixed Eulerian finite element mesh to solve the equations of motion at each time steps. It has been shown that this method is useful for the simulation of mechanical problems involving large deformations on history-dependent materials.

MPM can be seen as a Lagrangian finite element method with moving integration points (the material points). The main advantages of the Material Point Method, motivates to realize its validation and its application to problems where different materials are in contact and large deformations are involved. Therefore, this thesis focus on the analysis of the MPM methodology, of strengths and weaknesses. To do that, a series of simulations of standardized tests on concrete samples have been carried out. Their experimental behaviour is known and they are easily comparable with the traditional finite elements methods, FEM. Moreover, a preliminary application for the study of the behaviour of the method for the the specific case of the failure of the core of a rockfill dam in extreme conditions.

The study of the method in large deformations regime is done by observing how the push rockfill shoulder and the water affects the dam's core once and it is not protected anymore by the rockfill protection. In this regard, it should be noted that only preliminary analyzes have been carried out so to see the basis of the future research.

Further research is needed to simulate large geotechnical problems such as dam's simulations. For instance, contact algorithm must be implemented to solve stress transmission and friction problems between surfaces when different materials are involved.