8th. World Congress on Computational Mechanics (WCCM8)
5th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 –July 5, 2008
Venice, Italy

COUPLED DISCRETE/FINITE ELEMENT MODELLING OF GEOTECHNICAL PROBLEMS

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Key Words: *Geomechanics, Coupled problems, Discrete element method, Finite element method.*

ABSTRACT

The paper will present a coupled discrete/finite element technique to model geotechnical problems. Coupling different methods in one model allows us to take advantages of each method. The discrete element method (DEM) is a suitable method to take into account all kinds of discontinuities and material failure characterized with fracture, while the FEM is usually a method of choice in dealing with problems involving linear and nonlinear continuous material behaviour in domains of finite dimensions.

Combination of discrete and finite element methods can be achieved in different ways. The unified discrete/finite element formulation presented in [1, 2] enabled simultaneous use of the discrete element and finite element methods in disjoint parts of the model interacting with each other by means of contact forces. The present paper will present extension of the combined discrete/finite element formulation developed in [3] allowing us to use the two coupled methods in different subdomains of the same body.

Use of the discrete and finite element methods in different subdomains of the same body requires a special coupling between the DEM and FEM subdomains. The coupling is provided by additional kinematical constraints imposed by the Lagrange multiplier or penalty method. The interface between the FEM and DEM subdomains can introduce an artificial internal boundary causing unrealistic wave reflections. Correct performance of the coupling method in the presence of wave propagation has been demonstrated in different numerical benchmarks.

The finite element model considers problems with small compressibility. Such problems require special FEM formulations to eliminate the volumetric locking and pressure instability. In this work the CBS approach was used [4].

The combined DEM/FEM modelling has been applied to simulation of undeground excavation. Process of rock cutting with roadheader picks has been studied (Fig. 1). Discrete elements are used only in a portion of the analysed domain where material fracture occurs. Outside the DEM subdomain finite elements are used which is a more efficient approach for a continuum material. Coupled DEM/FEM

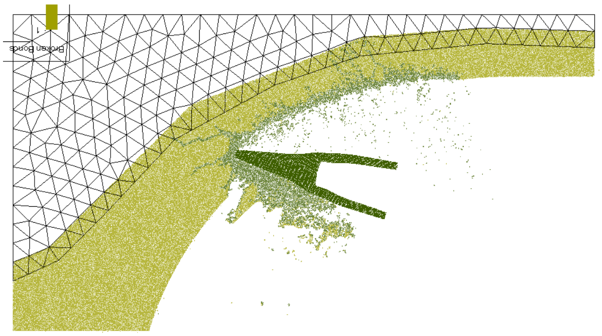

Figure 1: Hybrid DEM/FEM model

model proved its numerical efficiency and physical accuracy. It allowed us to obtain important practical results like forces occurring during rock cutting.

The work has been sponsored by the EU project TUNCONSTRUCT (contract no. IP 011817-2)

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