Master Thesis

Topic:

Numerical implementation of a 3D UEL for dynamic coupled hydro-mechanical problems

Description:

Soil is a material that usually consist out of three components: soil particles, fluid components (usually water) and gas components (usually air). In order to describe the behaviour of the soil as a multiphase system one has to take into consideration the physical interaction between the three components. First quantification of these interactions was done by Terzaghi for the fully saturated soil (no gas component) under quasi-statical conditions and is known as the Consolidation problem. A further development of the consolidation problem was done by [Biot 1956] where also the dynamic component was introduced. An analytical solution of these cases is just for simple cases posible e.g. for linear elastic behaviour of the soil skeleton. However, soils are highly non-linear materials and a solution in these cases is possible just numerical. [Zienkiewicz 1982] was the first to solve the dynamic consolidation problem of Biot by means of finite element methods and the solution procedure is known nowadays as the u-p-formulation. In the u-p-formulation the governing equations are solved based on the node displacements and node porewater pressure and assumes no relative acceleration between soil and water. Although the interes in simulating dynamic coupled problems in the last years rised, the most used FEM-Softwares (e.g. Abaqus) do not include this formulation in their element library so that one has to implement it via user element subroutine UEL.

Scope of work:

Scope of this master thesis is the extension of an existing UEL developed in Abaqus for 2D plane strain and axisymmetric conditions to a 3D case and to validate it using analytical solutions and benchmark problems.

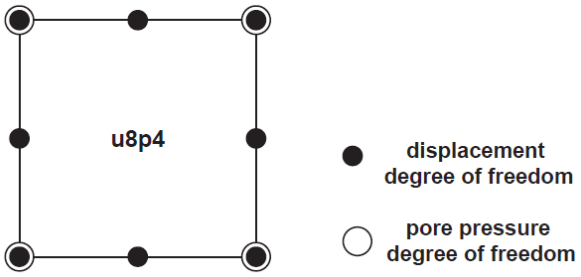

Fig 1: Implemented UEL

Special requirements and comments:

Interest in computational geomechanics, good finite element method knowledge and experience with FEM-simulations, preferably with Abaqus.

Supervisor:

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