Homework
Computational geomechanics - Civil 423

November 6, 2023

Deliverables The deliverables of the homework is a poster and the python scripts/notebooks used for your calculations (which we will re-run). The whole must be delivered as a zip file containing all the matlab codes necessary to run the script. We will hold a poster-session on December 18 at 4:15pm in GC B1 10.

The poster must have the following structure

1. Summary
2. Problem description and method of solution
3. Results and discussion

In all case, I encourage you to present your results in a dimensionless form - i.e. scaling appropriately the problem (by a proper characteristic lengthscale, pressure/stress scale, displacement scale and timescale).

1 Pressurization of a fracture in a poroelastic medium (impermeable walls vs permeable walls)

In this homework, we will model the case of a fracture (of fixed length - i.e. not propagating) at depth pressurized by a fluid. We will not model the wellbore (e.g. we consider it small enough compared to the fracture). The rock will be assumed homogeneous and of infinte extent. We focus on a plane strain configuration, and you will leverage the symmetry of the problem in its numerical solution.

Two sub-problems will be considered:

1. the case where the "walls" of the fracture are impermeable - such that only a mechanical pressure is applied to the fracture walls.
2. the case where the "walls" of the fracture are permeable - such that both a mechanical and a pore pressure are applied to the fracture walls.

In both cases, we will investigate the undrained and then transient response toward the drained/long term response. We will investigate the stress around the fracture (and check with well-known elastic solutions - caution the stress are singular at the tip). We will also pay particular attention to the time evolution of fracture width in both cases, as well as the amount of fluid leak-off in the medium for the second case.