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Finite Strain Poromechanics for Fractured Porous Media

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Fractures and faults in porous materials represent even in the simplest setting a complex modeling challenge. By their nature, the properties of a fracture depend strongly on the transverse extent (aperture), which in itself may strongly depend on the material response of the material.

We recognize that with the mixed-dimensional representation of fracture which has become popular when considering flow in fractured porous media, there is an inherent conflict between the length scale of the aperture (assumed to be geometrically negligible in a mixed-dimensional model), and other small length scales, such as the fundamental continuum assumption of continuum mechanics, as well as the assumption of small deformations in elasticity.

In this work, we elucidate this conflict of length scales, by introducing a mathematical theory of poromechanics built directly upon mixed-dimensional calculus. The resulting mathematical model allows for a clear statement of length scale assumptions, and importantly, is general enough to allow for non-linear poromechanics, in particular with respect to the crucial aspect of contact mechanics and friction in the fracture itself. Well-posedness of the model is also established subject to natural assumptions on the parameters. This talk summarizes results recently announced on arxiv [1].

REFERENCES

[1] Boon, W. M. and J. M. Nordbotten, *Mixed-dimensional poromechanical models of fractured porous media*. https://arxiv.org/abs/2112.05038