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Uniaxial deformation of a soft porous material CHRIS MACMINN, University of Oxford , ERIC DUFRESNE, JOHN WETTLAUFER, Yale University — Compressing a porous material will decrease the volume of pore space, driving fluid out. Similarly, injecting fluid into a porous material will drive mechanical deformation, distorting the solid skeleton. This poromechanical coupling has applications ranging from cell and tissue mechanics to geomechanics and hydrogeology. The classical theory of linear poroelasticity captures this coupling by combining Darcy's law with linear elasticity and then further linearizing in the strain. This is a good model for very small deformations, but it becomes increasingly inappropriate as deformations grow larger, and moderate to large deformations are common in the context of phenomena such as swelling, damage, and extreme softness. Here, we compare the predictions of linear poroelasticity with those of a rigorous large-deformation framework in the context of two uniaxial model problems. We explore the error associated with the linear model in both steady and dynamic situations, as well as the impact of allowing the permeability to vary with the deformation.

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