A Locking-free Numerical Method for Poroelasticity

Son-Young Yi

Department of Mathematical Sciences
The University of Texas at El Paso
El Paso, TX 79912, USA

e-mail: syi@utep.edu

Abstract

Poroelasticity is the modeling of the time-dependent coupling between the deformation of porous materials and the fluid flow inside. Modeling the mechanical behavior of fluid-saturated porous media is of great importance in a wide range of science and engineering fields including reservoir engineering, soil mechanics, environmental engineering, and, more recently, biomechanical engineering. It has been well-known that standard Galerkin finite element methods produce unstable and oscillatory numerical behavior of the fluid pressure, which is known as *locking* in poroelasticity. Overcoming locking effects in poroelasticity has been a subject of extensive research by many researchers.

In this talk, we present a mixed finite element formulation that has been designed to overcome locking effects. The formulation is based on coupling two mixed finite element methods for each of the flow and mechanics problems. A key idea underlying this approach is to use a finite element space for the displacement that contains non-constant divergence-free vectors. We discuss *a priori* error estimates and show some results of numerical simulations. Numerical results illustrate the accuracy of the methods and also show the effectiveness of the methods to overcome the nonphysical pressure oscillations.