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Finite-element discretization of a 3D hyperelastic model of skeletal muscle

Recent studies on whole-muscle biomechanics have shown the importance of mass and inertial effects on muscle function. Because traditional models based on massless springs cannot capture these features, we must turn our attention to continuum-based three-dimensional models. In this talk, we will discuss the discretization process of a dynamical model that views skeletal muscle as a hyperelastic (nonlinear) deformable solid. From a mechanical perspective, this material is quasi-incompressible, transversely isotropic, and can be deformed by the action of active and passive forces. We will go over the different types of approximations (physiological and numerical) that must be considered to make the equations more tractable. The three-field formulation is discretized in space using a standard second-order finite element. In addition, we will discuss the Newton-Krylov strategy used to solve the set of nonlinear equations.