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Mathematical model for isometric and isotonic muscle contractions. (English) Zbl 1381.92005
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Summary: A new mathematical model is presented to describe both the active and passive mechanics of muscles. In order to account for the active response, a two-layer kinematics that introduces both the visible and rest lengths of the muscle is presented within a rational mechanics framework. The formulation is based on an extended version of the principle of virtual power and the dissipation principle. By using an accurate constitutive description of muscle mobility under activation, details of microscopic processes that lead to muscle contraction are glossed over while macroscopic effects of chemical/electrical stimuli on muscle mechanics are retained. The model predictions are tested with isometric and isotonic experimental data collected from murine extensor digitorum muscle. It is shown that the proposed model captures experimental observations with only three scalar parameters.

MSC:

92C10 Biomechanics

Cited in 2 Documents

Keywords:

continuum mechanics; muscle modeling; active strain; isometric contraction; isotonic contraction

Software:

COMSOL

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