Abstract Submitted
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Modeling dynamic finite deformation and stress wave mechanics in the lung JOHN CLAYTON, ROHAN BANTON, US Army Rsch Lab - Aberdeen, ALAN FREED, Texas AM University — A new constitutive model for lung parenchyma, including soft tissue and internal fluid, is developed for dynamic loading protocols and injury assessment. The material is approximated as a homogeneous isotropic, nonlinear viscoelastic solid. Internal energy depends on finite strain, entropy, and internal variables. The equilibrium response in the hyperelastic limit follows from a strain energy functional depending on strain attributes resulting from an upper triangular decomposition of the deformation gradient [1]. Viscosity is addressed via an internal variable formalism that corresponds, in certain cases, to a further multiplicative decomposition of distortion [2]. Stiffness degradation and injury mechanisms (e.g., contusion, edema, atelectasis) are tracked by internal variable(s). The response of a column to high rate compressive loading is calculated. Depending on rate of loading, internal and external pressures, and fluid interactions with the external environment, compressibility of air inside strongly influences the response. Solutions for ramp loading and planar shocks are compared with experiment. [1] A.D. Freed et al., J. Mech. Mater. Struct., vol. 12, pp. 219-247, 2017. [2] J.D. Clayton, Differential Geometry and Kinematics of Continua, World Scientific, 2014.

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