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Morphing Continuum Theory: A First Order Approximation to the Balance Laws[1] LOUIS WONNELL, MOHAMAD IBRAHIM CHEIKH, JAMES CHEN, Kansas State Univ — Morphing Continuum Theory is constructed under the framework of Rational Continuum Mechanics (RCM) for fluid flows with inner structure. This multiscale theory has been successfully emplyed to model turbulent flows. The framework of RCM ensures the mathematical rigor of MCT, but contains new material constants related to the inner structure. The physical meanings of these material constants have yet to be determined. Here, a linear deviation from the zeroth-order Boltzmann-Curtiss distribution function is derived. When applied to the Boltzmann-Curtiss equation, a first-order approximation of the MCT governing equations is obtained. The integral equations are then related to the appropriate material constants found in the heat flux, Cauchy stress, and moment stress terms in the governing equations. These new material properties associated with the inner structure of the fluid are compared with the corresponding integrals, and a clearer physical interpretation of these coefficients emerges. The physical meanings of these material properties is determined by analyzing previous results obtained from numerical simulations of MCT for compressible and incompressible flows. The implications for the physics underlying the MCT governing equations will also be discussed.

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James Chen
Kansas State Univ

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