A simple thermodynamic framework for heat-conducting flows of mixtures of two mechanically interacting fluids

Josef Málek

Charles University, Faculty of Mathematics and Physics

malek@karlin.mff.cuni.cz

Within the theory of interacting continua, we develop a model for a heat conducting mixture of two mechanically interacting fluids described in the terms of the densities and the velocities for each fluid and the temperature field for the whole mixture. We use a general thermodynamic framework that determines the response of the material from the knowledge of two pieces of information, namely how the material stores the energy and how the energy of material is dissipated. This information is expressed in the form of the constitutive equations for two scalars: the Helmholtz free energy and the entropy production. Additionally, we follow the goal to determine the response of a mixture from a small (minimal) set of material parameters (bulk and shear viscosity, heat conductivity, the drag coefficient) that can be associated with the mixture as the whole. The same thermodynamic approach is used to obtain the model when the whole mixture responses as an incompressible material. For both the compressible and incompressible variants, we investigate two variants stemming from different definitions of the velocity associated with the mixture as a whole.