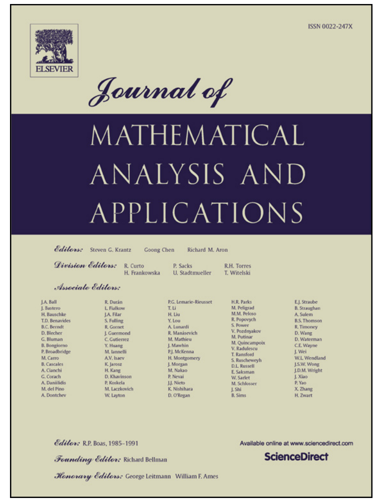

Global solutions for the 1-D compressible micropolar fluid model with zero heat conductivity

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Global solutions for the 1-D compressible micropolar fluid model with zero heat conductivity

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Abstract

We study global solutions for the 1-D compressible micropolar fluid model with zero heat conductivity, which is a hyperbolic-parabolic system. The pressure, velocity and angular velocity are dissipative because of viscosity, whereas the entropy is non-dissipative due to the absence of heat conductivity. Compared with the classical Navier-Stokes equations, there is an extra angular velocity ω in micropolar fluid model which brings both benefit and trouble. The benefit lies in the fact that the term $-v\omega$ is a damping term which provides extra regularity of ω,while the trouble is brought by the term $v\omega^2$ which increase the nonlinearity of the system. The global solutions are obtained by combining the local existence and a priori estimates if H^2- norm of the initial perturbation around a constant state is small enough. The asymptotic behavior is also obtained in this paper.

Keywords: micropolar fluids; global strong solution; zero-heat conductivity.
2000 MSC: 35Q35;, 76D03

1. Introduction

1.1. Formulation in Lagrangian coordinates

The model of micropolar fluids which respond to micro-rotational motions and spin inertia was first introduced by Eringen [1] in 1966. This model is more proper than Navier-Stokes equations to describe the motions of a large variety of complex fluids consisting of diploe elements such as the suspensions, animal blood, liquid crystal, etc. For more physical background, please refer to [2],[3]. In Euler coordinates, it was formulated in [4] as follows:

$$\begin{cases} \dot{\rho} + \rho div u = 0,\ x \in \mathbb{R},\ t > 0; \\ \rho \dot{u} = divT + \rho f, \\ \rho j \dot{\omega} = divM + T_{\alpha x} + \rho m, \\ \rho \dot{e} = T \cdot \nabla u + M \cdot \nabla \omega - 2T_{\alpha x} \cdot \omega + divq + \rho r, \end{cases} \tag{1.1}$$

where $\dot{\alpha}$ denotes material derivative of a field α:

$$\dot{\alpha} = \frac{\partial \alpha}{\partial t} + (\nabla \alpha) u, \tag{1.2}$$

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