Title: Micropolar Fluid Flow in a Thick Domain with Multiscale Oscillating Roughness and Friction Boundary Conditions.

Abstract

We consider an unsteady micropolar fluid flow in a two-dimensional domain Ω^ε. The velocity field is assumed to satisfy a fluid-solid friction interface condition on a part of the boundary while the micro-rotation field satisfies non-homogeneous Dirichlet boundary conditions. The thickness and the roughness of the fluid domain are described by multiple separated scales of periodic oscillations, i.e. $\Omega^\varepsilon = \{(z_1, z_2) : 0 < z_1 < L, 0 < z_2 < \varepsilon^m h^\varepsilon(z_1)\}$ with $h^\varepsilon(z_1) = h(z_1, \frac{z_1}{\varepsilon}, \frac{z_1}{\varepsilon^2}, \cdots, \frac{z_1}{\varepsilon^m})$, $0 < \varepsilon << 1$, and $m > 1$. Existence, uniqueness and uniform estimates of the solution are stated. Then we study the asymptotic behaviour of the flow as ε tends to zero by using the multiple scale convergence method for reiterated homogenization. We obtain a limit problem which is totally decoupled for the limit velocity and pressure (v^0, p^0) on the one hand and the limit micro-rotation field Z^0 on the other hand. Moreover v^0, p^0 and Z^0 are uniquely determined by auxiliary well-posed problems.