Eigenvalue bounds for micropolar shear flows

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Linear stability for general viscous 2D micropolar shear flows [3]

$$\mathbf{U} = (U(y), 0, 0),\ \mathbf{W} = (0, 0, W(y)),\ y \in (0,1),$$

is determined by the (dimensionless) equations [2]

$$\begin{aligned} &i\alpha\left[(U-c)(D^2-\alpha^2) - U''\right]\widetilde{\psi} = \\ &\qquad = \left(\frac{1}{R_\mu} + \frac{1}{2R_k}\right)(D^2-\alpha^2)^2\widetilde{\psi} - \frac{R_0}{R_k}(D^2-\alpha^2)\widetilde{w}, \\ &i\alpha\left[(U-c)\widetilde{w} - W'\widetilde{\psi}\right] = \\ &\qquad = \frac{1}{R_\gamma}(D^2-\alpha^2)\widetilde{w} - \frac{2R_0}{R_\nu}\widetilde{w} + \frac{1}{R_\nu}(D^2-\alpha^2)\widetilde{\psi}, \end{aligned}$$

where R_γ, R_μ, R_ν, R_k, and R_0 are dimensionless parameters and $D := \frac{d}{dy}$. Let $c = c_r + ic_i$ be any eigenvalue of this system. We show bounds for both its real and imaginary parts. The bounds obtained for the imaginary part c_i assure linear stability for the flow in an specific region of the parameters of the problem. These bounds are analogous to the classical result of [1] for flows governed by the Navier-Stokes equations, thus generalizing this classical result to the micropolar case. These results were published in [4].

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