9500 Gilman Dr.
La Jolla, CA 92093-0411 USA
100, Inha-ro, Nam-gu, Incheon 22212, Korea

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Cahn-Hilliard Regularization of the "mu(I)" Rheology JOE GODDARD, University of California, San Diego, JAESUNG LEE, INHA Technical College — Recently Barker et al. [J. Fluid Mech. 779 (2015) 794-818] have shown that the popular $\mu(I)$ model for the viscoplasticity of granular media is ill-posed, exhibiting short wave-length instabilities of the Hadamard variety. As one possible regularization of the model, we employ the dissipative analog of the classical Cahn-Hilliard (CH) model, with dissipation potential given by: $\psi(\nabla\mathbf{v}, \nabla\nabla\mathbf{v}) = \psi_0(\mathbf{D}) + k||\nabla\nabla\mathbf{v}||^2$, with $\mathbf{D} = \mathrm{Sym}(\nabla\mathbf{v})$ and $k > 0$, with stress for the standard $\mu(I)$ model given by $\partial\psi_0/\partial\mathbf{D}$, and with hyperstress given by $\partial\psi/\partial\nabla\nabla\mathbf{v}$. Following the linear-stability analysis of Barker et al. of the momentum balance and continuity equation, we obtain a modification of their dispersion relation giving growth rate in terms of spatial wave number. It is found that the higher-gradient terms in the CH model lead to a large wave number cut-off of the instability, so that the model provides a possibly useful regularization of the $\mu(I)$ model.

Joe Goddard
University of California, San Diego

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