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Viscoelastic Composites with Unbounded Overall Stiffness and Damping

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Searching for high stiffness and high damping materials is of scientific and engineering interest. The recent development of using negative stiffness inclusions to achieve extreme overall stiffness and mechanical damping reveals a new avenue for constructing high performance materials. Negative stiffness induced extreme effective properties is a natural consequence of the composite homogenization theory based on the theory of elasticity and viscoelasticity. However, the applicability and observability of this idea highly relies on the stability of the corresponding dynamical systems. In this paper, I will first introduce some theoretical results of systems with negative stiffness inclusions through composite models, such as the Voigt, Reuss, and Hashin-Shtrikman model. Then, investigations on the stability of systems of this sort will be presented through analyzing discrete rheological models with Lyapunov's indirect theorem as the fundamental stability criterion.

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