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A NOVEL TECHNIQUE FOR STUDYING THE SHEAR ELASTIC RESPONSE OF WEAK SOLIDS

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Traditionally, the shear elastic properties of solids have been measured using mechanical instrumentation, i.e. springs and balances. Commercially available instruments are designed to study engineering materials (steel for example) and are not useful for investigating weak solids, such as gels and electrorheological fluids. We have developed a simple, inexpensive, and precise technique to measure the shear elastic modulus of weak solids using electromagnetic and optical tools. This technique can easily be adapted to measure the viscosity of a liquid also. A Helmholtz pair was used to produce a torque on a permanent magnet mounted on the smaller of two concentric cylinders, coupled by the material to be studied. The torque was controlled precisely and measured accurately in terms of the current flowing through the coils of the Helmholtz pair. An optical lever was employed to measure the angular displacement of the inner cylinder as a function of the applied shear stress. The instrument has been validated by making measurements on lemon jello, and agarose gels of varying concentrations. The technique has also been applied to the study of electric field induced "freezing" of electrorheological fluids, a subject of enormous contemporary interest.

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