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Development of a Vibrating Wire Rheometer

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Vibrating wire devices have been used in the past to determine the viscosity of
Newtonian fluids. We are investigating the use of a vibrating wire device to measure the viscous and elastic moduli of non-Newtonian fluids. Our device consists of a small diameter tungsten wire under tension and immersed in a fluid. When a magnetic field is applied and an alternating current is passed through the wire, it vibrates at the driving frequency. The resonance frequency of the wire can be tuned by varying its length and the applied tension, giving an accessible frequency range of 600 - 6800 Hz. A dual phase lock-in amplifier is used to measure the in-phase and out-of-phase components of the voltage across the wire as a function of frequency.

The Navier-Stokes equations can be solved for this system and an analytic expression can be derived relating the voltage across the wire to the physical parameters of the system, including viscosity. The viscosity of a fluid can be determined by fitting the measured voltage to this function.

In this poster we discuss the design and operation of our vibrating wire rheometer and present results for a variety of Newtonian fluids and polymer solutions.

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