

Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Competing effects of inertia in passive microrheology¹

TSUTOMU INDEI, JAY SCHIEBER, ANDRÉS CÓRDOBA, Department of Chemical and Biological Engineering, Illinois Institute of Technology — Single-point passive microrheology is generalized to account for both bead and medium inertia, and to incorporate a nonlinear optical trap or elastic trap. We first show that inertial motion of the bead couples with the elasticity of the viscoelastic material, resulting in a resonant oscillation of the mean-square displacement (MSD) of the bead well beyond the time scales of bead inertia. However, this prediction is rather different from both the original result of GSER and what is typically observed for viscoelastic materials. We next show that medium inertia tends to attenuate the oscillations because it dissipates bead energy by radiation of transverse sound waves through the Basset force. Thus, bead inertia competes with medium inertia for the MSD's oscillation. We find that it is sufficient to damp bead oscillations via Basset forces when the bead density is $> 4/7$ of the fluid density, independent of most other details in the system. We also show that the non-conservative forces that exist in an optical trap [Roichman et al., PRL, **101**, 128301 (2008)] also result in circulation in a viscoelastic medium. However, the rates are not sufficiently rapid to excite elastic modes.

¹Army Research Office (grants W911NF-08-2-0058 and W911NF-09-1-0378)

Tsutomu Indei
Department of Chemical and Biological Engineering,
Illinois Institute of Technology

Date submitted: 16 Nov 2011

Electronic form version 1.4