# Hydrodynamics and rheology of fluctuating, semiflexible, inextensible, and slender filaments in Stokes flow

## ABSTRACT

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Every animal cell is filled with a cytoskeleton, a dynamic gel made of inextensible filaments / bio-polymers, such as microtubules, actin filaments, and intermediate filaments, all suspended in a viscous fluid. Similar suspensions of elastic filaments or polymers are widely used in materials processing. Numerical simulation of such gels is challenging because the filament aspect ratios are very large.

We have recently developed new methods for rapidly computing the dynamics of non-Brownian and Brownian inextensible slender filaments in periodically-sheared Stokes flow[1,2,4]. We apply our formulation to a permanently[1] and dynamically cross-linked actin mesh[3] in a background oscillatory shear flow. We find that nonlocal hydrodynamics can change the visco-elastic moduli by as much as 40% at certain frequencies, especially in partially bundled networks[3,4].

I will focus on accounting for bending thermal fluctuations of the filaments by first establishing a mathematical formulation and numerical methods for simulating the dynamics of stiff but not rigid Brownian fibers in Stokes flow.[4] I will emphasize open questions for the community such as whether there is a continuum limit of the Brownian contribution to the stress tensor from the filaments.

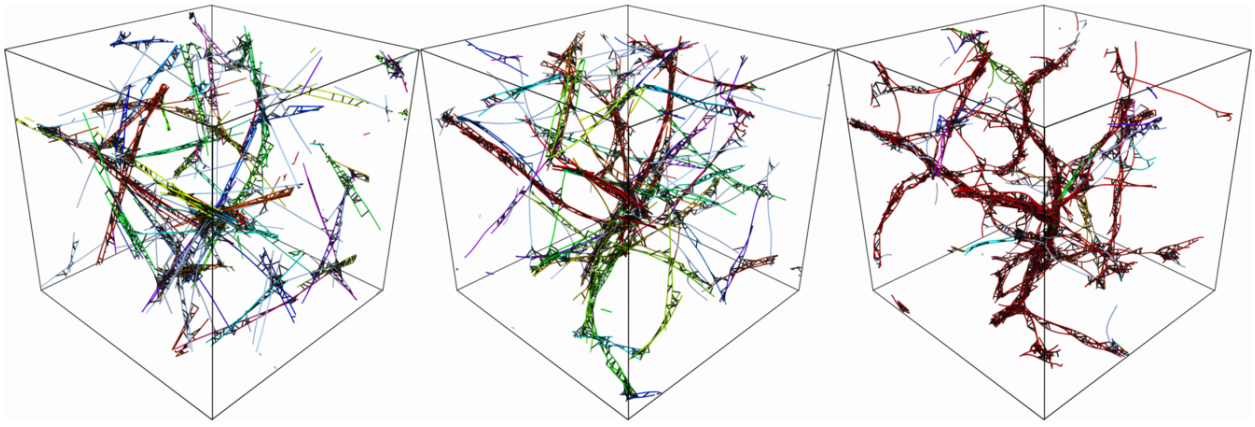

**Figure 1:** Bundling in a dynamically-cross-linked gel of Brownian actin filaments with decreasing persistence length from left to right.

## ACKNOWLEDGEMENTS

This work is supported in part by the U.S. National Science Foundation under grant DMS-2052515.

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