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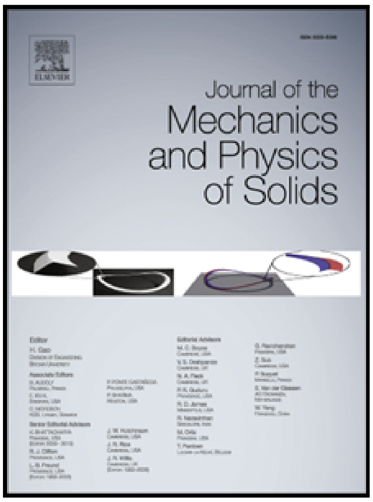

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Measuring the Flexural Rigidity of Actin filaments and Microtubules from Their Thermal Fluctuating Shapes: A New Perspective

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Abstract

Actin filaments and microtubules are important components of cytoskeletal networks and show both active and passive dynamic mechanical behaviors. Measuring the mechanical properties of individual filament can not only help us understand the mechanisms behind the complex dynamic behaviors, but also provide parameters that are needed to calibrate biological piconewton forcemeters. Although many methods have been proposed, the values of flexural rigidity reported in literature are still quite different for both actin filaments and microtubules. In this paper, a new formulation based on mode analysis of the thermal fluctuating shapes and principle of virtual work has been proposed, where both the linear and nonlinear assumptions are considered. What's more, following previous inspiring works, both the effects of sampling time interval and hydrodynamics are taken into account in our model. When applied to the experiment data in literature and the simulation data generated by finite element method software, our method gives good results and show an advantage over the previous methods. Besides, we suggest that the inconformity of the flexural rigidity in literature might be caused by the different sampling time intervals and hydrodynamic wall effects in experiments.

Keywords: Cytoskeletal filaments; mode analysis; flexural rigidity; Brownian forces; thermal fluctuations

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