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**Semiflexible filament networks viewed as fluctuating beam frames**
TIANXIANG SU[1], PRASHANT PUROHIT, University of Pennsylvania — We present a new method combining structural and statistical mechanics to study the entropic elasticity of semiflexible filament networks. We view a filament network as a frame structure and use structural mechanics to determine its static equilibrium configuration under applied loads in the first step. To account for thermal motion around this static equilibrium state, we then approximate the potential energy of the deformed frame structure up to the second order in kinematic variables and obtaina deformation-dependent stiffness matrix characterizing the flexibility of the network. Using statistical mechanics, we then evaluate the partition function, free energy and thermo-mechanical properties of the network in terms of the stiffness matrix. We show that penalty methods commonly used in finite elements to account for constraints, are applicable even when statistical and structural mechanics are combined in our method. We apply our framework to understand the expansion, shear, uniaxial tension and compression behavior of some simple filament networks. We are able to capture the stress-stiffening behavior due to filament reorientation and stretching out of thermal fluctuations, as well as the reversible stress-softening behavior due to filament buckling.

[1]Currently at Harvard University

Prashant Purohit
University of Pennsylvania

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