Active Contraction of Biological Fiber Networks

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Large-scale force generation is essential for biological functions such as cell motility, embryonic development, and muscle contraction. In these processes, forces generated at the molecular level by motor proteins are transmitted by disordered fiber networks, resulting in large-scale active stresses. While fiber networks are well characterized macroscopically, this stress generation by microscopic active units is not well understood. I will present a comprehensive theoretical study of force transmission in these networks [1]. I will show that the linear, small-force response of the networks is remarkably simple, as the macroscopic active stress depends only on the geometry of the force-exerting unit. In contrast, as non-linear buckling occurs around these units, local active forces are rectified towards isotropic contraction and strongly amplified. This stress amplification is reinforced by the networks' disordered nature, but saturates for high densities of active units. I will show that our predictions are quantitatively consistent with experiments on reconstituted tissues and actomyosin networks, and that they shed light on the role of the network microstructure in shaping active stresses in cells and tissue.

[1] Pierre Ronceray, Chase P. Broedersz and Martin Lenz, *Fiber networks amplify active stress,* arXiv:1507.05873 (2015).