Fiber networks rectify and amplify active stresses

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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. Although these fiber networks are well characterized macroscopically, this stress generation by microscopic active units is not well understood. We theoretically study force transmission in these networks. We find that collective fiber buckling in the vicinity of a local active unit results in a rectification of stress towards strongly amplified isotropic contraction. This stress amplification is reinforced by the networks' disordered nature, but saturates for high densities of active units. Our predictions are consistent with experiments on reconstituted tissues and actomyosin networks and shed light on the role of the network microstructure in shaping active stresses in cells and tissue.

Références

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