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Self-organization in Systems ofTreadmilling Filaments. KONSTANTIN DOUBROVINSKI, Princeton University, KARSTEN KRUSE, Universitaet des Saarlandes — The cytoskeleton is an active intracellular network of polar filaments responsible for maintenance of cell shape, cell division, and cell locomotion. A broad variety of cellular processes depend critically on the ability of cyoskeletal filaments to treadmill, i.e. to move by growing at one end while simultaneously shrinking at the other end. In particular, treadmilling is indispensable for cell crawling as well as for generation of various cellular appendages including stereocilia, microvilli, and filipodia. Quantitative modeling of systems involving treadmilling filaments is challenging since it requires describing long-range interactions of particles with many degrees of freedom. We introduce a novel framework for describing systems of treadilling filaments. Within our framework, we identify a class of systems that admit exact solution of the underlying dynamic equations. We compare the corresponding solutions to those obtained by coarse-graining, an approximation which is valid on large length-scales. We apply our new framework to treat two biological systems: cytoskeletal dynamics in fish melanophores and locomotion of human neutrophil cells. In both cases our theory faithfully accounts for the qualitative and semi-quantitative properties of the intracellular structures observed in the corresponding experiments.

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