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A particle based computational model for eukaryotic flagella
RAGHUNATH CHELAKKOT, MICHAEL HAGAN, Brandeis University — The structure of the eukaryotic flagella is very complex and the exact mechanisms responsible for flagellar beating are not clearly understood. Here we present a minimal model to study flagellar beating in two dimensions, which demonstrates that regular beating with a well defined characteristic frequency can arise spontaneously in the absence of external control. In this model, the flagella is represented by two stiff filaments clamped on a surface, on which model "molecular motors" take directed steps on one of the filaments and thereby apply a local force. The fluid medium is simulated using Multiparticle Collision dynamics (MPC), which is a particle based method for hydrodynamic simulations. Within a certain range of motor concentrations, large amplitude periodic oscillations with a well defined frequency are observed; other qualitatively different beating patterns arise outside of this range. We present a phase diagram that characterizes the beating behaviour as a function of relevant parameters such as filament length, motor density on the filament and motor velocity.

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