Flagellar activation mechanism: a non linear study

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Our work concerns modeling the mechanisms underlying flagellar propulsion. Flagella exhibit characteristic oscillatory motion, driven by molecular motors within their cytoskeletal structure. Various mathematical models have been proposed to elucidate how molecular motors self-regulate to generate oscillations.

Our presentation aims to make connections between these models, spanning both microscopic theoretical aspects and broader phenomenological insights. In order to undertake our investigation, we study a two-dimensional elastic filament immersed in a viscous fluid, which models a swimming flagella. The motion of this filament is governed by a partial differential equation describing the flagellar angle as a function of time and axial position. To model the internal activity generated by the molecular motors and also their auto-regulation, we couple the main PDE with the different non linear dynamics for the filament's internal moment.

We will present both linear analysis and fully nonlinear numerical simulations for each mathematical model. Specifically, we aim to shed light on the role of non-linearity, exploring the spectrum of flagellar motion behaviors in response to varying control mechanisms. To facilitate this exploration, we employ COMSOL software, implementing efficiently the non-linear system of equations.

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