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Biological Applications of the Thin-Film-Equation: From cellular motility to lateral spreading of biofilms

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In biological systems activity can manifest itself in different forms; as individual motility or as growth and production processes. I will present two different applications of the thin film equation coupled to active processes.
In both scenarios, the (reductionist's) model equations represent a gradient dynamics derived from a potential energy supplemented by bioactive terms which break the symmetry of the gradient dynamics.

In the first scenario, I introduce a model for invidual cell motiliy driven by active stress. Eukaryotic cells may translocate on homogeneous substrates by employing their cytoskeleton, an assembly of polar filaments and molecular motors.
I will discuss this model within the context bistability observed in keratocytes, which may coexist as immotile and motile cells.

In the second scenario, I will introduce a model for lateral biofilm spreading. When encountering surfaces or interfaces, many bacteria transition from a planktonic to a community lifestyle. The thereby formed bacterial colonies grow by cell division and spread as flat films along the interface. Here I will highlight the importance of passive surface forces and osmotic fluxes, compared to individual bacterial motility, for biofilm spreading on agar substrates under air.

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