BIFURCATION ANALYSIS AND OSCILLATIONS IN MECHANOCHEMICAL MODEL OF PATTERN FORMATION

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In this talk, I will present a nonlocal reaction–diffusion model coupling morphogen dynamics with tissue mechanics to describe pattern formation in regenerating *Hydra* spheroids. The model is given by the integro-differential equation

$$\partial_t u = D\partial_{xx} u - u + \kappa \frac{e^u}{\int_0^1 e^u \, dx},$$

for which I will perform a rigorous bifurcation analysis of the homogeneous steady state and show that symmetry breaking occurs via pitchfork bifurcations, which are supercritical for $\kappa > 1.5$ and subcritical for $\kappa < 1.5$. In the subcritical regime, I will further identify fold bifurcations leading to bistability between homogeneous and heterogeneous states.

I will then extend the framework to a time-dependent domain by introducing a tissue length $\ell(t)$, and show that the qualitative features of these oscillations are determined by the underlying bifurcation structure, in particular by whether the system undergoes subcritical or supercritical bifurcations.