ANMAR KHADRA, McGill University

Excitable media in fish keratocytes model: Canard explosion, traveling waves and beyond

A partial differential equation (PDE) model of a self-organizing lamellipodium in crawling keratocytes has been previously developed to understand the three spatiotemporal patterns of activity observed in such cells, namely, stalling, waving and smooth motility. The model consisted of three key variables: the density of barbed actin filaments, newly formed FAs called nascent adhesions (NAs) and VASP, an anti-capping protein that gets sequestered by NAs during maturation. Using parameter sweeping, the distinct regimes of behaviour associated with the three activity patterns were identified. By converted the PDE model into an ODE model, we successfully examined the excitability properties of this system and determined all of its patterns of activity. Our results revealed that there are two additional regimes not previously identified: bistability and type IV excitability (generated by three steady states and their manifolds). We found that these regimes are also present in the PDE model. Applying slow-fast analysis on the ODE model showed that it exhibits a canard explosion through a folded-saddle and that rough motility seen in keratocytes is likely due to noise-dependent motility governed by dynamics near the interface of bistability and type IV excitability. The two parameter bifurcation suggested that the increase in the proportion of rough motion is due to a shift in activity towards the bistable and type IV excitable regimes induced by a decrease in NA maturation rate. In this talk, I will provide a summary of these findings.