Understanding cell and tissue size and shape regulation in a stem cell niche - a computational morphodynamics approach

Plant meristems are stem cell niches continuously providing new cells throughout the life of a growing plant. The maintenance of the shoot apical meristem is regulated by an interaction between hormones and a gene regulatory network. A negative feedback between the stem cells and a stem cell activator is at the core, and the hormone cytokinin has been shown to provide an activating signal for the stem cell activator. We use a computational morphodynamics approach, where live imaging is combined with mathematical modeling, to better understand the regulation of differentiation and cell growth in the meristem tissue. I will discuss how the number of stem cells is scaling with the size and shape of the niche tissue.  Our model suggest that a plausible mechanism for the scaling results from an incoherent feed-forward network consisting of cytokinin and its receptors. In addition, I will show how the stem cell niche provides an environment where cell sizes are tightly regulated and discuss the cell size regulation of these plant stem cells in the context of single cell organisms.