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Patterns, cellular movement and brain tumours

Abstract

I present three pieces of work that illustrate the power of mathematics as a tool for understanding biology. Although the applications appear to be disparate the underlying mathematics is very similar.

I begin by looking at theoretical and experimental pattern formation, with emphasis on whisker formation in mice. Here, reaction-diffusion equations are used to provide insights into how the wavelength of the whiskers are controlled.

Next, I consider the phenomena of blebbing cells. Initially, I use a diffusion equation to understand the motion of muscle stem cells and illustrate how young cells fundamentally move differently to old cells. This is then extended to include solid mechanics, which allows us to link the structural properties of the cell to their motion.

Finally, reaction-diffusion equations are used to understand the formation of brain tumours. Critically, the cells move at different speeds in white and grey matter, including this information can lead to very different migration patterns of the tumours.