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Mathematics for multiple-scale modelling and emergent behaviour: case studies from biology

The role of mathematics in biology is to make sense of the complexity of our living world, to provide insight into mechanisms that may underlie observed phenomena. A significant challenge in modelling biological systems is to bridge the wide range of spatial and temporal scales on which biological processes operate.

In this talk, I will highlight mathematical approaches that deal with multiple scales, and provide methods to understand the emergence of properties of aggregated systems from the properties of its constituents.

Examples of application are taken from my research, ranging from the investigation of oscillations that play important roles in physiological phenomena such as breathing and the control of blood sugar to the investigation of spatial animal group patterns that result from different communication mechanisms.