AIPHA Distinguished Lecture Series

Dr. Francesca Scarabel
University of Leeds

Title: Bistability and complex dynamics in an infectious disease model with waning and boosting of immunity

Date: Friday, June 5, 2026
Time: 10:30 - 12:00 PM
Location: LIAM Lab, Room 277, Kinsmen Building

Abstract:

In this talk, I will present some results motivated by a model for transmission of an infectious disease with temporary immunity. The model is formulated in the literature either as a partial differential equation or, equivalently, as a delay differential equation (DDE) with distributed delay. Focusing on the DDE formulation, I will present an overview of the pseudospectral discretization approach to approximate a DDE with a system of ordinary differential equations. This method has recently been implemented in a DDE importer for the software package MatCont, allowing users to perform numerical bifurcation analysis of DDEs via the MatCont graphical user interface. I will show how waning and boosting of immunity give rise to very complex dynamics at the population level, including regions of parameters where multiple attractors exist (an equilibrium and a limit cycle or two stable limit cycles). Bistability phenomena can be particularly important to explain for instance the resurgence of pertussis cases after the COVID-19 pandemic, to levels different than pre-pandemic. I will then present some recent ongoing work to investigate the basins of attraction of DDEs.

Dr. Francesca Scarabel's Short Bio:

Francesca Scarabel is a Lecturer in Mathematical Biology in the School of Mathematics at the University of Leeds. Her research sits at the intersection of numerical analysis, dynamical systems, and mathematical biology, with a particular focus on population dynamics and infection modelling at multiple scales. She completed her PhD in Applied Mathematics at the University of Helsinki in 2018 and has since held research positions in Hungary, Canada, and the UK before joining Leeds.