THE CRM APPLIED MATHEMATICAL PHYSICS (CAMP) SEMINARS

CENTRE DE RECERCA MATEMÀTICA

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Detecting structural sensitivity in biological models: Developing a new framework.

Abstract:

When we construct mathematical models to represent a given real-world system, there is always a degree of uncertainty with regards to the model specification - whether with respect to the choice of parameters or to the choice of formulation of model functions. This can become a real problem in some cases, where choosing two different functions with close shapes in a model can result in substantially different model predictions. This phenomenon is known as structural sensitivity, and is a significant obstacle to improving the predictive power of models - particularly in fields where it is not possible to derive the functions suitable for representing system processes from theory or physical laws, such as the biological sciences.

In this talk, I shall revisit the notion of structural sensitivity and its relation to the property of structural (in)stability, and propose a general approach to reveal structural sensitivity which is a far more powerful technique than the conventional approach consisting of fixing a particular functional form and varying its parameters, since we consider the infinite-dimensional neighbourhood of a given model's unknown functions. In particular, a rigorous method to unearth sensitivity with respect to the local stability of a system's equilibrium points will be discussed. Then, I implement the method to explore sensitivity in several well-known multicomponent ecological models, demonstrate the existence of structural sensitivity in these models and show that conventional methods based on variation of parameters alone will often miss such sensitivity. I shall discuss the consequences that structural sensitivity and the resulting model uncertainty may have for the modelling of biological systems. In particular, I shall consider that structural sensitivity may allow models to represent far more complex dynamics than the dimension of the state-space may suggest, and that in a structurally sensitive model, the concept of a 'concrete' bifurcation structure may no longer be relevant, thus we can only describe bifurcations of completely deterministic systems with a certain probability. As illustrative example, I will consider various mathematical models of population dynamics.

Date:	**May 25, 2017**
Place:	**Room C1/028**
Time:	**12:00**