香港浸會大學
HONG KONG BAPTIST UNIVERSITY

Department of Mathematics

Distinguished Lecture Series

Mathematical Models of Living tissues and Free Boundary Problems

Professor Benoît Perthame

Laboratoire Jacques-Louis Lions, Sorbonne University, France

Biography:

Benoît Perthame is a professor of Laboratoire Jacques-Louis Lions, Sorbonne University. He is very well known for several landmark contributions to nonlinear partial differential equations. Over the past decades, Professor Perthame has designed a new research program in the domain of Partial Differential Equations for Biology and Medicine which led to organize an INRIA team, first called BANG, now Mamba. As a result, mathematical biology has become a major research area within the Laboratoire Jacques-Louis Lions and more generally, in France, which now counts as a leading country in mathematical biology.

He is a member of the French Academy of Sciences, Academia Europaea and European Academy of Sciences. Honours include Grand Prize INRIA-French Academy of Sciences (2015), Blaise Pascal Award, European Academy of Sciences (2013), R. Sacchi Landriani Prize, Accademia Lombarda (1997), Silver Medal of the CNRS (1994), Blaise Pascal Prize, French Academy of Sciences (1992) and Peccot Prize, College de France (1989).

Date: 11 May 2022 (Wednesday)
Time: 4:00-5:00 p.m. GMT+8 (Hong Kong Time)
Venue: Online via Zoom (Meeting ID: 916 9493 0182)

Abstract

Tissue growth, as it occurs during solid tumors, can be described at a number of different scales from the cell to the organ. For a large number of cells, 'fluid mechanical' approaches have been advocated in mathematics, mechanics or biophysics. Since the 70's the mathematical modeling has been progressing regularly, posing new mathematical questions.

We will give an overview of the modeling aspects and focuss on the links between two types of mathematical models. The 'compressible' description describes the cell population density using systems of porous medium type equations with reaction terms. A more macroscopic 'incompressible' description is based on a free boundary problem close to the classical Hele-Shaw equation. In the stiff pressure limit, one can derive a weak formulation of the corresponding Hele-Shaw free boundary problem and one can make the connection with its geometric form.

The mathematical tools related to these questions include multi-scale analysis, Aronson-Benilan estimate, uniform L^4 estimate on the pressure gradient and emergence of instabilities.

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