BRIN MATHEMATICS RESEARCH CENTER

Brin MRC Distinguished Lecture

Free Boundary Problems in Bio-Medicine

Professor Avner Friedman, Ohio State University

Date: Friday, November 11, 2022
Time: 3:15 PM
Location: 3206 Kirwan Hall

Abstract

A free boundary problem (FBP) consists of a system of partial differential equations in a domain with unknown boundary, which needs to be solved simultaneously with the unknown boundary of the domain. Such problems increasingly arise in models of bio-medical processes. Examples include cancer growth with treatment aimed at decreasing the growing unknown boundary, growing plaque in cardiac artery (which, by blocking the artery, will result in heart attack), chronic or diabetic dermal wound (which, if not healed in proper time, may require amputation), cartilage shrinkage in rheumatoid arthritis, and fungal skin infection (which, if not treated, may spread over the whole body).

Each of the aforementioned diseases was modeled as a FBP, and numerical simulations of the models were performed and used to gain understanding and to make recommendations for effective treatments in experimental studies or in clinical trials. However, not much has been done in terms of rigorous analysis of these models. In this talk, I will briefly review such models and then proceed to describe some theoretical results for simplified versions of the models, showing that these results actually capture, in some "generalized" sense, those derived from the numerical simulations. I will also state some related open problems.

About the Speaker

Avner Friedman is a Distinguished Professor of Mathematics and Physical Sciences at Ohio State University. His primary field of research is partial differential equations, with interests in stochastic processes, mathematical modeling, free boundary problems, and control theory. He held numerous administrative positions, including Director of Institute for Mathematics and its Applications (IMA), founding director of Minnesota Center for Industrial Mathematics, founding Director of the Mathematical Biosciences Institute at Ohio State University and President of Society for Industrial and Applied Mathematics (SIAM). His many prestigious accolades include membership of the National Academy of Sciences, elected Fellow of the American Academy of Arts and Sciences (AAAS), American Mathematical Society (AMS) and SIAM. He was awarded the National Science Foundation Special Creativity Award, the Sloan Fellowship, the Guggenheim Fellowship and the Stampacchia Prize. He directed 27 doctoral dissertations in mathematics and has published 25 books and over 500 peer-reviewed research papers.

DEPARTMENT OF MATHEMATICS

SCAN ME