2007 Summer Program in Systems Physiology

Each summer the MBI hosts a 3-week education program. The first week is spent in a tutorial, which combines morning lectures with active learning laboratories in the afternoon. The following two weeks are spent working on guided team projects and participating in a miniconference to share project results. The program is meant primarily for graduate students; college instructors and qualified undergraduates will also be considered.

The 2007 Summer Program will concentrate on issues related to systems physiology. The dates are July 23 - August 10 and the principal lecturer will be Jim Keener from the University of Utah.

In these lectures Professor Keener will give an introduction to mathematical models of cellular physiological processes, based on material found in the book by Keener and Sneyd, Mathematical Physiology. Included will be discussion of enzyme kinetics and biochemical reaction networks, cellular transport processes (channels, transporters, ATPases), membrane excitability, calcium handling, cell regulatory processes, bursting and secretion, cellular communication and coupling, and waves in continuous and discrete media. The lectures will assume familiarity with ordinary and partial differential equations, and some understanding of stochastic processes (Markov processes).

For more details visit: http://www.mbi.osu.edu/eduprograms/2007description.html

Undergraduate Summer Program

This program consists of two parts: (a) two weeks of introductory lectures plus short projects and a computer lab, and (b) a summer long research experience (six weeks to be followed immediately after the two weeks) devoted to projects in the interface of mathematics, statistics, and biological sciences.

The program dates are July 9-20, 2007. The topics include: phylogenetics, mathematical neuroscience, bioinformatics, environmental statistics, and chemogenomics.

A Year in Mathematical Bioengineering

The 2007-2008 scientific program at the MBI will be Mathematical Bioengineering. Members of the organizing committee are Philip J. Holmes, Melissa Knothe Tate, Arte Kuo, Michael Savageau, Allen Tannenbaum, and Dawn Taylor.

The 2007-2008 MBI Year in Mathematical Bioengineering will focus around six workshops on Metabolic Engineering, Cell and Tissue Engineering, Neuroengineering, Brain Imaging, and Neuro-mechanics, the latter being covered in two linked workshops. Tutorials will be offered to prepare participants, especially students and postdoctoral fellows interested in entering the field. While omitting large areas, these workshops provide examples of the central subject matter, and they highlight two key modes of operation of bioengineering: as a conduit for experimental methods, modeling and analytical tools from the physical sciences and mathematics into biology, and as a conduit for biological inspiration to the applied sciences and engineering, as in bio-inspired design of new devices and materials.

Fall Workshop for Young Researchers in Mathematical Biology (WYRMB)

To provide a forum for young mathematical biologists to interact with their peers, the MBI will host the Young Researchers Workshop in Mathematical Biology. The workshop will bring together approximately 45 young researchers in mathematical biology, to broaden their scientific perspective and to develop connections that will be important for their future careers.

Each participant will present a poster of current research and give a 5-minute advertisement of the poster. The workshop will also feature working group discussions on broad issues relevant to researchers in mathematical biology.

Plenary talks will be given by leading researchers in mathematical biology:

- Carlos Castillo-Chavez, Department of Mathematics and Statistics, Arizona State University
- Nancy Kopell, Department of Mathematics, Boston University
- Mark Lewis, Department of Mathematics, University of Utah
- Michael Reed, Department of Mathematics, Duke University
- Bruno Sobral, Virginia Bioinformatics Institute, Virginia Tech
- Angela Stevens, Max Planck Institute for Mathematics in the Sciences
- Suzana Strauss, Department of Chemistry, University of British Columbia

For more information and details on how to apply, please visit the following link:
Tutorials and Short Courses 2007-2008

There will be numerous tutorials and short courses at the MBI during the 2007-2008 academic year. Many of these will precede the workshops.

Introduction to mathematical modeling in cellular physiology and neuroscience
October 1-4, 2007

There will be a one-week intensive short-course in cellular physiology and neuroscience. Lectures will be given by David Terman (OSU) and Greg Smith (Williams and Mary). Topics covered include: membrane transport and diffusion, classical biophysics of the squid giant axon, Markov chain models of single channel gating, cell signal transduction, the buffered diffusion of intracellular calcium, intracellular calcium responses and excitability, bistability, oscillations, and bursting in a physiological context. We will also consider activity patterns in networks of synaptically coupled neurons, along with specific applications including models for sleep rhythms, Parkinsonian tremor, and sensory processing. Each topic will be studied from the perspective of nonlinear dynamics (either deterministic or stochastic). Mathematical idealizations of each phenomena will be constructed and then analyzed using computer simulation (numerical integration) and graphical techniques (phase-plane analysis).

Tutorial for Workshop 2, October 18-19, 2007
Speaker: Keith Gooch

The first session will begin with a brief history of cell, organ, and culture from the early 1900s to the present and its relationship to modern efforts in cell and tissue engineering. The focus of this hour will be a survey of current and proposed applications of cell and tissue engineering. Using these applications as a starting point, the second hour will be a survey of the recurring approaches to (paradigms) and methods evident in CTE applications. The third hour will cover major challenges in CTE and some promising approaches to dealing with them.

Joint tutorials for Workshop 3 and 4: Introductory orientation on comparative biomechanics of locomotion:

Part 1: Tutorial for Workshop 3, January 10-11
- Muscle: muscle physiology
- Limb: dynamics of multi-body systems, passive walking
- Brain: feedback control and state estimation

Part 2: Tutorial for Workshop 4, March 27-28
- Mechanics: walking and running models, hybrid dynamical systems, including numerical methods
- Neurobiology: CPG models and sensory circuits state estimators
- Control and co-ordination: feedback and feedforward control

These tutorials will link with the neuroengineering workshops.

Tutorial for Workshop 5, May 8-9: Brain physiology related to movement control and epilepsy
- Intracortical unit recording studies of normal movement
- Field potential recording studies of normal movement
- Deep brain structures and movement disorders
- Physiology and epilepsy

Tutorial for Workshop 6
- Basic signal and image processing
- Issues in medicine (ethics, IRB approval, patient confidentiality, metrics for successful treatments)
- Mathematical techniques (overview of some of the general mathematic ideas being used in modern medical imaging)
Miniworkshop on Microfluids

November 12-14, 2007

Mathematical biology has long attempted to capture qualitative and quantitative mechanisms underlying the functioning of biological systems in the form of equations and laws, which could ultimately facilitate conceptual understanding of biological complexity. However, the progress in mathematical biology and its predictive power has often been hampered by the mismatch between the precision of mathematical analysis and very approximate measurement of biological read-outs. If one resorts to metaphors, mathematical treatment often asks for statement of boundary and initial conditions, which are frequently either unknown or poorly controlled in biomedical investigations. Recently, developments in micro- and nano-technology occurring in the fields of electronics and material sciences, have created an opportunity to rectify this problems and allow for significantly more control in definition of the micro-environment of single cells and cell ensembles. As a result, the applications of microfluidics in the analysis of live cells have skyrocketed, creating fertile ground for renewed interest in tight integration of mathematical and experimental biology. This technology is likely to become a new staple of experimental labs interested in the behavior of cells and tissues, providing increasing promise for beginning and well established mathematical biologist.

This workshop is designed to introduce the community of mathematical biologists to the promise and recent developments in the microfluidic analysis of live cells and tissues. It is also aimed at allowing the experimentalists working in development of microfluidic applications to biological research to be exposed to the power of mathematical treatment in biology. Thus it is envisioned that the workshop, by way of examples of exciting and timely research, may provide a bridge between the communities and a platform for discussion of possible future interactions.

MBI Newsletter

Avner Friedman, director of the MBI, has been awarded the title of Distinguished University Professor by the Ohio State University Board of Trustees. The announcement of this award included the following brief bio:

Avner Friedman, a professor of mathematical and physical sciences at Ohio State for the past six years, is well known at the university as a skilled teacher and mentor for students of all levels.

Friedman’s main research focus is in partial differential equations, an area in which he has helped develop the theories and models currently used to analyze a wide class of problems. He has published more than 400 research articles and 20 books. In addition, he has given hundreds of invited lectures and served on more than a dozen editorial boards and numerous scientific advisory committees.

One of Friedman’s greatest accomplishments is directing the Mathematical Biosciences Institute, one of the biggest and best programs of its kind today. He has served as director of the institute since its creation in 2002.

The primary goal of the MBI is to develop mathematical theories, statistical methods and computational algorithms to solve fundamental problems in the biosciences. It is designed to involve mathematical scientists and bioscientists in the solutions of these problems and to nurture a community of scholars in mathematical biosciences.

Friedman’s work with the MBI has made him one of the most visible applied mathematicians in the world and he is well respected among his colleagues.

“He has influenced generations of mathematicians with his ideas, results and programs. His boundless energy and vision have led to the creation of a national institute that has made Ohio State the top university in mathematical biosciences,” a colleague said.

Friedman received his master’s and Ph.D. in mathematics at Hebrew University.
Suggest New Ideas and Programs

The MBI programs are aimed at bringing mathematical scientists and bioscientists together to interact on significant problems from the biosciences. It is expected that such activities will also open new research areas for mathematicians and statisticians.

The MBI wishes to encourage the mathematical sciences community and the biosciences community to solicit program ideas.

Your suggestions may be submitted in the form of a preproposal for

- a workshop that falls within a thematic year;
- a stand-alone workshop;
- an extended program, several months to a year; and
- a summer education program.

We welcome ideas from the broad spectrum of mathematical biosciences: you may focus more on the mathematics/statistics motivated by biology, or on biological problems which will require the development of new mathematical/statistical methods.

Please submit your ideas in the form of a few pages describing the background and motivation, and what the program is going to accomplish.

If you want to suggest a specific workshop, we would like to have a list of organizers, a description of the workshop, and a tentative list of speakers and participants.

Please contact the Director or one of the Associate Directors as you develop your ideas for pre-proposal:

**Avner Friedman, Director:** afriedman@mbi.osu.edu
**David Terman, Senior Associate Director:** terman@math.ohio-state.edu
**Libby Marschall, Associate Director:** marschall.2@osu.edu
**Dennis Pearl, Associate Director:** dpearl@mbi.osu.edu
**Andrej Rotter, Associate Director:** arotter@mbi.osu.edu

We’re Moving!

The MBI is moving to historic Jennings Hall in August 2007. One of the university’s oldest landmarks, Jennings Hall was known as the Botany & Zoology building when it first opened in 1914, and is now named after former OSU president Edward H. Jennings. Home to many biology classrooms and labs, nearly every student takes classes in this building during their careers.

The MBI’s move into 9100 sq ft on the top floor will place it in the heart of spaces occupied by OSU’s College of Biological Sciences (CBS), including being on the same floor with CBS research labs. Jennings Hall is also a very short walk to the OSU Medical complexes to the south and to the departments comprising the College of Mathematical and Physical Sciences to the north.

The MBI will nearly double its space for postdocs, visitors, and events, as well as house state of the art technology for event interaction and presentation, both local and remote. Come visit us!

Initiate Focused Math-Bio Research Groups

The MBI is calling for proposals for Focused-Discovery Groups (FDG). The FDG idea is for a group of researchers from different institutions to get together at the MBI for a period of (typically) one week in order to discuss, intensively investigate, and aim to resolve a significant problem in the biosciences. The MBI will pay the local expenses of the participants, and will provide facilities (office space, computer support).

Proposals should be sent to the Director or one of the Associate Directors. A proposal should describe the problem to be addressed (one or two pages) and list the people who have agreed to participate.

The proposed dates of MBI residence for the FDG should be between six months and one year from the time of submission.
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The mission of the MBI is:

- to develop mathematical theories, statistical methods, and computational algorithms for the solution of fundamental problems in the biosciences;
- to involve mathematical scientists and bioscientists in the solutions of these problems;
- to nurture a community of scholars through education and support of students and researchers in mathematical biosciences.

Apply for a Visit!

Long term visit application: http://mbi.osu.edu/forms/visitorapplication.html
Workshop/Tutorial application: http://mbi.osu.edu/applyworkshop.html
Postdoctoral application: http://mbi.osu.edu/forms/postdocapplication.html

If you would like us to include information on the following, please contact David Terman at terman@mbi.osu.edu:

- Upcoming meeting/programs
- Employment opportunities