

2009 Summer School on  
**Parameter Estimation in Physiological Models**  
([www.biomatematica.it/lipari2009](http://www.biomatematica.it/lipari2009))

*third event of the EC Marie Curie Conferences series*  
*"Mathematical Modeling of Human Physiological Systems with Biomedical Application"*  
**Island of Lipari (Sicily, Italy) September 13-26, 2009**

## **FINAL ANNOUNCEMENT**

### **AIM AND FOCUS**

Within the realm of mathematical and computer modeling of physiological processes, attention has been traditionally given to direct problems, i.e. to the process whereby, starting from known facts and reasonable assumptions on the system structure, the behavior of a simplified, hypothetical system is predicted. While fundamental for the understanding of the involved mechanisms, direct modeling does not answer, in and by itself, the main experimental question, which is to infer the system structure given the experimentally observed behavior. The Lipari 2009 summer school will be dedicated to the study of modeling from the side of parameter estimation (when the investigator presumes a functional form for the family of models representing the system, and is trying to identify the relevant parameter values) and from the side of qualitative study of the models, both deterministic and stochastic (with the goal of assessing congruency of behavior of the model with the known features of the experimental system under investigation). This school will address mathematical modeling and statistical estimation in a single framework; will tightly integrate methods and applications; and will provide understanding of the methodological problems in this field and a frame of reference for more individually focused study after-school.

The summer school is intended for PhD-students and Post-Doc's interested in parameter estimation for physiological models. The number of participants will be limited to 60. The issues, problems, and methodologies for modeling and parameter estimation of complex physiological systems touch several competence domains. Participants with backgrounds in applied mathematics, bioengineering, or biomedicine are welcome.

### **EVENT OVERVIEW**

The event is structured as 13-day summer school aimed at PhD and Post-Doc students; the last 2 days of the summer school consist of a scientific workshop on mathematical models for the glucose/insulin system.

### **CONFERENCE SCHEDULE**

The school proper will be conducted during two working weeks, Monday September 14th through Wednesday September 23rd, including the morning of the intervening Saturday, for a total of 68 teaching units (including courses and participant presentations). Each day there will be 8 teaching units (lectures by instructors and invited speakers of 40 min, including 5' questions and discussion) as well as participant presentations. The

"Mathematical Modelling for the Glucose/Insulin system" workshop will take place on Thursday 24th and Friday 25th September. Participants will be given ample opportunity to interact with instructors during and after hours.

## **COURSES and SCIENTIFIC WORKSHOP**

The school will be organized along the following main courses:

- **Qualitative behavior of solutions** (Yongwimon Lenbury, Franz Kappel, Pasquale Palumbo, 10 units): The study of the qualitative properties of the model is the basis for the consideration of what parameter values ought to be. A structurally unsound model, which behaves differently than observed, is likely to determine doubtful parameter estimates from available data.
- **Introduction to Inverse Problems** (Thomas Banks, 4 units): A synthetic presentation of the basic recurring themes in inverse problems (including sensitivity and information, propagation of uncertainty, aggregate vs. individual data) will set the stage for more detailed treatment of specific aspects.
- **A-priori model identifiability and robust identification** (Eric Walter, 4 units): The meaning of identification will be discussed, pitfalls commonly encountered when progressing directly to numerical fitting will be explored and techniques for robust estimation will be introduced.
- **Numerical Integration** (Oscar Angulo-Torga, Luis Abia, 4 units): Numerical schemes for the integration of systems of ordinary, partial, delay and stochastic differential equations will be presented, their convergence properties discussed and practical advice to non-numerical analysis will be given.
- **ML Population Estimation** (Marc Lavielle, Adeline Samson, 10 units): The basics of frequentist estimation will be presented, centered on different approximations to Maximum Likelihood. The common problem of population estimation by nonlinear mixed effects will be given particular emphasis, describing alternative approaches, their usefulness and shortcomings.
- **Bayesian Estimation** (Aristides Dokoumetzidis, Mathieu Kessler, 10 units): The philosophy of Bayesian estimation will be briefly introduced, with specific attention to Bayesian population estimation of nonlinear models for repeated measurements. MCMC techniques will be treated and practical applications through the use of the software WinBugs will be presented.
- **Kalman filtering and Nonlinear Observer techniques** (Alfredo Germani, Hien Tran, 8 units): The engineering approach to system identification via filtering will be introduced, working up from basic linear finite dimensional systems to nonlinear systems and the nonlinear observer techniques.
- **Parameter Estimation for Stochastic Differential Equations** (Susanne Ditlevsen, Valentine Gentot-Catalot, 9 units): An introduction of modeling physiological systems by means of stochastic differential equations will be given. The treatment of the possible MLE-related approaches to the identification of the relative parameters will show the relationship between these techniques and filtering.
- **Stochastic Geometry** (Vincenzo Capasso, Alessandra Micheletti, 3 units): The construction of stochastic structural models for observed materials, tissues and organs naturally introduces the need of estimating the parameters describing their

complicated geometry. Necessary stochastic measures must be defined and appropriate numerical methods designed.

## **SCIENTIFIC WORKSHOP**

The scientific workshop on "Mathematical modeling of the Glucose/Insulin system" will take place during the last two days of the school. It will cover the following topics:

### **Thursday Sept. 24<sup>th</sup>: “Modeling and control of glucose homeostasis”**

Morning, “Modeling”: Giovanni Pacini, Andrea Mari, Jiaxu Li, Roman Hovorka

Afternoon, “Control”: Claudio Cobelli, Pierdomenico Pepe, Pasquale Palumbo, Jorge Bondia

### **Friday Sept. 25<sup>th</sup>: “Modeling insulin secretion”**

Morning, “Cellular level models”: Jean-Claude Henquin, Alessandro Bertuzzi, Morten Gram Pedersen

Afternoon, “Models for insulinemia oscillations”: Niels Pørksen, Iva Tolic, Andrea De Gaetano

## **LANGUAGE**

The official language of the school is **English**

## **PARTICIPATION**

Acceptance to the school is competitive (see the [eligibility for support](#)), aiming also at regional and gender balance. The school is mainly supported by the [European Commission Marie Curie Program](#). Eligible candidates (both from the EU and from outside the EU) will have complete financial support for living accommodations and possibly partial support for traveling to the school. Details on eligibility may be found [here](#). Non-EU supported participants may also participate paying a [School Fee](#). If you are interested in participating in the school please note that the [web application form](#) is the only way to apply to the school. Besides filling in the required fields in the form, one signed letter of recommendation in English on letterhead paper (scanned from the original in color, minimum resolution 300 dpi) must be uploaded through the [application webpage](#). Once the application has been completed, the applicant will be kept up-to-date with all developments.

## **TIME TABLE**

**May 31:** deadline for applications

**June 15:** communications to applicants on admission results

**August 31:** course materials online

**September 12:** welcome dinner in Lipari

**September 27:** farewell breakfast

## **LOCATION AND INFRASTRUCTURE**

School participation includes tuition, social events and full board with accommodation in double rooms at the [Tritone Hotel](#) (Lipari, Sicily, Italy), from Sunday evening, September 13th, 2009, until Saturday morning, September 26th, 2009.

Lipari island is served by hydrofoil via Messina, Milazzo and Reggio Calabria. The Messina and Milazzo harbors are reachable by bus from Catania airport. Reggio Calabria has its own airport. Bus shuttle services will be available on Sunday Sept. 13th and Saturday Sept 26th between Lipari harbor and the Tritone hotel. On Sunday, September 13<sup>th</sup>, visible reference desks will welcome participants at Catania airport and at Lipari harbor to help making connections. Relevant transportation timetables are available at the following links:

- <http://www.usticalines.it>
- <http://www.saisautolinee.it>

## **ORGANIZATION**

Consiglio Nazionale delle Ricerche

IASI Istituto di Analisi dei Sistemi ed Informatica “A. Ruberti”, Laboratorio di BioMatematica.

[www.biomatematica.it](http://www.biomatematica.it)

[lipari2009@biomatematica.it](mailto:lipari2009@biomatematica.it)