

Modeling Transport and Metabolism in the Respiratory and Cardiovascular Systems:

One-week courses in modeling analysis of experimental data, hosted by the University of Washington Physiome Project and the Simulation Resource Facility, Departments of Bioengineering, Applied Mathematics, Medicine and Radiology. Course Director: James Bassingthwaite; Course Manager: Gary Raymond (garyr@u.washington.edu)

Two courses: 14-19 June 09 and 23-28 August 09. Details or register: www.physiome.org.

Location: University of Washington, N140 Foege Bioengineering Bldg., 1705 NE Pacific St., Seattle WA 98195-5061

This course is designed as an aid to developing techniques and strategies in using modeling as an integrative tool for the analysis of data on cellular and physiological systems. Using basic biophysical and biochemical principles, the analysis begins with a visual and deductive approach to the data, attempting to develop a quantitative testable hypothesis that might provide an explanation, then translating this into computer models using a simple equation-based modeling language from which solutions are computed and compared to the original data sets. Methods for parameter optimization to fit models to data automatically and for assessing the validity of the models are central to the successful use of modeling in clinical and research settings.

COURSE CONTENT

Day 1: Basics of Linear Systems Analysis: Analysis of experiments probing the role of endothelial cells in blood-tissue exchange of solutes. [Learn: modeling principles, design and coding of models, develop compartmental and spatially distributed models, use of modeling interface systems, sensitivity analysis, optimization for parameter confidence intervals.]

Day 2: Transport, reaction and fluxes in non-linear systems: Tracer principles and practice in physiology and pharmacology. [Learn: enzymatic reactions, facilitating transporters, countertransport, Nernst potential, ion transport through channels, mass/charge balance.]

Day3: Cellular systems biology: Creating a model from modules. [Learn: create cellular action potential models, Hodgkin-Huxley AP, add new channels, cardiac AP models; Michaelis Menten reactions, biochemical reaction sequences, oscillating and chaotic glucose-ATP systems, stochastic reaction kinetics.]

Day 4: Circulatory and Respiratory Networks: Mechanics of blood and gas transport.
[Learn: mechanical and electrical equivalents as ordinary differential equations, setting up equations for the computers to solve, circuit diagrams, elastic and viscous elements, pulse wave transmission and solute carriage in blood, recirculation, slaving solute carriage models to pressure flow models, pharmacokinetic analysis.]

Day 5: Analyzing PET, MRI and CT image sequences: Estimating regional myocardial blood flows with deposited tracers; transpulmonary transport of X-ray contrast agents; assessing regional tissue hypoxia using S-adenosyl homocysteine. [Learn: identifying modular components of large models, multiscale model construction, biochemical models in imaging, purine nucleoside/nucleotide network, volumes of distribution, networks of operators .]