

An Introduction to CellML for Modelling Cellular and Subcellular Processes

Tutorial given by: Autumn Cuellar and Poul Nielsen,
Fred Livingston, Adam Muzikant, and Madhu Natarajan

The Bioengineering Research Group, The University of Auckland and
Physiome Sciences, Inc.

Introduction

Computer modelling of biological processes can be a useful aid to experimental research. Computer models can be used to predict behaviours and find errors that cannot be found with experimental methods alone. The standing problem with sharing mathematical models is that the model is coded in one programming language, and the results are published in text. Sometimes the published text and the mathematical code are inconsistent, and it is a long and arduous process sharing computer models if the same platform or language is not used. On top of all this, it is difficult to re-use parts of a model without dissecting the computer code. CellML has been designed to address these problems with the use of the eXtensible Markup Language (XML).

This tutorial will be split into two parts: the first half will be a basic introduction into CellML offering instruction in putting a simple model together; the second half will consist of a demonstration of Physiome Sciences' PathwayPrism software and how it relates to CellML.

Tutor's Backgrounds

Adam Muzikant received a Ph.D. in biomedical engineering from Duke University in 1998, and a B.S. in bioengineering from U.C. San Diego in 1993. His Ph.D. research focused on a combined modeling and experimental approach to validate a large-scale model of conduction in cardiac tissue, emphasizing the effect of the 3-d fiber architecture on the spread of excitation. Adam joined Physiome Sciences in August 1998 as a scientist. Currently, he is the director of the modeling sciences group.

Madhu Natarajan received a Ph.D. in Neurobiology from Northwestern University in 2001, and a B.E. in Electronics and Communication Engineering from the University of Madras, India in 1994. His Ph.D. work focused on the physiology of how autonomic nervous centers in the brainstem controlled the cardiovascular and respiratory systems. The work included spectral analysis of experimental in-vivo extra-cellular recordings and nerve recordings to piece together models of brainstem architecture capable of controlling and maintaining blood pressure in anesthetized rats. His prior research in the department of Biomedical Engineering at the University of Akron included developing computational models of aberrations in cardiovascular systems such as the Cushing response and neurogenic pulmonary edema. He joined Physiome Sciences in May 2001. Currently, he is a Product Design Scientist.

Fred Livingston received a Ph.D. in neurobiology from Duke University in 2000, and a B.A. in biology from the University of Pennsylvania in 1993. Fred's Ph.D. work concerned brain mechanisms of avian vocal learning. His thesis work focused the electrophysiological properties of neurons that are critical for song learning, and how changes in these neuronal properties control song learning. Fred joined Physiome Sciences in August 2001 as a Bioinformatics Scientist.

Poul Nielsen received his Ph.D. in Bioengineering from the University of Auckland, a B.Sc. in Physics and Mathematics, and a B.E. in Engineering Science. His Ph.D. thesis was titled "The Architecture of the Heart: The Finite Element Model." Poul did his post-doc at McGill in Montreal and is currently a Senior Lecturer of Bioengineering at the University of Auckland.

Autumn Cuellar received her B.S. in biomedical (biochemical) engineering from the University of Southern California in 2001. Her research at U.S.C. was in the Materials Science department, testing carbon composites for possible use in ankle-foot orthoses. Autumn joined the University of Auckland in July 2001 as a Research Engineer.