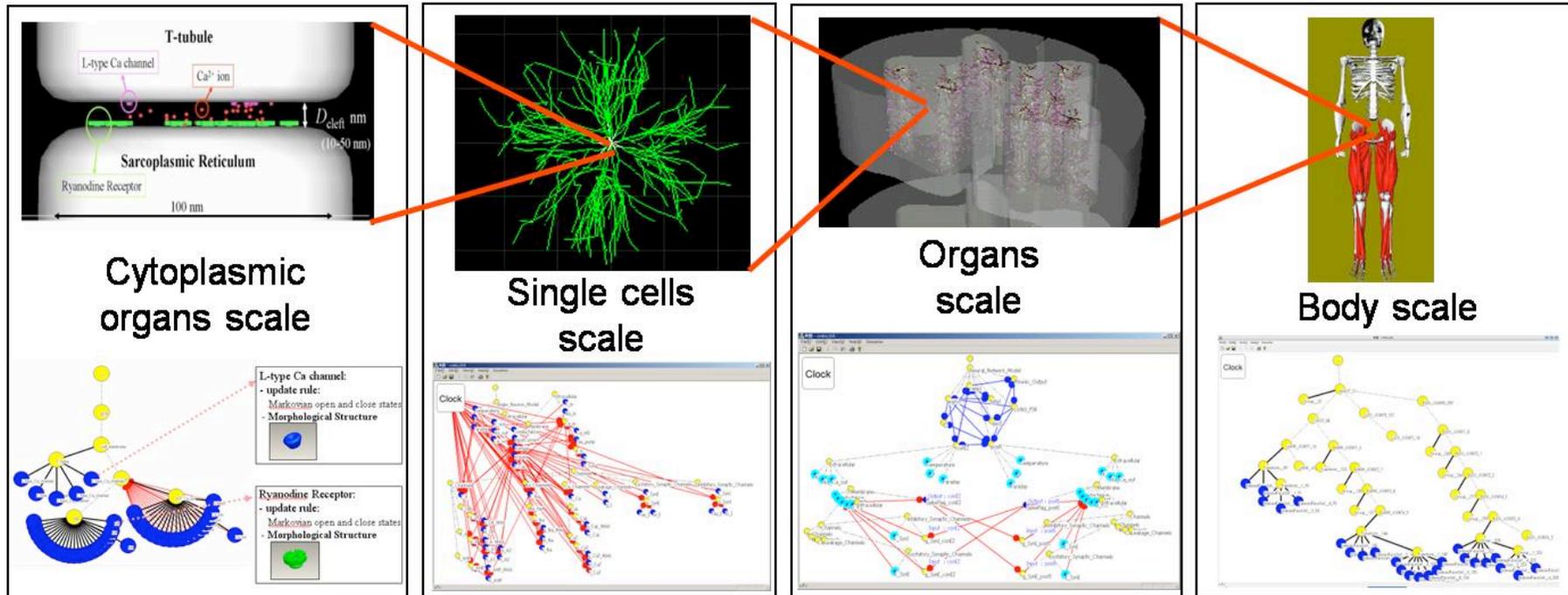


CellML-Compatible Integrated Development Environment for Multilevel Modeling of Biophysical Functions

Yoshiyuki Asai

Osaka University, JAPAN



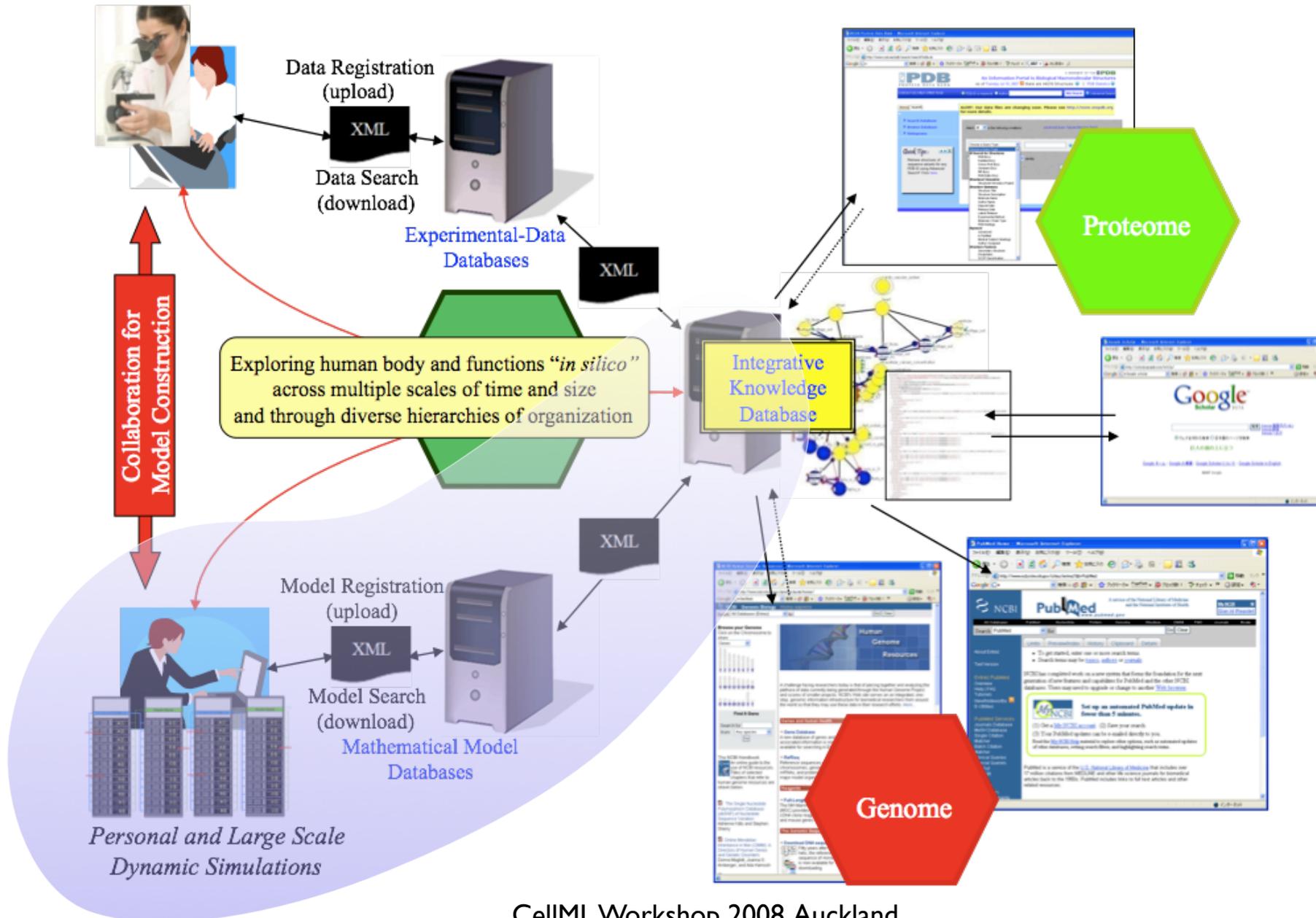


Databases covering multiple scale human structure and functions (Physiome)

Multiple scale modeling and simulations of human functions (Systems biology)

in silico human

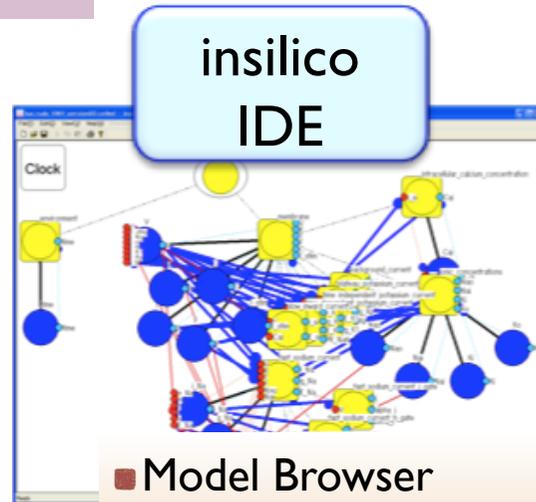
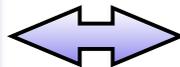
Establishment of “*in silico human*” will be able to provide solutions for clinical problems based upon understanding of the dynamic mechanisms of human physiology and pathology. Trials *in silico* for drug discovery, medical/welfare apparatus improves the development of products with higher efficiency, reliability and safety while reducing cost.



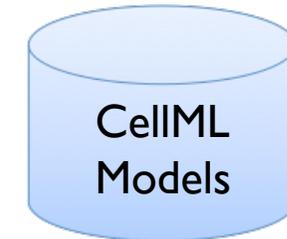
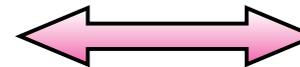
A CellML Compatible Tool



IUPS Physiome Project



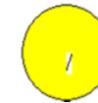
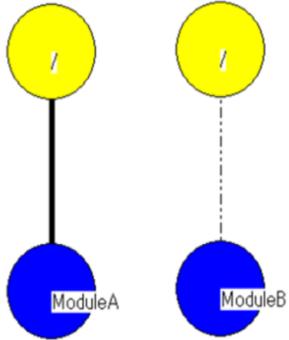
- Model Browser
- Model Editor
- Simulation Source Code Generator



- **insilicoIDE** can import **CellML** models.
- User can easily construct a new model by importing **CellML** files.
- Translation **CellML** and **insilicoML** is fully supported

Hierarchical Structure

Include / Constitute



Module

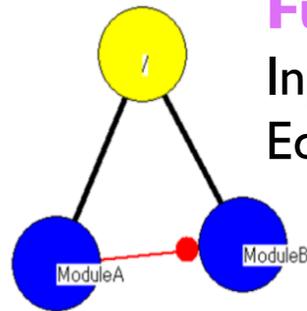
Functional Unit.

A group of Modules can be treated as a Module

Functional Link

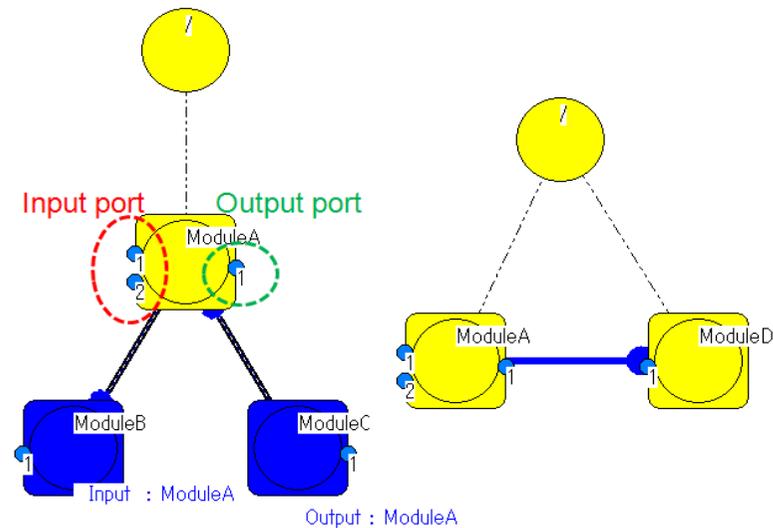
Input / Output Edge

Edges are connected via Ports

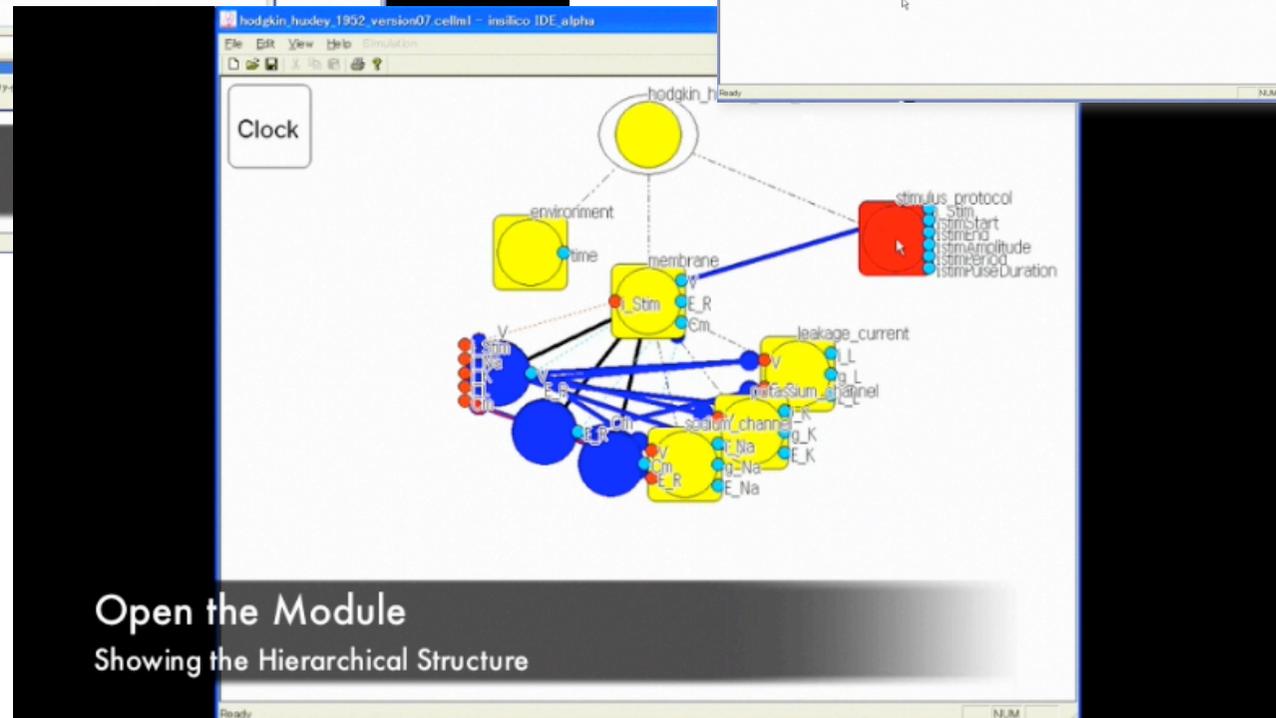
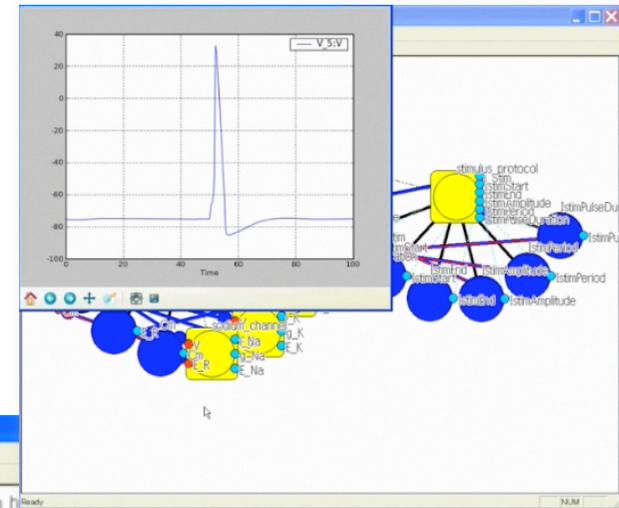
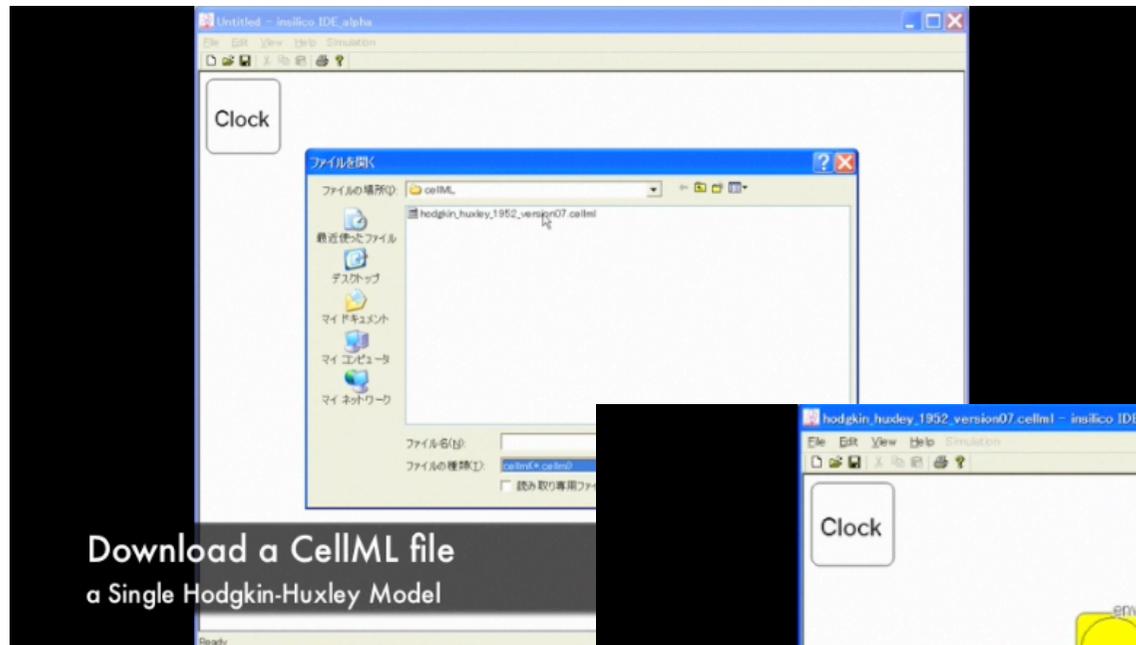


Encapsulation

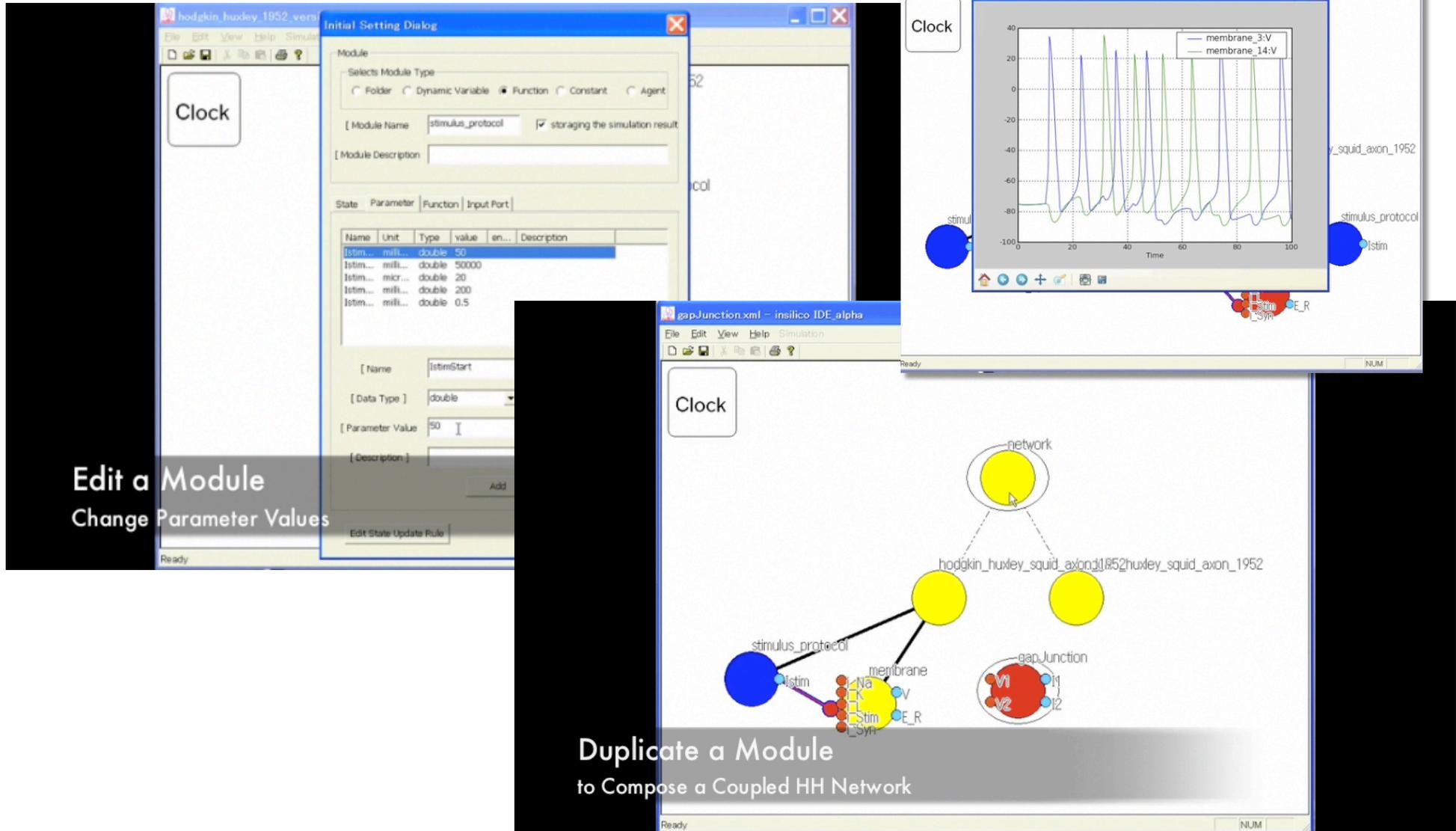
Representing a Bundle of Functions



Import a HH model written in CellML format and execute simulation.



Build a new model using a model imported from CellML.



Initial Setting Dialog

Module: stimulus_protocol

State Parameter Function Input Port

Name	Unit	Type	value	en...	Description
Istim...	milli...	double	50		
Istim...	milli...	double	50000		
Istim...	micr...	double	20		
Istim...	milli...	double	200		
Istim...	milli...	double	0.5		

[Name] IstimStart

[Data Type] double

[Parameter Value] 50

[Description]

Figure 1

membrane_3:V (blue line)

membrane_14:V (green line)

Time (0 to 100)

Network Diagram

network

hodgkin_huxley_squid_axon31852

hodgkin_huxley_squid_axon_1952

stimulus_protocol

gapJunction

membrane

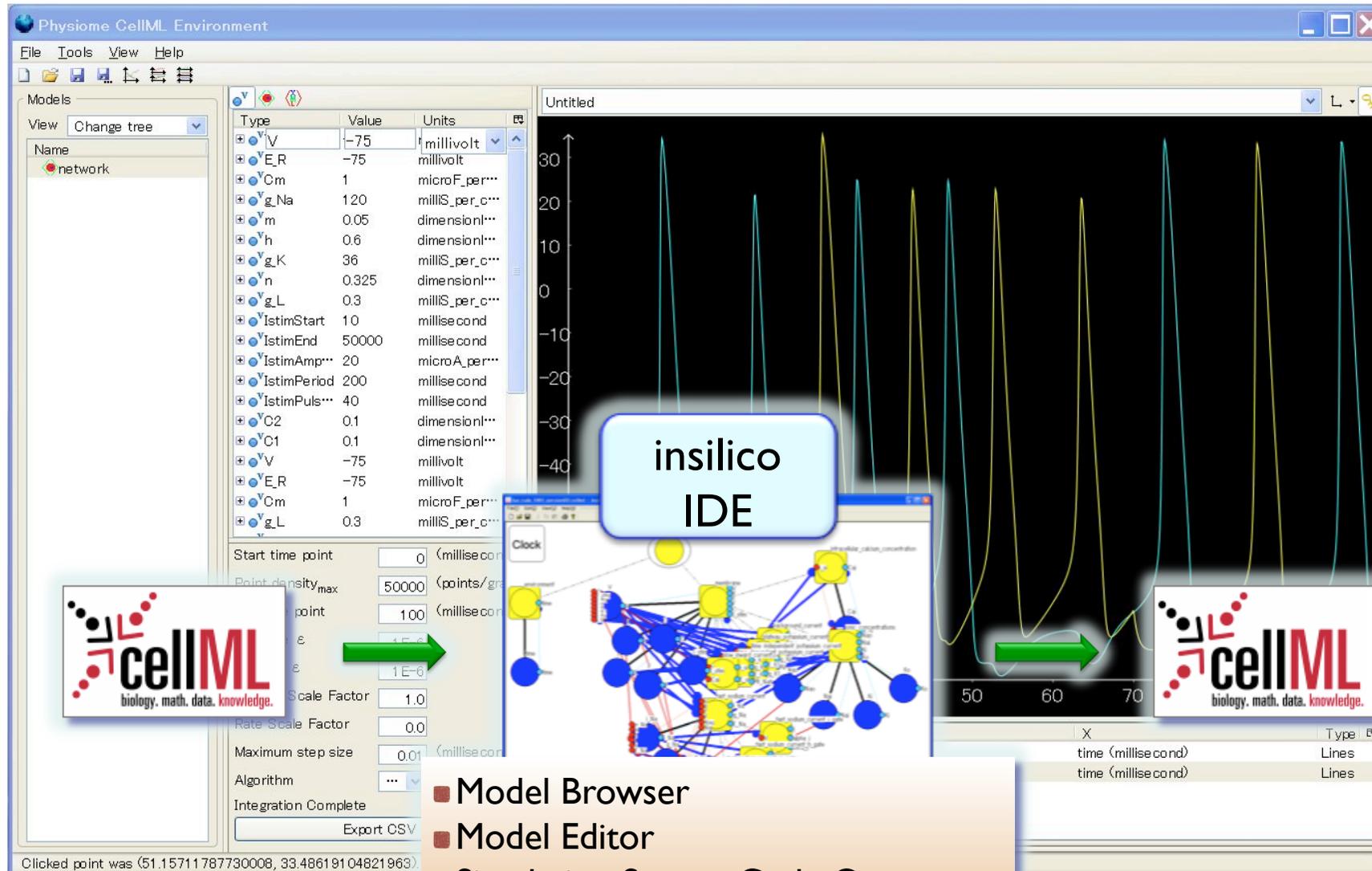
Stim

E_R

v1, v2, i1, i2

Edit a Module
Change Parameter Values

Duplicate a Module
to Compose a Coupled HH Network



insilico IDE

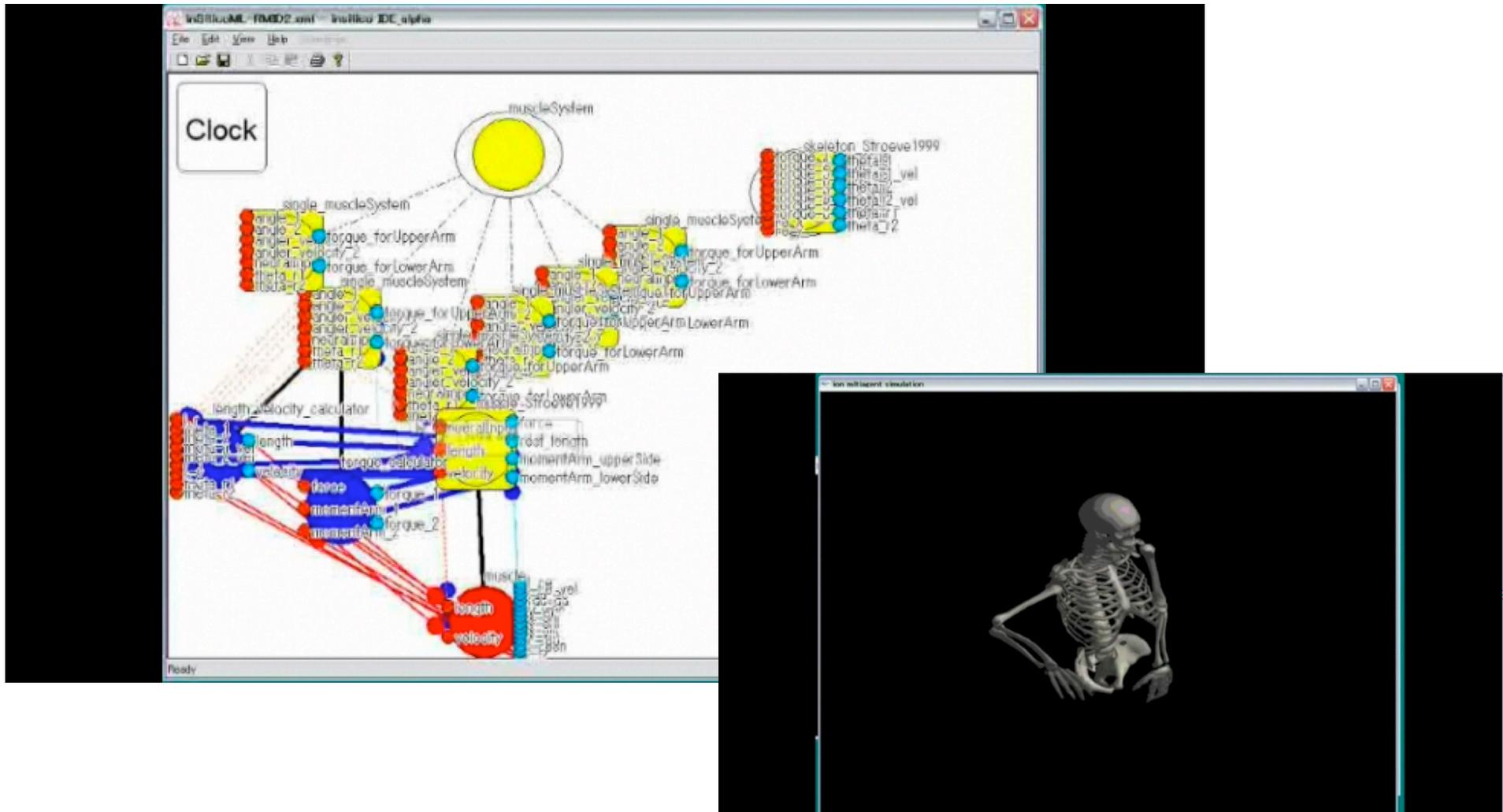
cellML
biology. math. data. knowledge.

cellML
biology. math. data. knowledge.

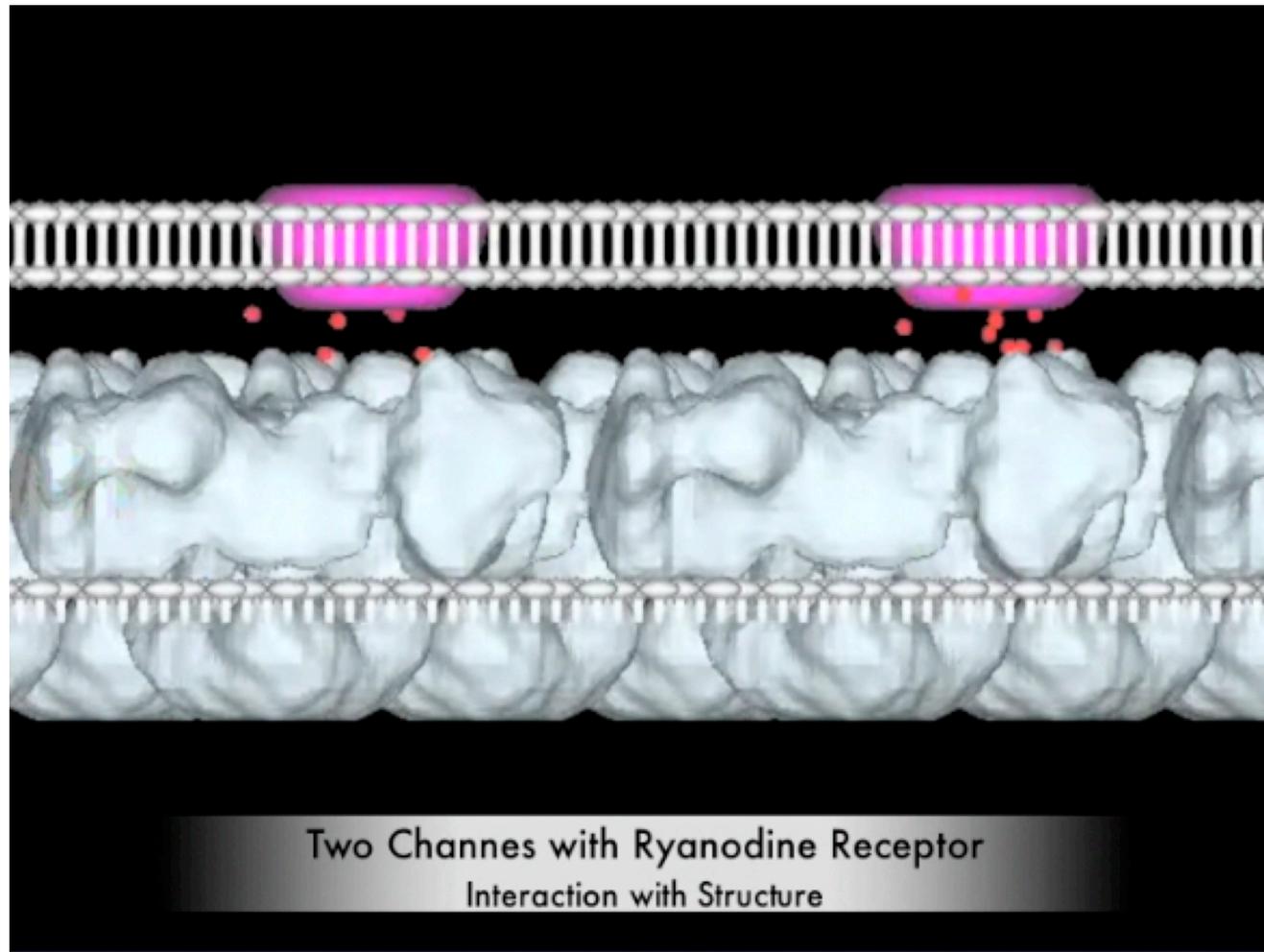
- Model Browser
- Model Editor
- Simulation Source Code Generator

```
1 <?xml version="1.0" encoding="UTF-8" standalone="no"?>
2 <insilico:ModuleSet
3   xmlns:insilico="http://www.physiome.jp/ns/insilicoml"
4   xmlns:m="http://www.w3.org/1998/Math/MathML"
5   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
14 <insilico:Module ClassID="3C8E9563-69C3-433C-9083-
15   <insilico:Author/>
29 <insilico:Geometry>
30   <insilico:VisualModel FormatType="wrl" href="hum
31   <insilico:PositionVector>
32     <m:math>
33       <m:vector>
34         <m:cn>-0.15</m:cn><m:cn>-0.15</m:cn><m:cn>
35       </m:vector>
36     </m:math>
37   </insilico:PositionVector>
38
39   <insilico:RotationMatrix>
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41       <m:matrix>
42         <m:matrixrow>
43           <m:cn>1</m:cn>
44           <m:cn>0</m:cn>
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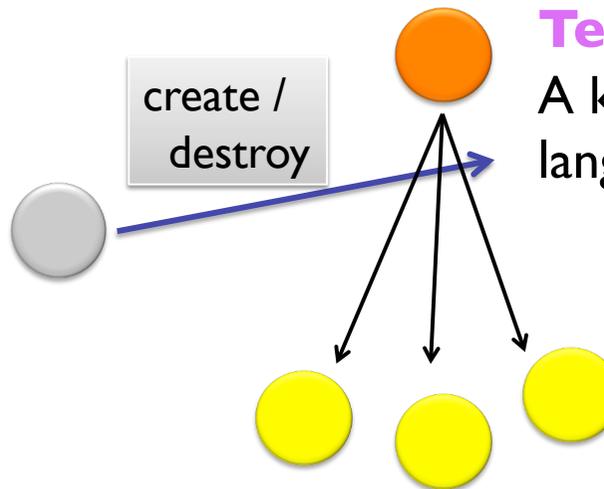
Arm model with muscles and neural control



Ion dynamics emitted from channel(s) on the cell membrane



Controller of Template
A manager of instances of the
template



Template Module

A kind of “Class” in objective language

Instances can be generated dynamically during simulation
or

managed in a lump on the ISIDE according to rules



Necessary to build large scale model

Developpers



Yoshi Kurachi@MEI
Project Coordinator



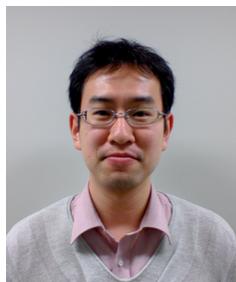
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Project Coleader



Yoshi Asai@MEI
Chief Developer



Taka Urai@Intasect
Head Programmer



Masa Nakanishi@ES
General Developer
Database
Neuronal Networks



Eric Heien@IST
HPC Developer



Toshi Kawazu@ES
Developer
Cardiac Cells



Yasu Suzuki@ES
Developer
CellIML Interface
Musculo-Skeletal



Masa Ato@ES
Developer
Drug Metabolism



Yoshi Taniguchi@ES
Developer
RDF Database