TRD 3: Simulation

SCiRun 4.6
with BioMesh3D

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This is not a logo!
“The overall goal of the CIBC is to provide biomedical scientists with access to comprehensive and sophisticated software tools with which to define the assumptions, the domains, and the initial or boundary conditions and, then, to carry out simulations using advanced and robust numerical and computation algorithms.”
Simulation Aims

1. Simulation of multiscale bioelectricity
2. Application of electric fields to excitable tissues
3. Development of efficient software
4. Verification, validation, sensitivity analysis
5. Curation of open-source models and results

Personalized Medicine
IBM & S Pipeline

Image Acq. & Processing
Segmentation & Structure Identification
Geometric Modeling & Fitting Structures
Visualization

Discrete points e.g., sensors

Meshing Volume Modeling
Simulation/Estimation
Verification/Validation

Boundary conditions
Measured Data

SCIRun
Simulation in CIBC
Estimation in CIBC
Estimation in CIBC
It is Time to Unite
What is the Place of CIBC Simulation in the World?

At Least the Small World of Cardiac Bioelectricity
The Cardiac Bioelectricity Workflow

1. Make a Model
2. Solve Equations
3. Calculate Parameters
4. Report Results
Cardiac Inverse Problems

Gaining Traction through Translation
Interactions

CIBC Research and Software Pipeline

Driving Biological Projects

IBM

SIM

EST

VIS

Small-Animal Phenotyping

Atrial Fibrillation

Analysis of Hip Dysplasia

Stimulation for Bone Growth

Cardiac Defibrillation

Deep Brain Stimulation

Pediatric Epilepsy

EEG Source Imaging

Biomedical Researchers and Clinicians
Interactions
CIBC as Simulation Hub

Radboud Universiteit Nijmegen

Newcastle University

KIT

R.I.T.

Virtual Physiological Human

network of excellence

INRIA

[ simula research laboratory ]
CIBC as Simulation Hub
What is the Place of CIBC Simulation in the World?

At Least the LARGE World of Neural Bioelectricity
CIBC in Neural Bioelectricity

Transcranial DC Stimulation (tDCS)

Neural Source Localization
SCIRun: Problem Solving Environment
Landscape of ideas

Many paths to take...
Simulation Progress

Simulation of Ischemia

Role of Conforming Mesh

Alternans in ECGSim
Simulation Progress

ECGSIM

SCIRun Forward/Inverse ECG Toolkit

SCIRun 4.6 Documentation

Chaste

Cardiac Arrhythmia Research Package

IONIC MODELLING  BIDOMAIN  VISUALIZATION  MESH GENERATION  MULTIPHYSICS
Demos
Future Directions