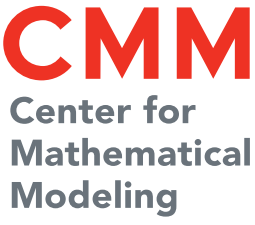

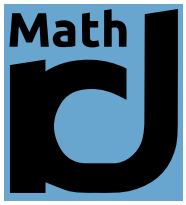

1st Summer School on Cardiovascular Modeling

January 18-20, 2017

Center for Mathematical Modeling
Universidad de Chile

Organizers: C.Bertoglio, C.Conca, G.Panasenko

Universidad de Chile, Santiago, 2017

1st Summer School on Cardiovascular Modeling, Santiago, Chile, January 2017

Mini courses

Tissue mechanics

Stéphane Avril
Center for Biomedical and Healthcare Engineering
École de Mines Saint Etienne
Course topic: Soft tissue mechanics

Blood flows

Cristóbal Bertoglio
Center for Mathematical Modeling
Universidad de Chile
Course topic: Blood flows modeling

David Nolte
Center for Mathematical Modeling
Universidad de Chile
Course topic: Simulating incompressible flows with Fenics

Vitaly Volpert
Institut Camille Jordan
University Lyon
Course topic: Mathematical modeling of coagulation

Electrophysiology

Alexander Panfilov
Department of Physics and Astronomy
Gent University
Course topic: Biophysics of cardiac electrophysiology

Daniel Hurtado
Department for Structural Engineering
Pontificia Universidad Católica de Chile
Course topic: Numerics of cardiac electrophysiology

Agenda

Venue: Room B112, Beauchef 851

Wednesday January 18th

8:50 – 9:00 **Overview on Cardiovascular Modeling**
Cristóbal Bertoglio

Mini-course: Vascular mechanics

9:00 – 10:30 **Modeling approaches for soft tissues biomechanics**
Basics of continuum mechanics and possible alternatives. Hyperelasticity. Other constitutive laws.
Stéphane Avril

10:30 – 11:00 Pause

11:00 – 12:30 **Finite-element modeling of soft tissues**
Basics of nonlinear finite-elements. Implicit. Explicit. Implementation of hyperelastic constitutive laws.
Stéphane Avril

12:30 – 14:00 Lunch

14:00 – 15:30 **Experimental techniques for soft tissue mechanics**
Basics testing. Full-field measurements and imaging. Digital image correlation. Image registration.
Stéphane Avril

15:30 – 16:00 Pause

16:00 – 17:30 **Inverse problems at different scales in soft tissues**
Mechanobiological origin of regional variations. Elastography. Inverse problems. The virtual fields method.
Stéphane Avril

Mini-course: Numerical hemodynamics

17:30 – 19:00 **Mathematical models in fluid mechanics**
Conservation laws. Navier-Stokes equations. Boundary conditions. Analytical solutions. Reduced order models
Cristóbal Bertoglio

Thursday January 19th

Mini-course: Numerical hemodynamics (cont.)

9:00 – 10:30 **Numerical solution of incompressible flows**
Spatial discretization. Temporal discretization. Linear solvers. Projection methods. Backflow stabilization
Cristóbal Bertoglio

10:30 – 11:00 Pause

11:00 – 12:30 **Simulating blood flows with Fenics**
Meshing with Gmsh. Python & the Fenics library. Navier-Stokes simulations. Postprocessing with Paraview.
David Nolte

12:30 – 14:00 Lunch

14:00 – 15:30 **Inverse problems in blood flows**
Clinical hemodynamics. Sequential estimation. Geometry uncertainties. Direct pressure estimation.
Cristóbal Bertoglio

15:30 – 16:00 Pause

16:00 – 17:30 **Mathematical modeling of blood coagulation**
Biological background. Different regimes of clot grow. Normal and pathological conditions.
Vitaly Volpert

Mini-course: Cardiac electrophysiology

17:30 – 19:00 **Introduction to non-linear waves**
Spiral waves. Cardiac arrhythmias
Alexander Panfilov

Friday January 20th

Mini-course: Cardiac electrophysiology (cont.)

9:00 – 10:30 **Electrophysiology of cardiac cells and their modeling**
The HH, LR and TNNP models
Alexander Panfilov

10:30 – 11:00 Pause

11:00 – 12:30 **Dynamic instabilities and ventricular fibrillation**
Alternants. Wavebreaks. Ventricular Fibrillation.
Alexander Panfilov

12:30 – 14:00 Lunch

14:00 – 15:30 **Cardiac tissue electrophysiology**
Tissue architecture, cable equation. Bidomain and monodomain models. Temporal discretizations.
Daniel Hurtado

15:30 – 16:00 Pause

16:00 – 17:30 **Spatial discretizations in cardiac electrophysiology**
Finite elements. Whole organ models: ventricles, atria. Variational principles. Incompatible modes.
Daniel Hurtado

17:30 – 18:00 Pause

18:00 – 19:00 **Cardiac electromechanics**
Mechano-electric feedback. Stretch activated channels and cardiac arrithmias.
Alexander Panfilov