INdAM Workshop

“Mathematical and Numerical Modeling of the Cardiovascular System”

Roma, 15-19 April 2024

Città Universitaria – P.le Aldo Moro 5

00185 Roma, Italy

DAY BY DAY PROGRAM

DAY 1 – MONDAY APRIL 15

14:15-14:30 OPENING & WELCOME

14:30-16:00 KEYNOTE LECTURES (Chairman: Luca F. Pavarino)

- 14:30-15:15 Natalia A. Trayanova (Johns Hopkins University, Baltimore, USA) Advancing arrhythmia care with digital twins and AI
- 15:15-16:00 Simone Pezzuto (Università degli Studi di Trento, Italy) Probabilistic learning of the cardiac activation from the electrocardiogram

16:00-16:30 COFFEE BREAK

16:30-18:10 CONTRIBUTED TALKS (Chairman: Simone Pezzuto)

- 16:30-16:50 Sara Frusone (Université Cote d’Azur, Sophia Antipolis, France) Persistent atrial fibrillation: mathematical modeling of the STD vs non-STD identification criteria
- 16:50-17:10 Niccolò Biasi (Università degli Studi di Pisa, Italy) A framework for patient-specific electrophysiology simulations in healthy and post-infarction patients
- 17:10-17:30 Sofia Botti (Università della Svizzera Italiana, Lugano, Switzerland) A novel atrial-specific ionic model for stem cells derived CMs
- 17:30-17:50 Edoardo Centofanti (Università degli Studi di Pavia, Italy) Operator learning for ionic models in cardiac electrophysiology
- 17:50-18:10 Anna Crispino (Università Campus Biomedico di Roma, Italy) Experimental-based mathematical modeling of thermo-electric spatio-temporal cardiac excitation
DAY 2 – TUESDAY APRIL 16

9:00-9:45 KEYNOTE LECTURE (Chairman: Francesco Regazzoni)

- 9:00-9:45 Edward J. Vigmond (University of Bordeaux, France) Using modelling to improve interpretation of cardiac electrograms

9:45-10:45 JUNIOR KEYNOTE LECTURES (Chairman: Francesco Regazzoni)

- 9:45-10:15 Ngoc Mai Monica Huynh (Università degli Studi di Pavia, Italy) Tailoring preconditioners for enhanced efficiency in cardiac modeling: insights from domain decomposition
- 10:15-10:45 Fatemeh Chegini (Zuse Institute Berlin, Germany) Efficient simulation of cardiac electrophysiology with algebraic adaptivity

10:45-11:15 COFFEE BREAK

11:15-12:15 CONTRIBUTED TALKS (Chairman: Gianluigi Rozza)

- 11:15-11:35 Federica Caforio (University of Graz, Austria) Parameter estimation in cardiac biomechanical models based on physics informed neural networks
- 11:35-11:55 Michele Torre (Università degli Studi di Pavia, Italy) Cardiac tissue modeling via an isogeometric collocation method
- 11:55-12:15 Mohammadreza Kariman (University of Graz, Austria) Exploring the impact of left ventricular growth on ECG morphology: unveiling insights into hypertrophy

12:15-13:00 KEYNOTE LECTURE (Chairman: Gianluigi Rozza)

- 12:15-13:00 Francesco Regazzoni (Politecnico di Milano, Italy) Accelerating cardiac simulations: numerical methods and scientific machine learning

13:00-14:30 LUNCH BREAK

14:30-16:00 KEYNOTE LECTURES (Chairman: Christian Vergara)

- 14:30-15:15 Aslak Tveito (SIMULA, Oslo, Norway) Numerical simulation of the electrophysiology of stem cell-derived cardiomyocytes in microphysiological systems
- 15:15-16:00 Mark Potse (LIRYC Institute Bordeaux, France) Modeling the heart, cell by cell

16:00-16:30 COFFEE BREAK

16:30-17:30 CONTRIBUTED TALKS (Chairman: Roberto Piersanti)

- 16:30-16:50 Fabio Marcinò (EPFL, Lausanne, Switzerland) Myocardial infarction risk assessment by numerical approximation of haemodynamic-based indices in coronary arteries
• **16:50-17:10 Janina C. Datz** (Technical University of Munich, Germany) *Patient-specific coronary angioplasty simulations with mixed-dimensional contact mechanics for stent-artery interaction*

• **17:10-17:30 Alessia Lucca** (Università degli Studi di Trento, Italy) *Numerical method for efficient blood flow simulations in coronary artery trees*

• **17:30-17:50 Giovanni Montino Pelagi** (Politecnico di Milano, Italy) *Integrated modeling of coronary flow and myocardial perfusion in healthy conditions and coronary artery disease*
DAY 3 – WEDNESDAY APRIL 17

9:00-9:45 KEYNOTE LECTURE (Chairman: Simone Scacchi)

- 9:00-9:45 Xiao-Chuan Cai (University of Macau, China) A parallel implicit algorithm for simulating patient-specific human heart

9:45-10:45 CONTRIBUTED TALKS (Chairman: Simone Scacchi)

- 9:45-10:05 Alessio Gizzi (Università Campus Biomedico di Roma, Italy) Thermo-hyperelastic microstructure constitutive modeling of myocardial tissue for cardiac radiofrequency ablation
- 10:05-10:25 Stefano Severi (Università degli Studi di Bologna, Italy) Sinoatrial node heterogeneity and fibrosis increase atrial driving capability in a two-dimensional human computational model
- 10:25-10:45 Ping Lin (University of Dundee, UK) Phase-field models and their finite element schemes for the deformation and interaction of red blood cells in a narrowed artery

10:45-11:15 COFFEE BREAK

11:15-12:15 CONTRIBUTED TALKS (Chairman: Ngoc Mai Monica Huynh)

- 11:15-11:35 Pasquale C. Africa (SISSA, Trieste, Italy) Challenges in cardiovascular CFD: the potential of multi-fidelity models
- 11:35-11:55 Nimra Muqaddas (Università degli Studi di Palermo, Italy) Finite difference analysis for pulsating flow through 2D axisymmetric locally narrow artery: physiology of cardiovascular disease

12:15-13:00 KEYNOTE LECTURE (Chairman: Ngoc Mai Monica Huynh)

- 12:15-13:00 Cristobal Bertoglio (University of Groningen, Netherlands) Inverse problems in cardiovascular models from velocity measurements

13:00-... LUNCH + FREE AFTERNOON
DAY 4 – Thursday April 18

9:00-9:45 KEYNOTE LECTURE (Chairman: Cristobal Bertoglio)

- 9:00-9:45 Irene E. Vignon-Clementel (INRIA Saclay Ile-de-France Research Center, France) Cardiovascular models for organ perfusion assessment and treatment planning: facing constraints for parameterization from patient data

9:45-10:45 JUNIOR KEYNOTE LECTURES (Chairman: Cristobal Bertoglio)

- 9:45-10:15 Roberto Piersanti (Politecnico di Milano, Italy) Enhanced Laplace-Dirichlet rule-based methods for modeling and analyzing cardiac muscular fibers: validation and comparative analysis
- 10:15-10:45 Surabhi Rathore (SISSA, Trieste, Italy) PDE-constrained time optimal control problems with reduction modeling: cardiovascular applications

10:45-11:15 COFFEE BREAK

11:15-12:15 CONTRIBUTED TALKS (Chairman: Luca F. Pavarino)

- 11:15-11:35 Francesco Viola (GSSI, L'Aquila, Italy) Investigation of the hemodynamics features past bioprosthetic valves: effects of the valve deployment location
- 11:55-12:15 Luca Crugnola (Politecnico di Milano, Italy) Computational aortic hemodynamics indicators to predict transcatheter aortic valve implantation degeneration

12:15-13:00 KEYNOTE LECTURE (Chairman: Luca F. Pavarino)

- 12:15-13:00 Francesco Migliavacca (Politecnico di Milano, Italy) Digital twins for cardiovascular and neurovascular interventions: details matter

13:00-14:30 LUNCH BREAK

14:30-16:00 CLINICAL SESSION (Chairman: Christian Vergara)

- 14:30-15:00 Santi Trimarchi (Università degli Studi di Milano, Italy) Numerical modeling in vascular surgery
- 15:00-15:30 Giovanni Battista Luciani (Università degli Studi di Verona, Italy) Clinical relevance of mathematical models in cardiac surgery
- 15:30-16:00 Riccardo Maragna (Centro Cardiologico Monzino di Milano, Italy) Imaging-based assessment of cardiovascular risk

16:00-16:30 COFFEE BREAK
16:30-17:30 CLINICAL SESSION (Chairman: Christian Vergara)

- 16:30-17:00 Maurizio Del Greco (Ospedale S. Maria del Carmine di Rovereto, Italy) *High quality 3D study of the electrophysiological substrate of complex arrhythmias and left ventricular conduction disturbances in human*

- 17:00-17:30 Gabriele Dell’Era (Azienda Ospedaliera Universitaria Maggiore della Carità, Novara, Italy) *Conduction System Pacing: new opportunities for patients, new challenges for modelling*

17:30-18:30 DISCUSSION

20:00-... SOCIAL DINNER
DAY 5 – FRIDAY APRIL 19

9:00-9:45 KEYNOTE LECTURES (Chairman: Francesco Migliavacca)

- 9:00-9:45 Zeike Taylor (University of Leeds, UK) Virtual patient populations for in silico trials: from twins to chimeras
- 9:45-10:30 Cristiana Corsi (Università degli Studi di Bologna, Italy) Medical imaging for patient-specific modelling: the best option to run realistic simulation studies

10:30-11:00 COFFEE BREAK

11:00-12:20 CONTRIBUTED TALKS (Chairman: Gianluigi Rozza)

- 11:00-11:20 Miriam Loecke (University of Groningen, Netherlands) Parameter estimation from undersampled MRI in frequency space
- 11:20-11:40 Francesca Renzi (Università degli Studi di Verona, Italy) Patient-specific image-based computational fluid dynamic model of the right heart
- 11:40-12:00 Martino A. Scarpolini (GSSI, L'Aquila, Italy) Data-driven simulation of ventricle and aorta integrating in-vivo data and FSI model
- 12:00-12:20 Paolo Melidoro (King's College London, UK) Global sensitivity analysis of potential contributing factors of thrombus formation in the left atrial appendage for patients with atrial fibrillation

12:20-13:05 KEYNOTE LECTURE (Chairman: Simone Scacchi)

- 12:20-13:05 Olaf Doessel (Karlsruhe Institute of Technology, Germany) Computerized modeling of the human atria

13:05-13:15 CLOSING REMARKS
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