

CRIMSON WORKSHOP: SIMPLE PROTOTYPING OF MATERIAL & BOUNDARY CONDITIONS IN 1D & 3D BLOOD FLOW SIMULATIONS

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MINI-SYMPOSIUM PROPOSAL

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1 OBJECTIVES

The purpose of this workshop is to demonstrate the [CRIMSON](#) (CardiovasculaR Integrated Modelling and SimulatiON) software environment. CRIMSON provides a powerful, complete and user-friendly system for performing computational hemodynamics studies, permitting segmentation of vascular structures from medical images, construction of analytic arterial geometric models, finite element mesh generation, designing and applying boundary conditions, running incompressible Navier-Stokes simulations, and post-processing and visualizing the results, including velocity, pressure and wall shear stress fields.

CRIMSON leverages in open-source standards such as [MITK](#), [VMTK](#), [OpenCascade](#), and [Verdandi](#), and provides state-of-the art 1D and 3D fluid-structure interaction solvers.

CRIMSON aims to provide a cardiovascular simulation environment that is both easily customizable for the research community and user-intuitive for a wider audience, including clinicians and students.

1.1 Format of the Workshop

The workshop will combine a series of short talks and demonstrations by both the organizers and the speakers. The organizers will provide an overview of the workflow and basic features of the software. Special emphasis will be made on the Python interface of the code, which enables simple yet powerful prototyping of rules for material tissue properties and boundary condition specification.

The organizers will also demonstrate the use of CRIMSON's Netlist Boundary Condition Modes (BCM) to define lumped-parameter models for inflow and outflow boundary conditions. Using this approach, the circuits defining the boundary conditions are literally sketched-out by the user. The software then assembles the resulting set of Ordinary Differential Equations which are implicitly coupled to the Navier-Stokes flow solver.

Additional demonstrations will include geometric modeling, different approaches to centerline extraction, and tissue properties specification.

1.2 Logistics

Participants are encouraged to [download the software](#) prior to the meeting and install it on their laptops. Windows version is preferred, although a Linux version is available as well. Participants are also encouraged to review the [software documentation](#) available on the CRIMSON website prior to the meeting. Participants are encouraged to contact the workshop organizers prior to meeting if they are interested in developing their own Python-based scripts for material or boundary condition specification.

REFERENCES

- [1] R. Khlebnikov, C.A. Figueroa. “CRIMSON: Towards a software environment for patient-specific blood flow simulation for diagnosis and treatment”. In “Clinical Image-Based Procedures. Translational Research in Medical Imaging”. Ed: C. Oyarzun Laura et al. Publisher: Springer. 4th International Workshop, CLIP 2015, Held in Conjunction with MICCAI 2015, Munich, Germany, October, 2015. DOI: 10.1007/978-3-319-31808-0 2. 2016. ISBN: 978-3-319-31808-0
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