Scientific Computing

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Talk: VMTK, the Vascular Modelling Toolkit - October 29

We have the pleasure to announce a guest lecture on Monday Oct. 29, to be given by Luca Antiga from Mario Negri Institute for Pharmacological Research. He will talk about VMTK, the Vascular Modelling Toolkit. The Vascular Modeling Toolkit is a collection of libraries and tools for 3D reconstruction, geometric analysis, mesh generation and surface data analysis for image-based modeling of blood vessels.

More info on Antiga and his work:

Luca Antiga is the head of the Medical Imaging Unit at Mario Negri Institute for Pharmacological Research. He obtained his PhD degree in 2003 at "Politecnico di Milano", and carried out his Post-Doctoral fellowship at the Robarts Research Institute, in London, Ontario, Canada, under the supervision of David Steinman, who is still a close collaborator today. Luca's interests span medical imaging, image processing, computational geometry and computational hemodynamics. He is the main developer of the Vascular Modelling Toolkit (vmtk.sourceforge.net) and contributes to several open-source projects (VTK, ITK, Slicer3).

The Mario Negri Institute for Pharmacological Research is a private foundation for scientific research and tuition. Established in 1963, the MNI is based in Milan, with research centres in Bergamo and Ranica. Within the Institute, over 600 people are involved in experimental and clinical research which spans from immunology, vascular biology, cancer, central nervous system, nephrology and biomedical engineering. The main fields of research of the Bioengineering Department are biological mass transport, effects of fluid mechanics on vascular cells, tissue engineering, medical imaging and CFD for biomedical applications.

Further information regarding VMTK can be found at: http://villacamozzi.marionegri.it/~luca/vmtk/doku.php

The VMTK Features

Segmentation of vascular segments (or other anatomical structures) from medical images:

- Gradient-based 3D level sets segmentation. A new gradient computation modality based on upwind finite differences allows the segmentation of small (down to 1.2 pixels/diameter) vessels.
- Interactive level sets initialization based on the Fast Marching Method. This includes a brand new method for selecting a vascular segment comprised between two points automatically ignoring side branches, no parameters involved. Segmenting a complex vascular tract comes down to selecting the endpoints of a branch, letting level sets by attracted to gradient peaks with the sole advection term turned on, repeating the operation for all the branches and merging everything in a single model.

Geometric analysis and surface data processing of 3D models of blood vessels (and tubular objects in general)   1):

- Compute centerlines and maximal inscribed sphere radius of branching tubular structures given their polygonal surface representation
- Split surface models into their constitutive branches based on centerline geometry
- Compute centerline-based geometric quantities (such as bifurcation angles, planarity, symmetry, branch curvature, tortuosity) and surface-based geometric quantities (such as distance to centerlines, surface curvature, deviation from tangency to maximal inscribed spheres)
- Robustly map branches to a rectangular parametric space
- Generate rectangular patches based on the parametric mapping for statistical analysis of geometric and CFD data over populations.

Scripts, I/O tools and simple algorithms to easily work with images and meshes:

- Read and write a number of image, surface and volume mesh formats. Includes a DICOM series reader with auto-flipping capabilities, Netgen mesh format reader, libMesh xda mesh format writer, Tetgen mesh generator wrapper, FIDAP FDNEUT mesh format reader and writer and a Newtetr input file generator
- Display images and meshes
- Incapsulate several VTK classes and make them available as pipeable scripts (e.g. Marching Cubes, surface smoothing, clipping, normal computation, connectivity, subdivision, distance between surfaces, ICP registration)
- Add cylindrical extensions to surface model boundaries as a preprocessing step for CFD simulations.
- Generate boundary layers of prismatic elements with varying thickness for CFD

What	
When	Oct 29, 2007 from 11:15 AM to 12:00 PM
Where	Bakromet at Simula
Contact Name	Kent Andre Mardal
Add event to calendar	vCal iCal