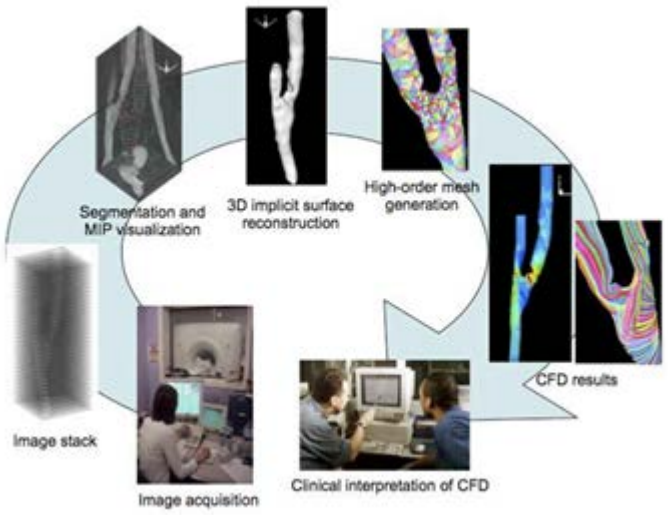
MSc project “Pipeline for image based numerical simulations”

Background

Biophysics models (numerical simulation) can help providing additional information to the clinician based on medical images. Examples are different type of cardiac related calculations like CFD for flow or mechanics based on cardiac motion.

A bottleneck in setting-up numerical simulations from medical images is the creation of high quality numerical mesh from the image derived geometries. This requires often several manual steps and hinders integration of simulations with image processing tools in the clinical workflow.

At Philips, advanced tools are available for automatic image segmentation deriving geometries. Also, high level expertise is available on numerical simulations in the clinical domain. Philips is interested in developing methods/tools which can optimally integrate the two in the clinical workflow.



Example from *Peiro et al, Automatic reconstruction of a patient-specific high-order surface representation and its application to mesh generation for CFD calculations, 2008*

Overall goal of the project

The overall goal of the project is to investigate methods to create high quality volumetric meshes from medical images, which are directly usable for numerical simulations.

Research scope

The MSc research will consist of:

- Inventory and testing of possible options for creating 3D geometries for numerical simulation from images e.g:
  - Direct use of volumetric binary masks for numerical simulation
  - Methods to improve segmentation to guarantee quality simulation
- Define use case(s).
- Development and implementation in software of the most promising methods.
- Evaluation of the selected methods.
- Reporting of the evaluation outcome: MSc thesis, final presentation, potentially a conference or journal publication.

Expected outcome

Ample insight into the possibility of creating high quality volumetric meshes from medical images for numerical simulations, consolidated in a prototype algorithm and reported in an MSc thesis, presented in a 30 min final presentation, and potentially a paper submission to a scientific conference or journal.

Required expertise and capabilities

- Knowledge of numerical methods, FE modelling.
- Knowledge of state-of-the-art in image analysis algorithms.
- Experience in programming (MatLab/Python, preferably also basics of C, C++ or C#).
- Fluent English speaking and writing.
- Good communication skills.
- And: highly motivated, independent, analytical, systematic, good planner.

Hosting group & supervision

Philips Research Eindhoven (PRE)
Multiphysics & Optics
Eindhoven, The Netherlands

Supervisors: Prof. Dr. Marcel Breeuwer (TU/e), Dr. Kevin Lau (PRE) and Dr. Marco Baragona (PRE)

Start date & duration

Start date: after summer 2018
Duration: minimally 9 months full-time

Contact

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