Patient-Specific Flow Simulation. Part 1. Geometry: Image Processing and Mesh Generation

Dr. Igor Sazonov
Civil and Computational Engineering Research Centre, Swansea University

Every year more nearly eight million People die of cardio-vascular deceases. Development of aneurysm and stenosis is often the result of local flow pattern, vortex structures and wall shear stress (WSS), which in turn depend on blood vessel geometry. It is extremely complicated to measure these flow parameters in vivo at present time. Therefore, the patient-specific numeric modelling, based on true geometry obtained from MR or CT scans could be used to study aneurysm growth or stenosis formation.

A scan-based, subject-specific computational modelling approach includes three stages. The first stage is the image segmentation to construct the object geometry from 3D scans. Next step is to convert the object into a 3D volumetric mesh with a smooth surface that is as close to the actual domain as possible. The third and final stage is the flow solution. Performance of the flow solution depends significantly on the mesh quality. Powerful mesh generation methods exist for technological applications in which the object boundaries are well-defined (analytically or piecewise analytically). In subject-specific biomedical geometries, the boundary is not well-defined. Therefore, additional difficulties are faced in surface mesh generation.

In this talk the first two (geometrical) stages will be discussed.