GridgenApp

A Unique Gridgen® Application

Gridgen
Reliable CFD Meshing

CFD and FEM for Medical Applications Using Gridgen Meshes

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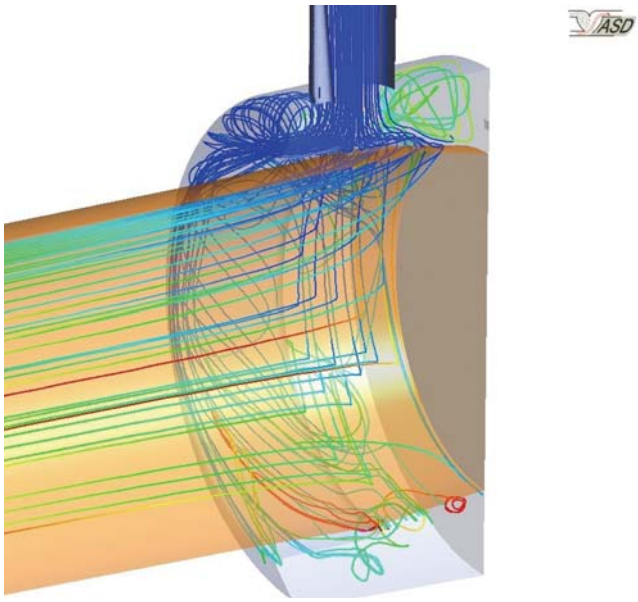

Streak lines of the dialysate inflow into the fiber bundle (the orange cylinder represents the fiber bundle).

ASD Advanced Simulation & Design GmbH provides expert numerical simulation services in the field of medical technology by assisting manufacturers in product development and design processes. Both flow simulations and structural mechanical analyses are performed using several commercial simulation software packages. For these often very different applications, ASD uses Gridgen as the favored mesh generator because of its ability to create structured, unstructured and hybrid meshes and its interfacing to many software packages.

Simulations are performed over a wide range of very different applications including dental, orthopedic and traumatologic implants, blood pumps, oxygenators and dialyzers. Specific expertise is provided with modelling non-Newtonian blood behavior, including clotting, and mechanical damage processes or the highly non-linear and anisotropic mechanical properties of living bone and tissue by translating related models into CFD and FEM software.

As an example, ASD developed a virtual dialyzer. With a virtual dialyzer, not only can the blood and dialysate flow behavior be investigated, but also the convective and diffusive mass transfer across the membrane. In general, a dialyzer consists of a fibers bundle with up to 10,000 fibers with an outer diameter of about 0.38 mm and a fiber length of 200 mm. The large amount of fibers and the small dimension of a single fiber compared to the size of the dialyzer housing makes it impossible to simulate simultaneously both the mass transfer across the membrane and the global flow in only one geometrical model. Therefore, the virtual dialyzer model consists of a global and a local model.

In the global model, the fiber bundle is assumed as a porous object considering the anisotropy of the radial and axial permeability factors. From the resulting global velocity and pressure distributions, the boundary conditions for the local model are generated. This local model contains a representative segment of the entire fiber bundle geometrically resolving the membrane and the intra- and extraluminal space. Using this model, the mass transfer across the membrane can be predicted by considering the diffusive and convective transport of different substances solved in the blood. The virtual dialyzer was validated with experimental data and was successfully applied to the design. For manufacturers this offers the chance for assessing and optimizing existing designs or designing new devices very fast and cost-effectively.

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