3D Bifurcating Artery (steady) - Verification & Validation

Author(s): Keith Works, Cornell University

Verification & Validation

Verification

The first two things we check for verification are the mass conservation and inlet boundary conditions. We check the inlet boundary conditions to ensure that the conditions are as we expect. Then, we do a mesh refinement and use a smaller time-step to check whether the results are consistent with the original calculation. By using a finer mesh and a smaller time-step, we investigate the effects of truncation error caused by spatial discretization and temporal discretization. Then we will do a case comparison for the results obtained after spatial and temporal refinement.

Mass conservation

To check whether mass is conserved in this calculation, go back into Fluent and go to Reports Fluxes and then under options, check "Mass flow rate". Then select the one inlet and two outlets. We would expect the mass flux to sum up to zero (or extremely small).
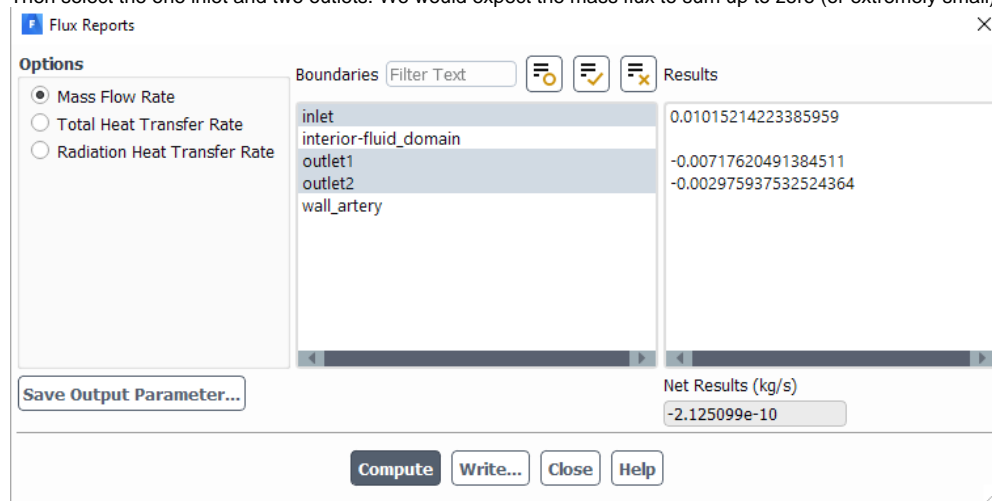
As we can see from the window above, the mass fluxes add up to -2.125e-10, which is very close to zero. Thus, we can conclude that mass is conserved in the simulation.

Checking the Inlet boundary conditions

Under construction

Mesh Refinement & Smaller Pseudo-timestep

Under construction

Validation

It is also always good to compare the results obtained from simulations with experimental results. In this case however, we do not have experimental data but we do have description of flow in the carotid artery, courtesy of your textbook. We find that the flow in the internal and external carotid arteries should be approximately 70% and 30% of the total flow in the common carotid artery. We can check this in Fluent by using the mass flow rate values we found earlier.

References:

"Transport Phenomena in Biological Systems" by Truskey, Yuan, and Katz.

Acknowledgement:

This tutorial is made under great help and support from Dr. Rajash Bhaskaran, Cornell University.

Go to Step 8: Exercise

Go to all FLUENT Learning Modules