Acceleration technique for Schwarz methods

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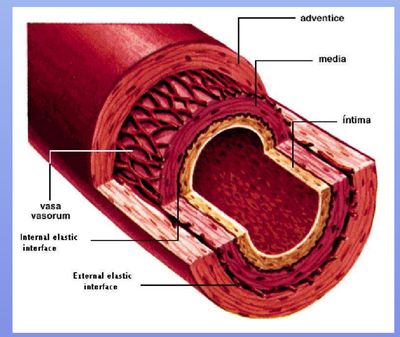
Abstract: Schwarz Domain Decomposition Methods are natural tools to use in multi-physic simulations. But the largest the number of sub-domain, the slowest the convergence is. Can we keep the simplicity of the algorithm and the scalability of the implementation, but improve the numerical efficiency of the scheme?

Introduction:

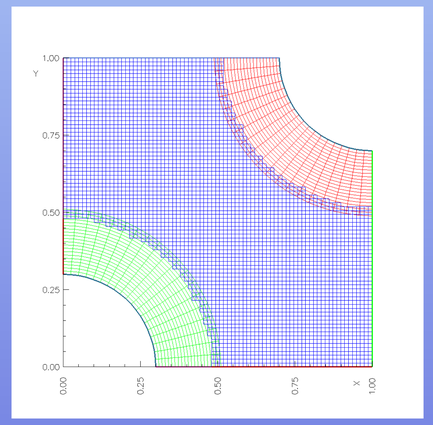


Multi-physics in an artery

- Today's simulations tend to be multi-physics and have to be solve on thousand's of processors.
- Schwarz Domain Decomposition Methods should be therefore natural tools for those problems.

- The goal of this research is to improve those algorithms to keep ease of implementation and parallel scalability, and increase their numerical efficiency.

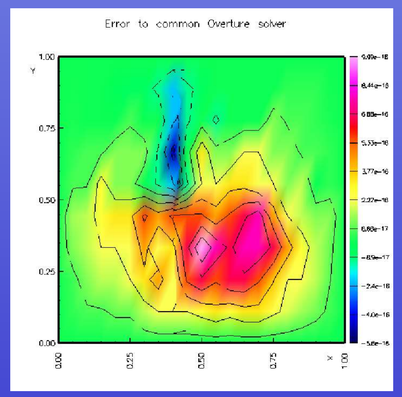
Methods:



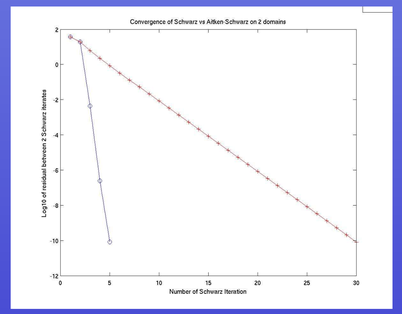
Overset grids generated with OVERTURE

- OVERTURE : generate Overset grids and solve sub-domains problems.
- Schwarz algorithm : solve on each domain independently and then interpolate the solutions at virtual boundaries. Repeat the process until convergence.
- Aitken Acceleration : Compute the eigenvalues of the trace transfer operators to decrease the number of Schwarz iterations required.

Results:



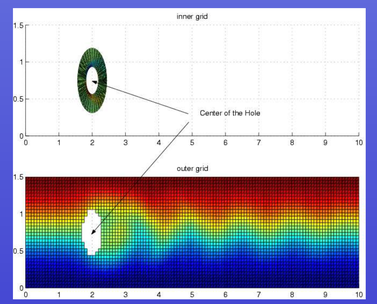
Error between OVERTURE and Aitken-Schwarz solvers



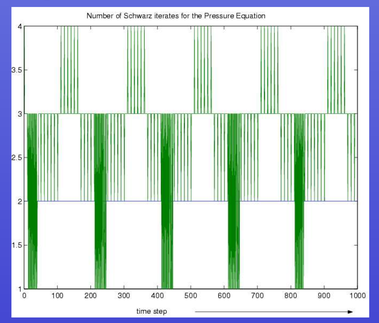
Convergence history : Schwarz vs. Aitken Schwarz

Discussion:

- Solve Navier-Stokes equations using vorticity-stream formulation
- Apply the acceleration method to complex geometries



Overset grids for vorticity-stream Navier-Stokes equations



Number of Schwarz iterations history through the simulation

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