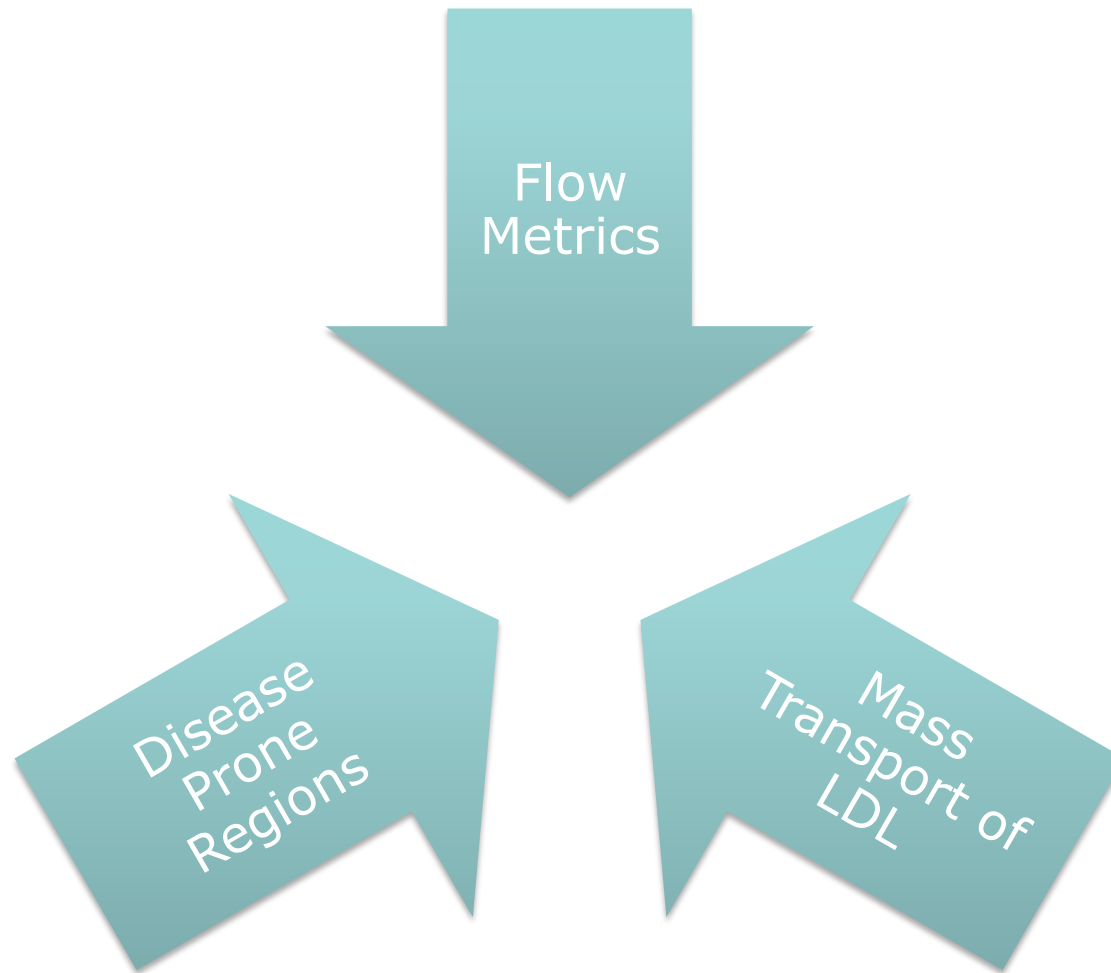


Wall Shear Stress, Mass Transport and Atherosclerosis

Yumnah Mohamied

What is Atherosclerosis?

- Underlying cause of most heart attacks and strokes.
- Cardiovascular disease characterised by accumulation of lipids within the arterial wall.
- Leads to progressive narrowing and hardening of the arteries.
- Disease develops non-uniformly – has a distinctly focal nature occurring at sites of branching and high arterial curvature.
- Local risk factors therefore significant.

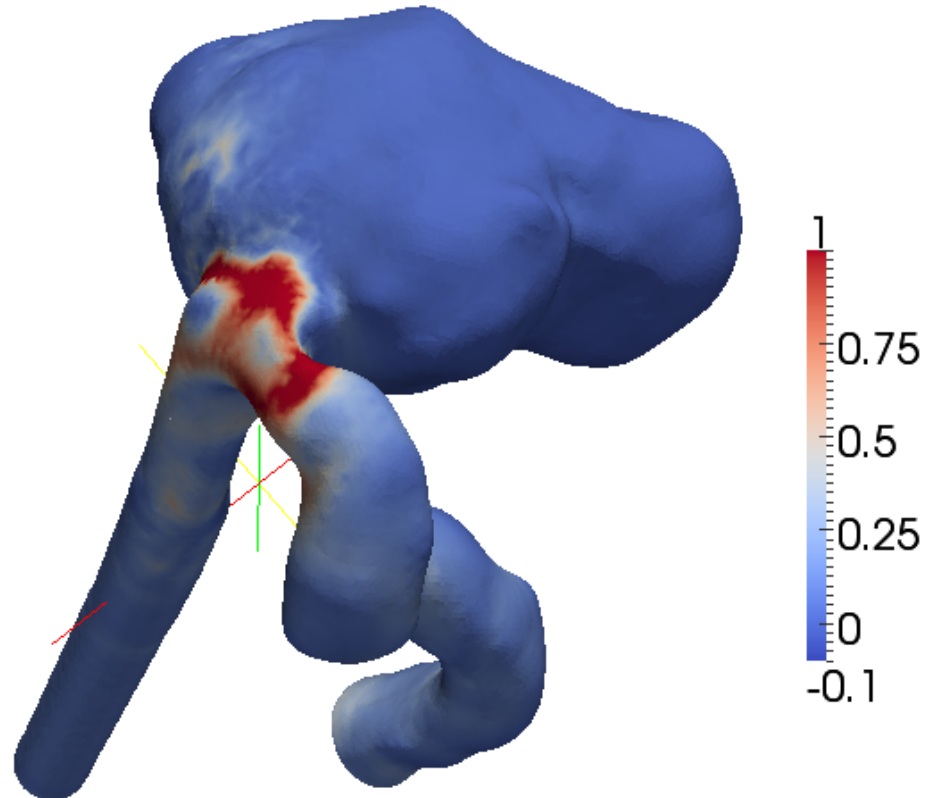


Background

- Current 35 year-old consensus is that disease likely to occur at regions of low or oscillation WSS.
- Emerging view that this is an oversimplification – age affects lesions maps!
- Traditional metrics (WSS, OSI, RRT) don't distinguish pulsatile and oscillatory uni-directional flows from multi-directional flows.
- Patterns of TransWSS do correlate in some cases very well with disease patterns.

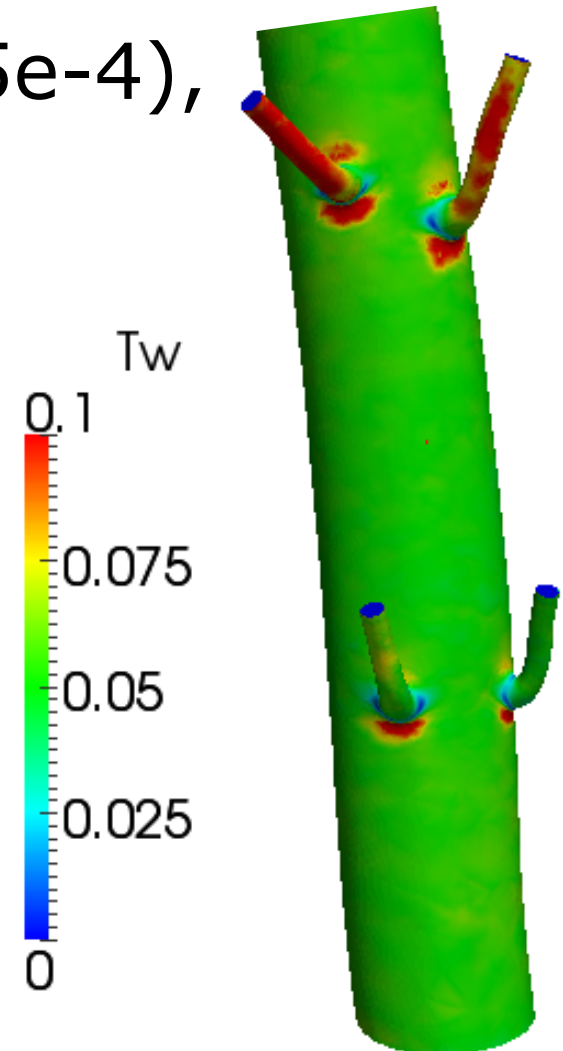
Aneurysm

- 5000 time steps ($dt = 2.5e-4$),
nummodes = 4, no.of.elements:
27k
- ~8 hours



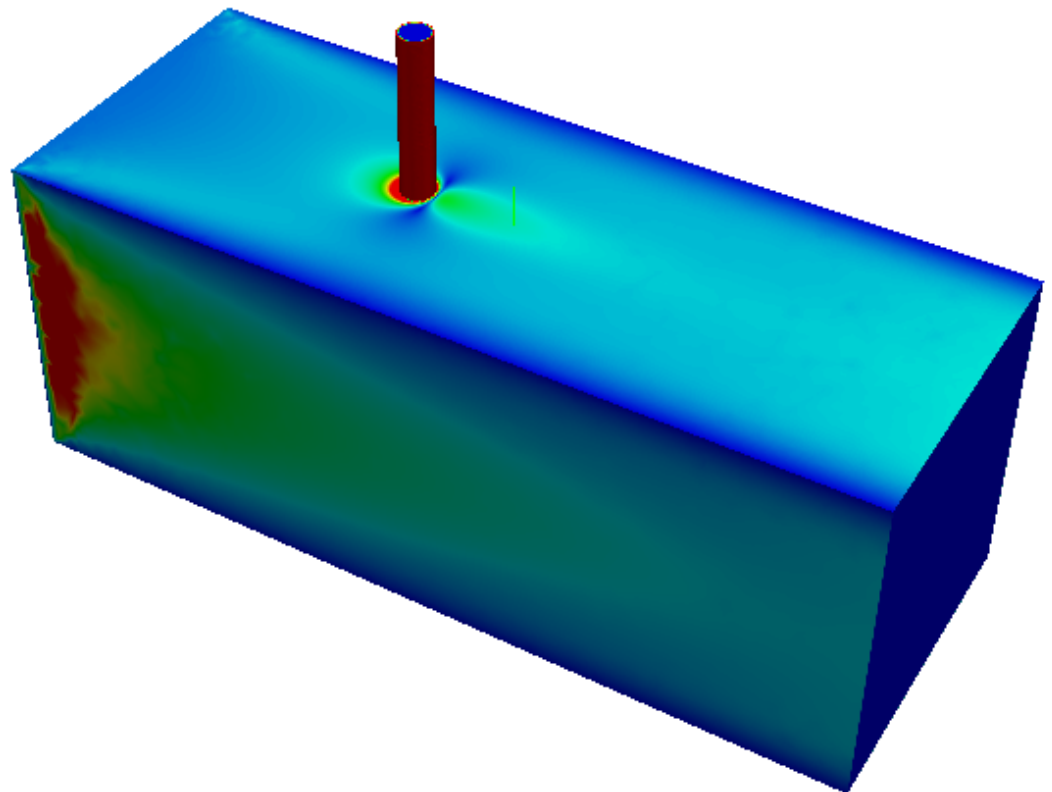
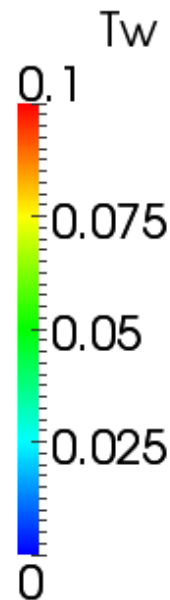
Aorta Segment

- 3000 time steps ($dt = 5e-4$),
nummodes = 5,
no.of.elements: 40k
- ~ 2 days
- ~4k iterations
for pressure



Box with side branch

- 3000 time steps ($dt = 5e-4$),
nummodes = 4, no.of.elements:
50k
- $\sim 8h40m$



Mass Transport of LDL

- Use ADRSolver.
- Transport is dominated by advection since diffusion coefficient is very small.
- Very fine boundary layer required.
- This fine mesh would be computational expensive and inefficient to solve for with the IncNavierStokesSolver
- fieldtofield utility, which would interpolate values from a coarse mesh onto a fine mesh.