Automatic Segmentation of Human Aorta through 4D MRI

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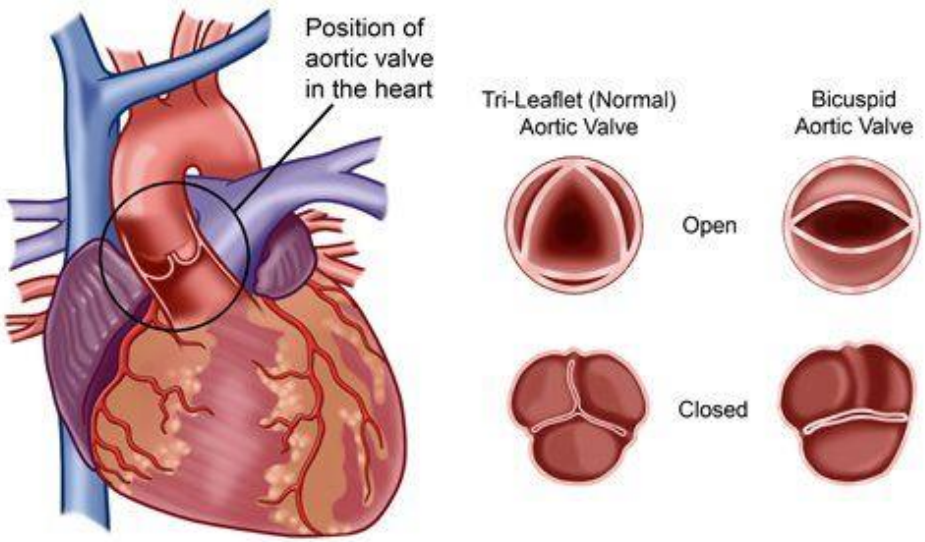
Research Motivation

To study the influence of aorta geometry on hemodynamics



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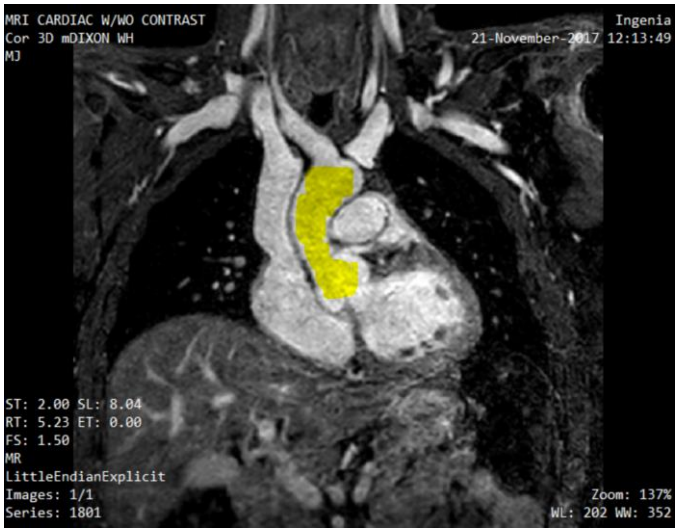
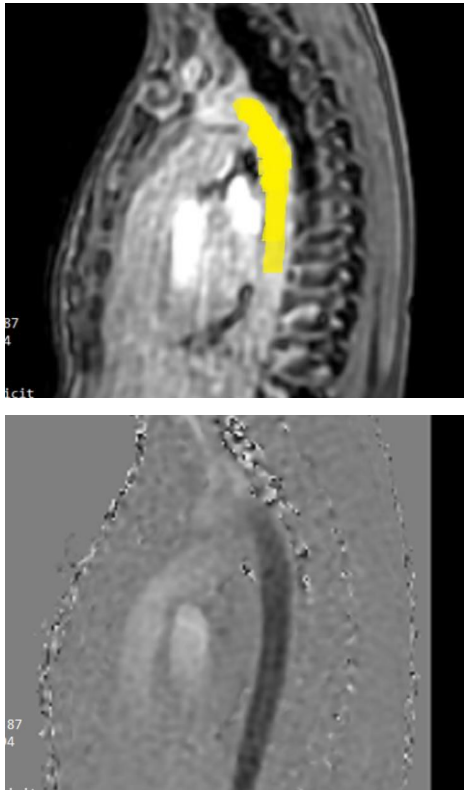
Phase Contrast MRI ?

Regular MRI



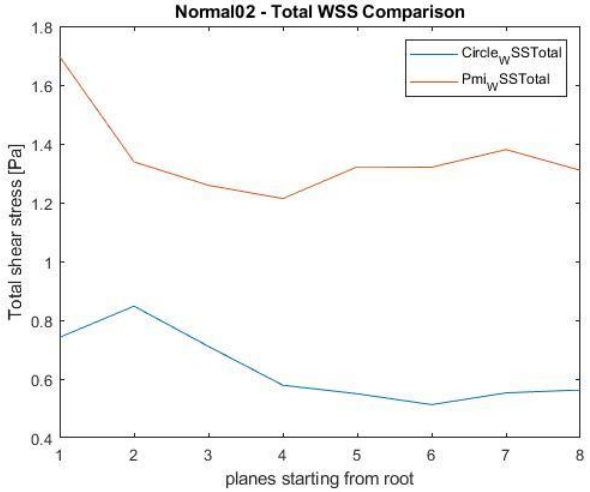
MRI with Phase Contrast



Softwares used : Slicer3d, Paraview

Why not use existing software?

- Flow analysis limited to shear stress and pressure
- Restrictions on exporting data for further analysis
- No transparency in mathematical models used
- Different results from different software



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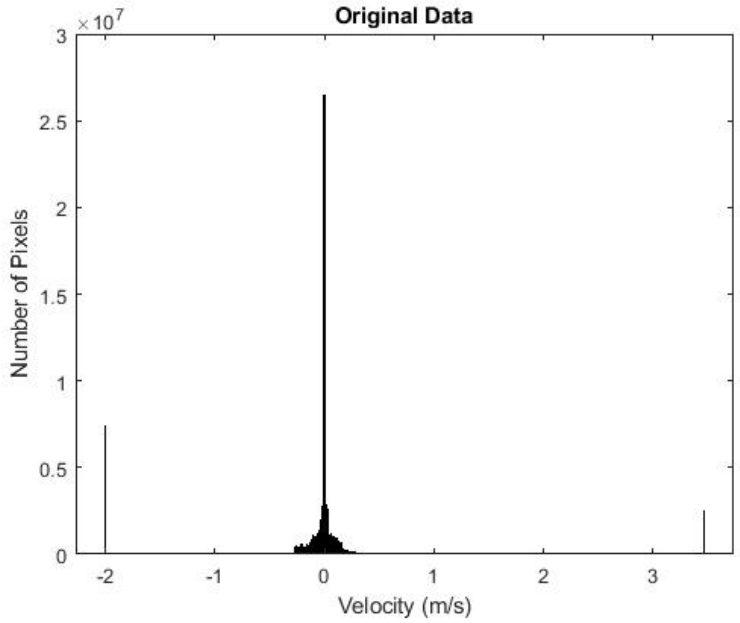
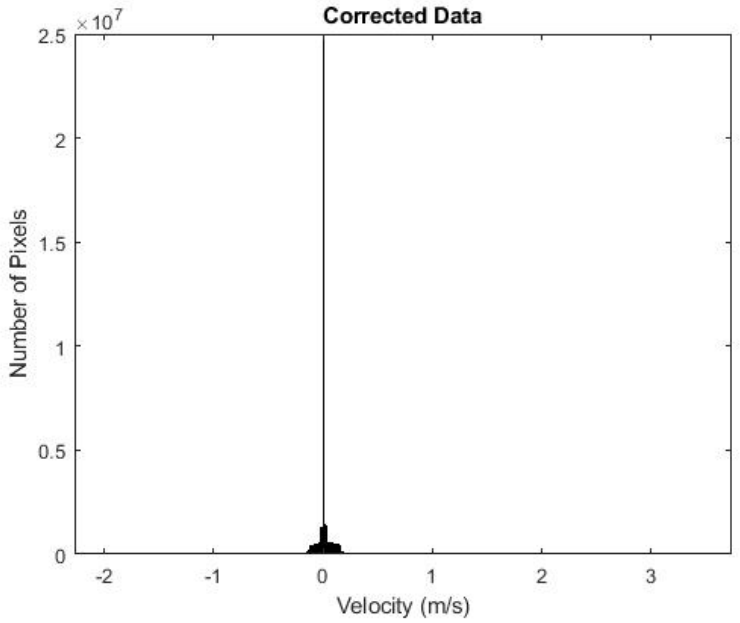
Velocity Corrections in 4D MRI

- Remove pixels with low magnitudes
- Eddy current offset errors reduced based on static tissue
- Remove calibration artifacts





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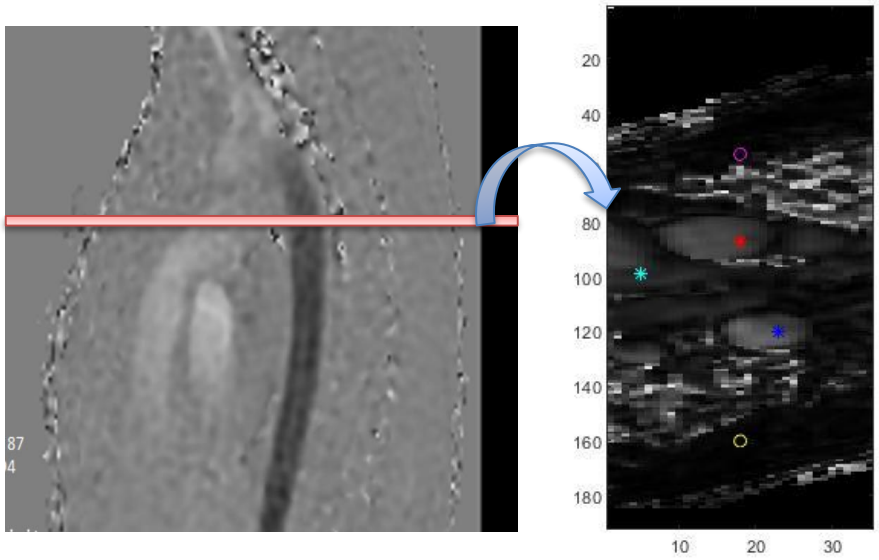
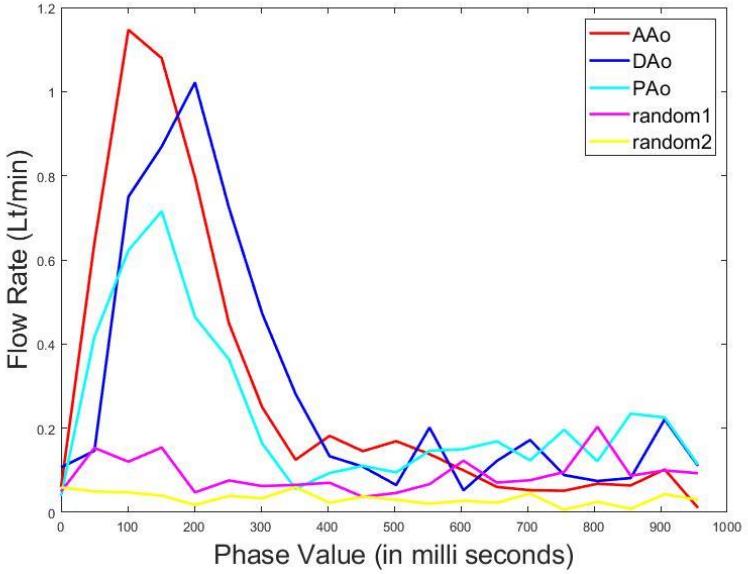
Segmentation - 1

- Remove pixels with high velocity at second half of cardiac phase
- Identify descending aorta and calculate flow rate through it.





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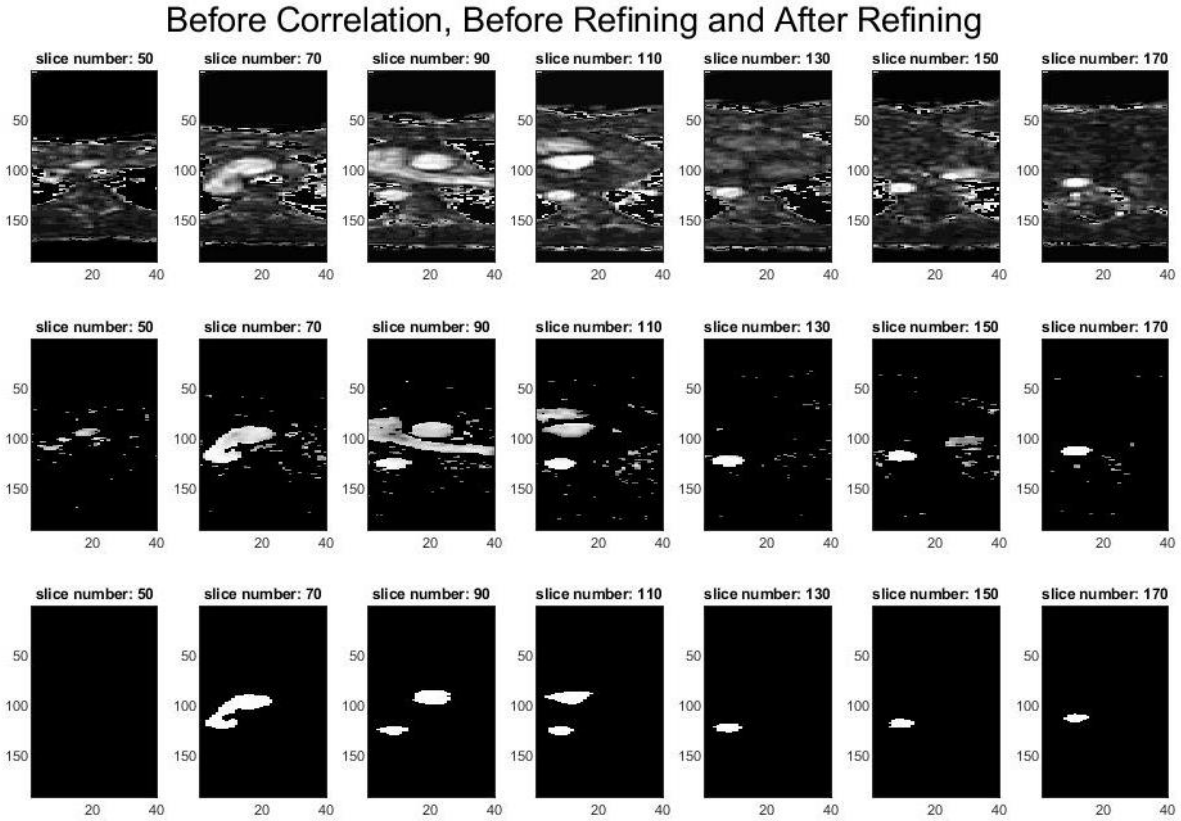
Segmentation - 2

- Using DAo flow rate, Refine rest of the domain using correlation.
- Use axial component of velocity to separate aorta and pulmonary artery



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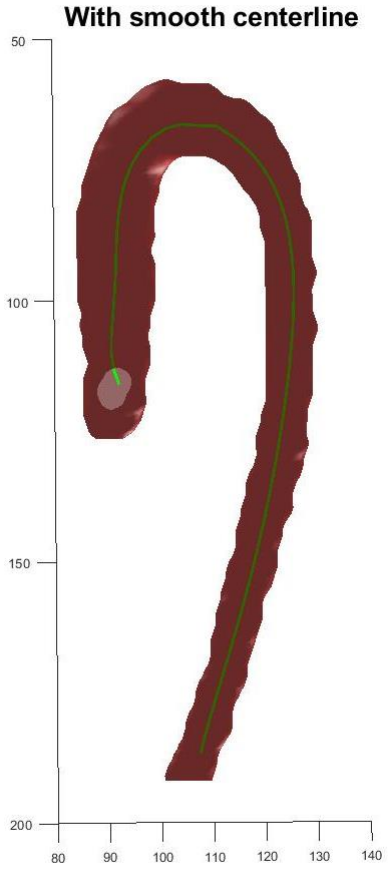
Segmentation - 3

- Calculate centerline.
- Remove branches.
- Smoothen centerline



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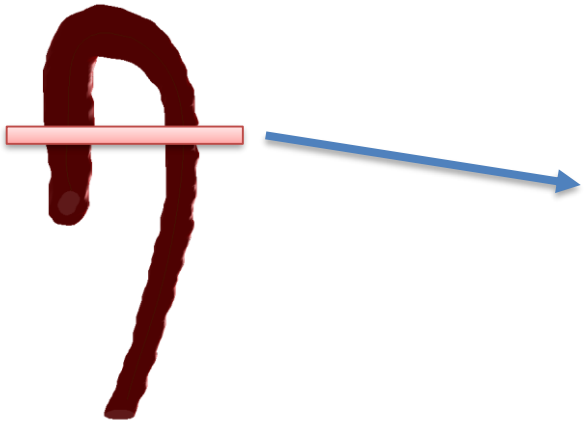
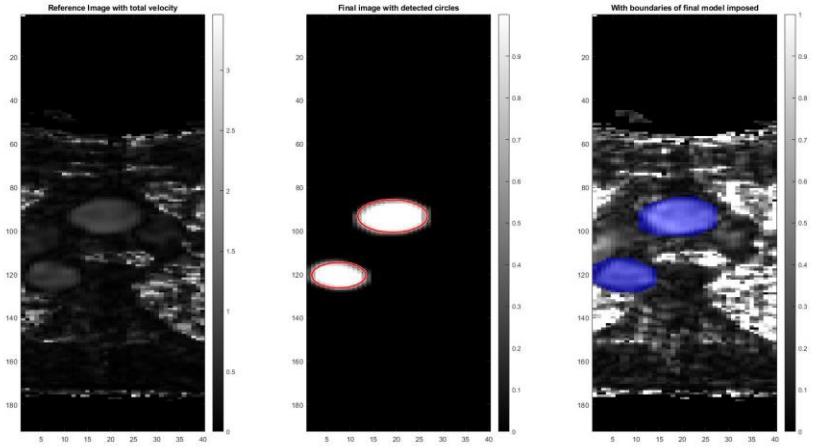
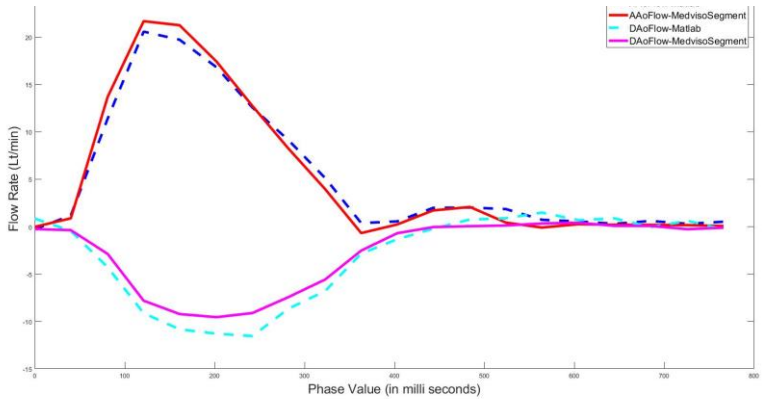
Segmentation - 4





- Check the final mask
- Compare the results with manual segmentation



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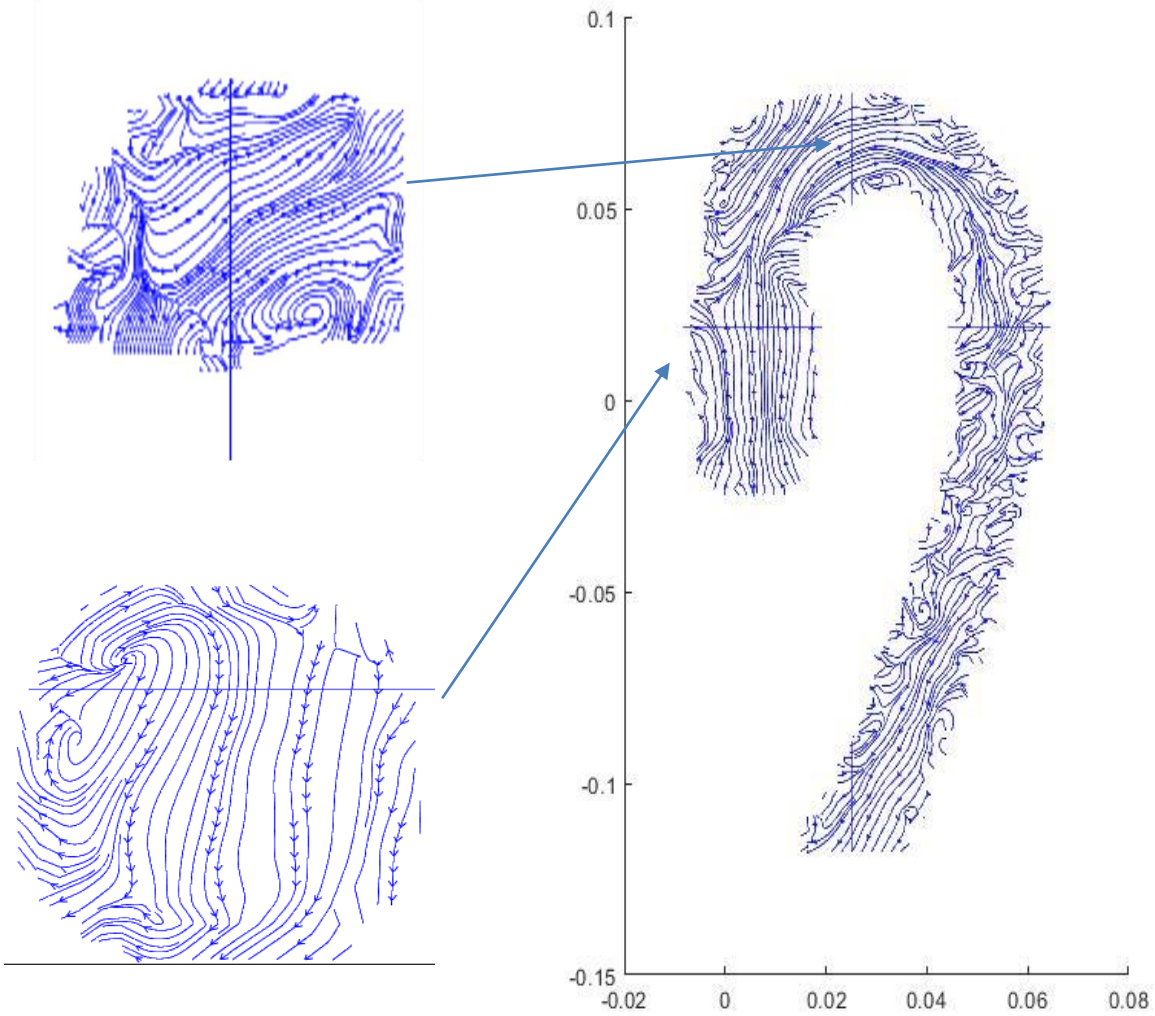
Planar streamlines



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Current status

- Correct errors in 4D MRI scans
- Segmentation and extraction for aortas with tricuspid and bicuspid values
- Plot velocity and it's derivatives along desired planes

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Future

- Calculation of number of vortices and their positions.
- Extend current algorithm for unicuspid and diseased values/aortas.
- Automatic segmentation of 3D MRI and CFD simulation.

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Thank you

Questions ?

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