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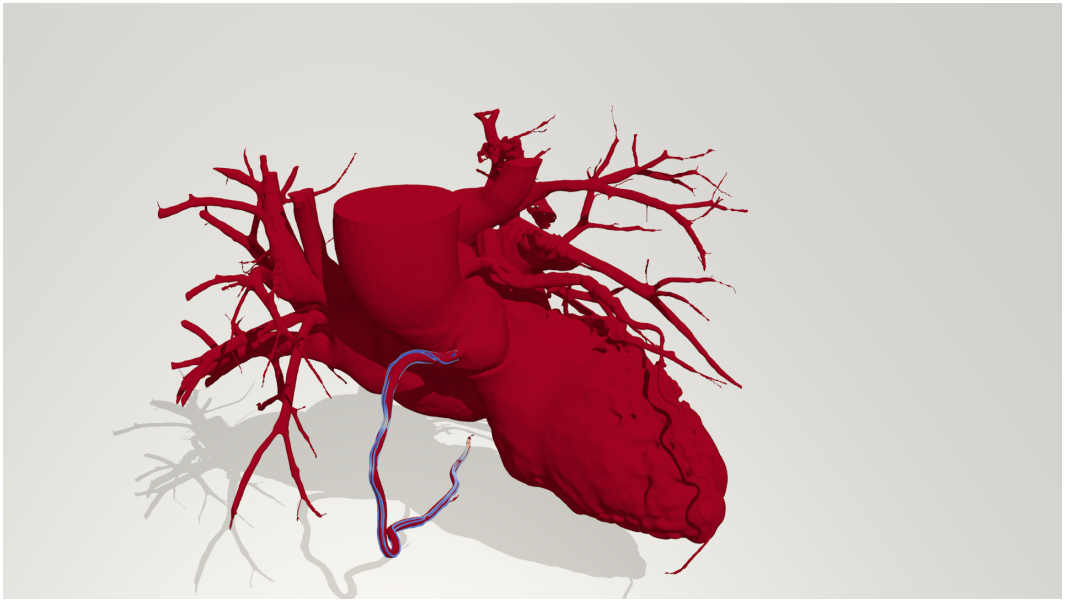
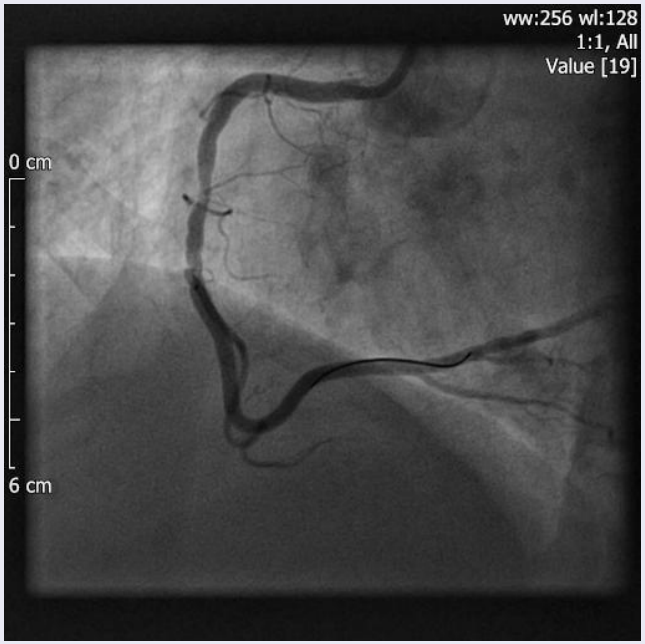


Introduction

Applying CFD to medical imaging for prediction of Coronary Artery Disease

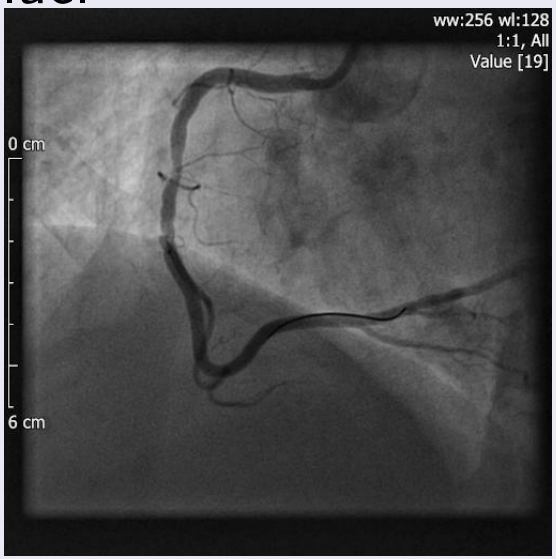
Currently an invasive procedure is performed to retrieve a dimensionless value called FFR (Fractional Flow Reserve) which quantifies the pressure drop over a diseased vessel.

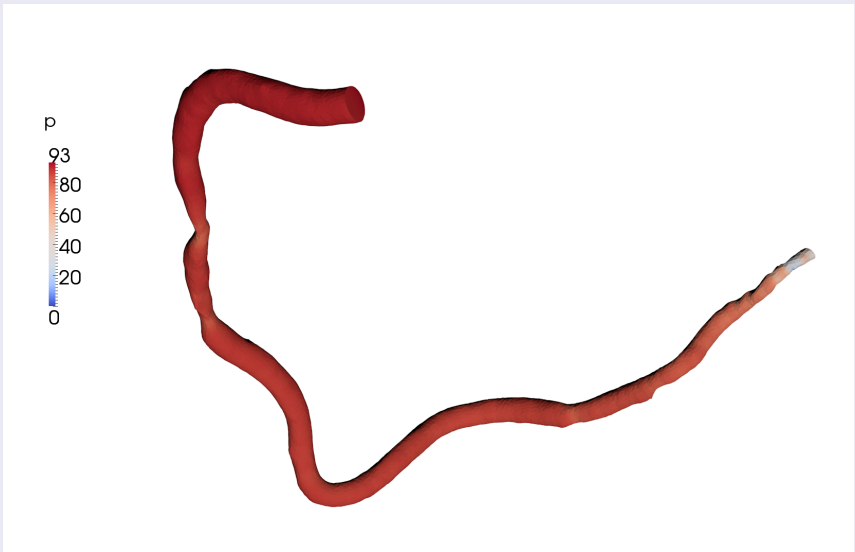


Creating the geometry

To try and retrive the FFR non-invasively 3d models of the diseased artery can be generated from processing the CT data.

The models can then have CFD techniques applied to try and find the FFR value.





Simulation approach

Past efforts to simulate FFR using CFD techniques involved truncating the artery at around 50-70% of length. Then complicated boundary conditions are applied that attempt to acknowledge the truncated section of the geometry using resistance based modelling. Resistance parameters are estimated through empirical observation. Transient simulations are then run and time averaged pressure values are used to estimate the FFR.

Our approach was to use new CT processing techniques to use the entire length of the artery. Then referenced pressure outlets are applied to that boundary and a steady state simulation is executed using simpleFOAM. This dramatically reduces the computational cost as well as using contributions of the entire length of the artery to the solution.

Results

To test the approach the results of the steady state solver is compared against the procedural values. Further resistance based transient models were applied to the same geometry to see the difference.