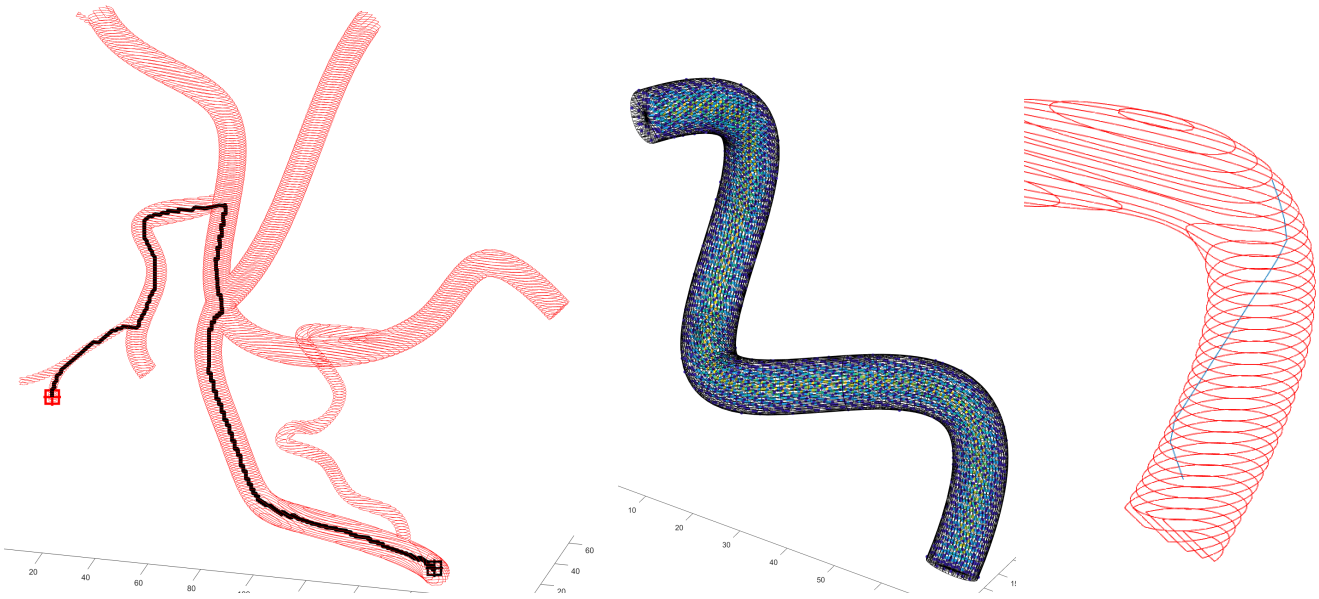

Design of a Guidewire Simulation to Analyze Damage to Arterial Walls

Client: Advanced Micro and Nanosystems Lab (AMNL), University of Toronto
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Client Need & Impact

The client requires a method to quantify the damage caused to arterial walls as a guidewire navigates a blood vessel. The guidewire is oriented using a magnetic field, which influences magnets attached to the wire, and is mechanically ‘fed’ to travel further into the blood vessel. With this simulation, the client will be able to objectively compare different navigation methods and guidewire configurations to minimize damage to vessel walls during operations that use guidewires. The main impact of this project is the subsequent research enabled by it. It will allow for the theoretical testing of different guidewire designs and guidance methods to see if they are less harmful to patients than current existing methods.

Overview of Design/Key Results

The simulation used in this project was designed entirely in MATLAB, a commercial programming and numeric computing platform. The guidewire is modelled as a string of rod segments with the vessel geometry provided as a standard .STL file. The damage to the surfaces of the vessel is determined as the wear parallel to and normal to the walls.

The simulation of the guidewire was achieved using a quasi-static finite element analysis of its model, where the wire was simulated as stationary at regular steps through its movement in the vessel. The tip was treated as a controlled point to simulate the behaviour of a magnetic-based system and followed a prescribed path that the system determined without human intervention (other than declaring a start and end point). At each step, the normal forces experienced by the guidewire’s segments are recorded to determine damage.

Due to COVID-19 restrictrictions, the simulation results have not been physically verified at the present time.