SimulationModel_Description.pdf

Title:

Interactive Dash-Based Simulation of Posterior Aortic Displacement

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Purpose and Context:

This interactive simulation model was created to demonstrate the hemodynamic effects of posterior aortic displacement at the clavicular level. The tool supports the technical report titled *"Anatomical Reversal of Major Thoracic Vessels at the Clavicular Level With Clinical Implications and Predictive Simulation Using an Interactive Dash Application."*

Technical Overview:

The simulation was developed using the **Dash framework (Python 3.11)** and standard scientific libraries including **Plotly**, **NumPy**, and **pandas**. The model allows users to visualize spatial displacement of thoracic vessels and to adjust parameters related to vessel curvature and compression.

Key functions include:

- Dynamic adjustment of aortic arch curvature
- Visualization of venous structures relative to displaced aorta
- Approximation of **relative perfusion changes** and **wall shear stress (WSS)** distribution
- Export of static figures and short animations for analysis or teaching

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Data Integrity Statement:

All simulation data are **synthetic** and **non-clinical**.
No human participants, live tissue, or identifiable imaging data were used.
The geometries are based on **average anatomical parameters** derived from published literature and used purely for computational visualization.

Outputs:

- Predicted relative cerebral perfusion reduction (~50–55%)
- Regions of elevated wall shear stress near compression zones
- 2D and 3D plots generated dynamically within the Dash interface

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Availability:

The source code, schematic illustrations, and explanatory materials are available at:
☞ https://github.com/derderi/thoracic-vessel-reversal-simulation

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