* Developed a framework coupling Computational Solid Mechanics and Deep Learning to estimate aortic wall mechanics.
* Introduced a dataset generation pipeline integrating patient-specific geometries, material properties, and blood pressure.
* Trained neural networks to predict spatial distributions of the Second Piolla-Kirchoff stress and the Right Cauchy-Green strain considering patient-specific anatomies and wall properties.
* Demonstrated that the surrogate model achieves accurate, patient-specific predictions with a drastic reduction in computational time compared to full numerical simulations.
* Identified the instantaneous pressure as a dominant factor influencing model performance.

Coupling Computational Solid Mechanics and Deep Learning for Surrogate Modelling of Aortic Wall Mechanics

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We present a Deep Learning driven framework combining statistical shape analysis, computational solid mechanics, and neural networks to estimate patient-specific aortic wall stress and strain. The surrogate model accurately predicts spatial distributions of mechanical quantities considering patient-specific anatomies and wall properties. The model produces the estimations with a fraction of the computational cost of the high-fidelity numerical simulations, enabling rapid assessment of wall mechanics under physiological conditions.