

# Active Subspaces for Enhancing Uncertainty Quantification of Cardiovascular Hemodynamics

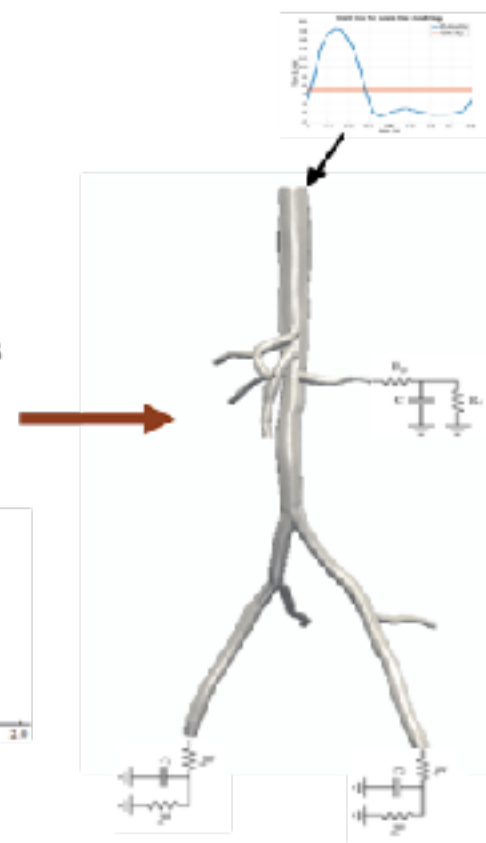
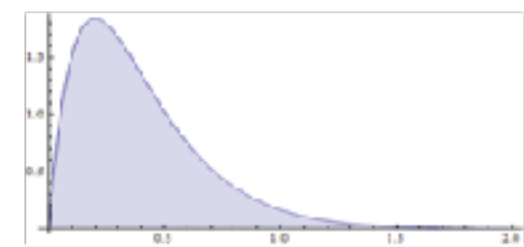


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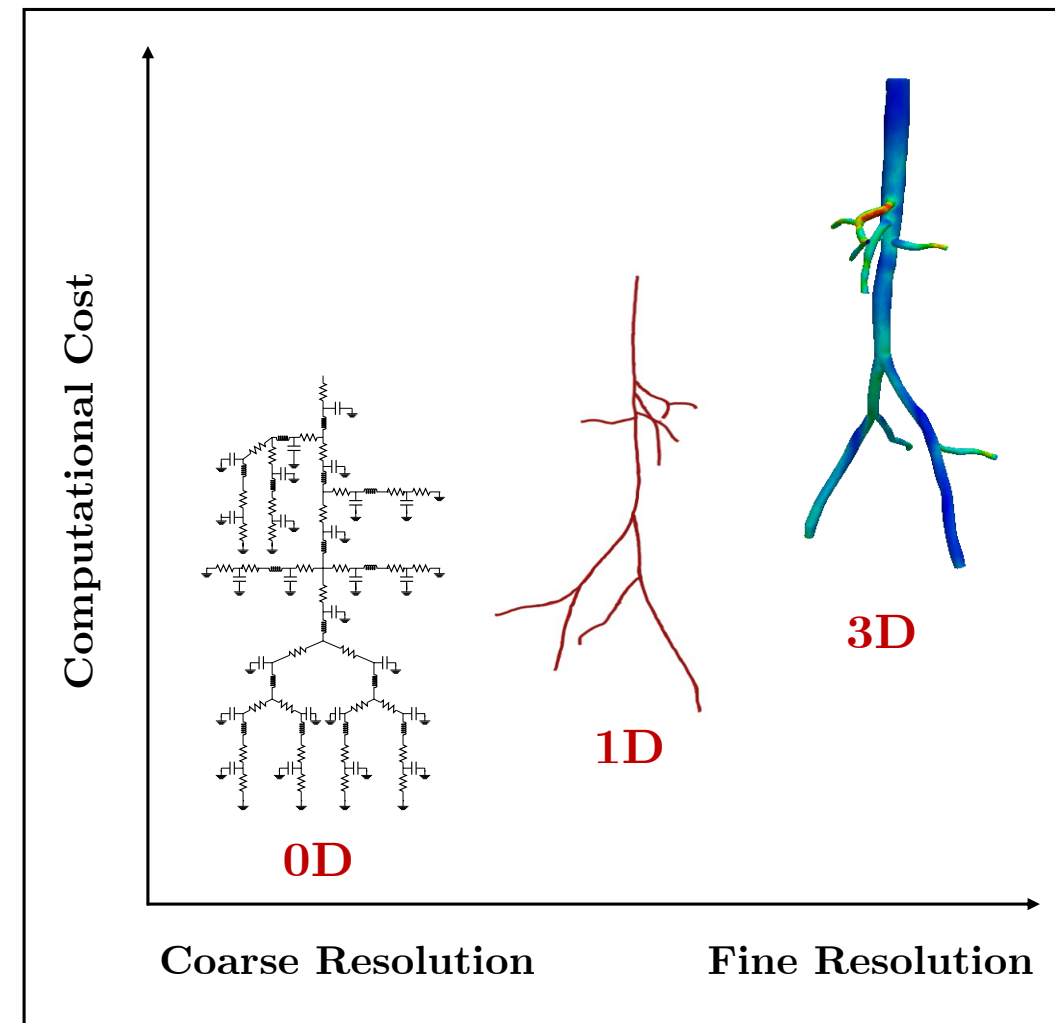
- Uncertain Inputs**
- Image data noise
  - Clinical data
  - Boundary conditions
  - Physiologic assumptions
  - Material properties
  - Geometry



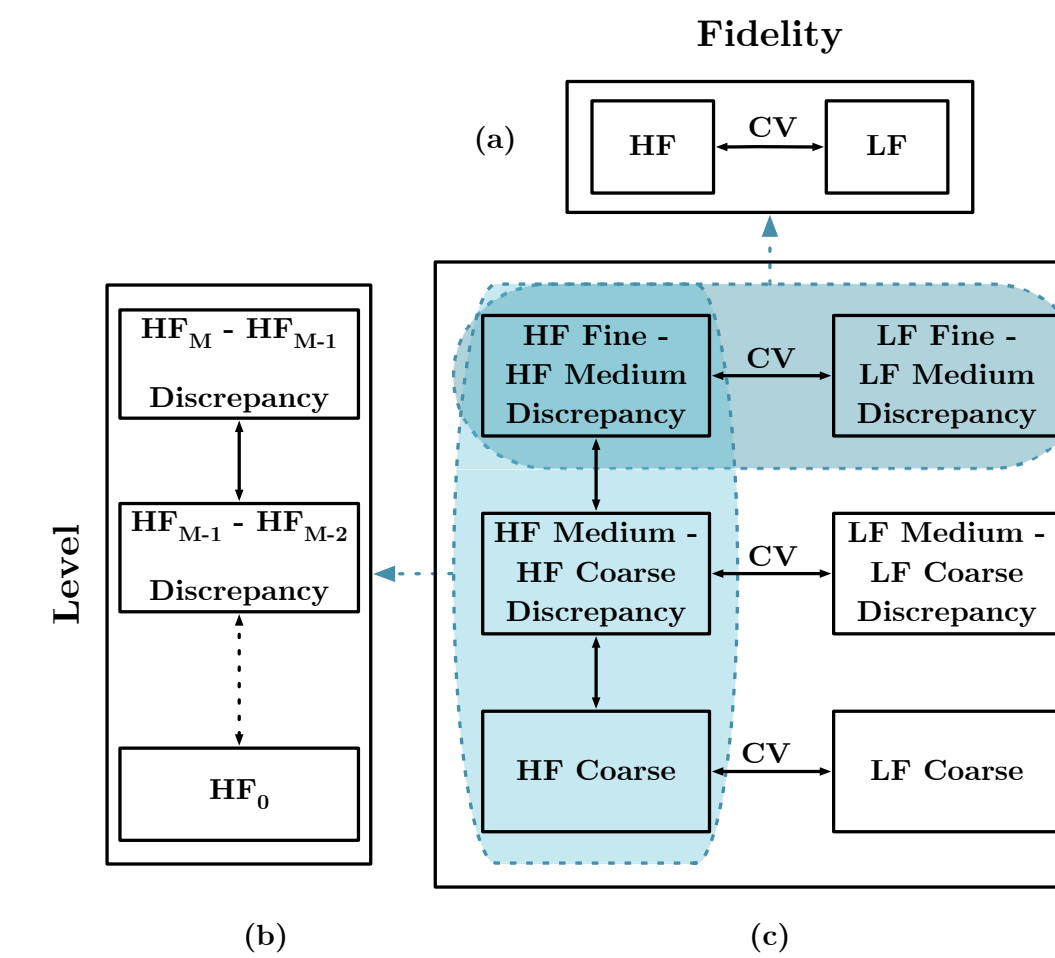
- Uncertain Outputs**
- Flow rates
  - Pressure levels
  - Wall shear stress
  - Oscillatory shear index
  - Cardiac work
  - Residence Time



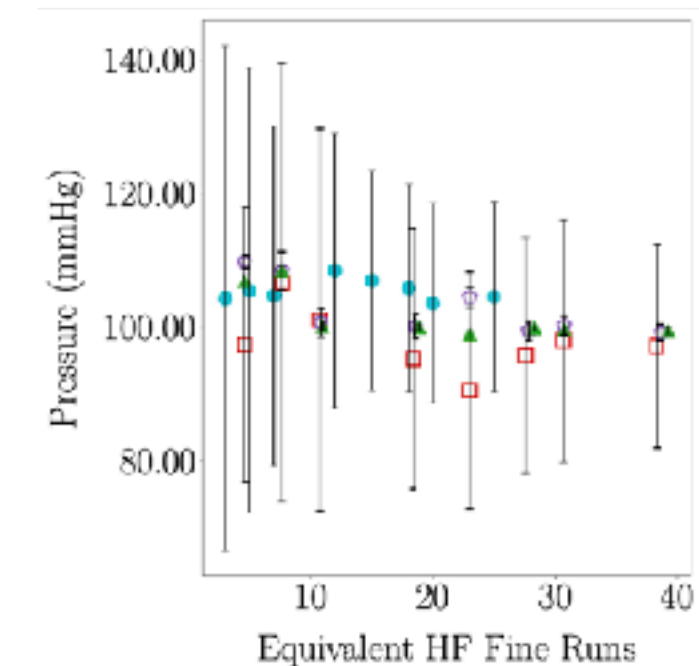
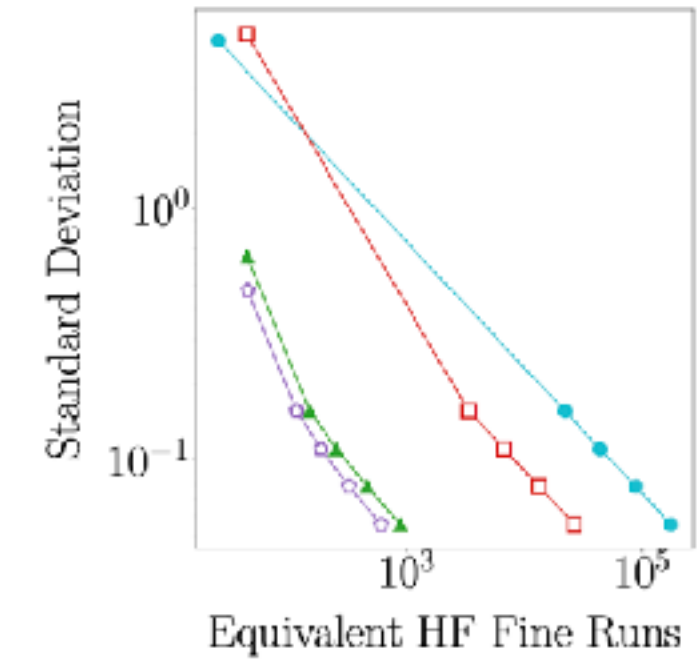
Impacts of Uncertainty



Modeling Tradeoffs

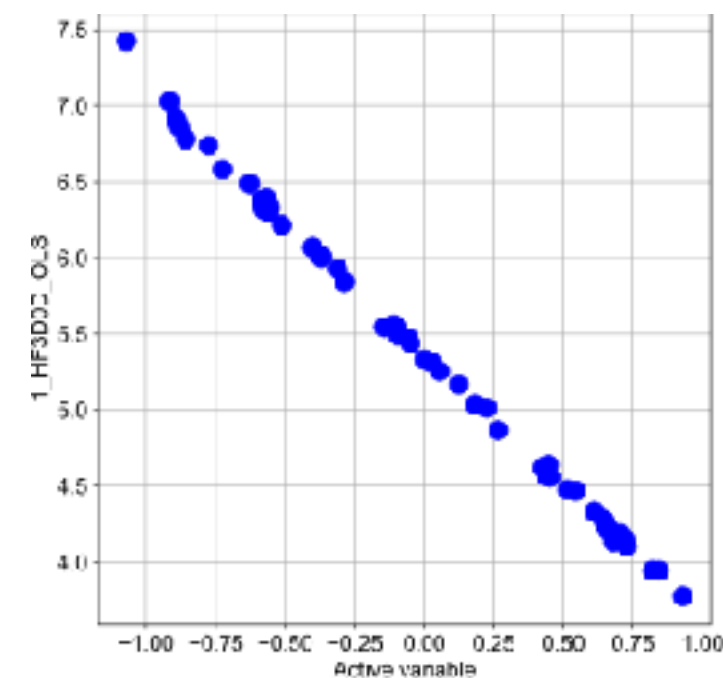


MLMF Framework

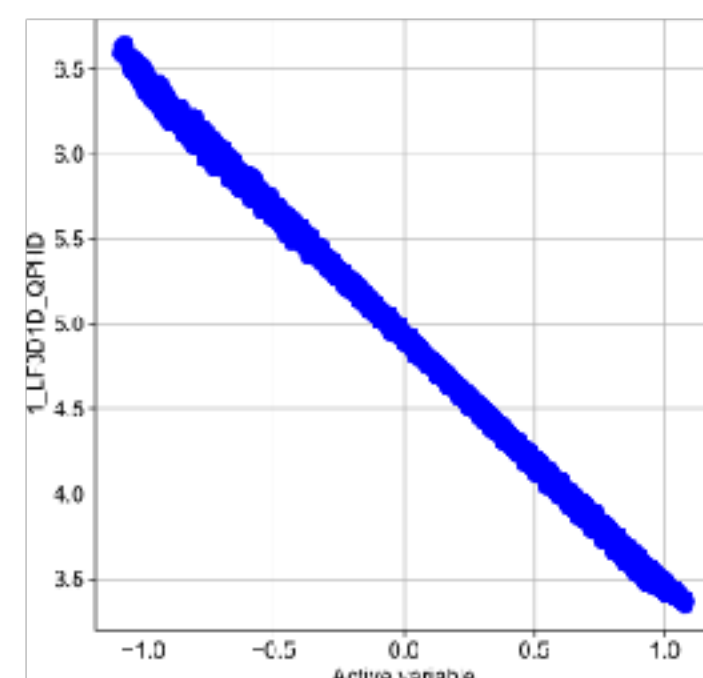


MLMF Performance

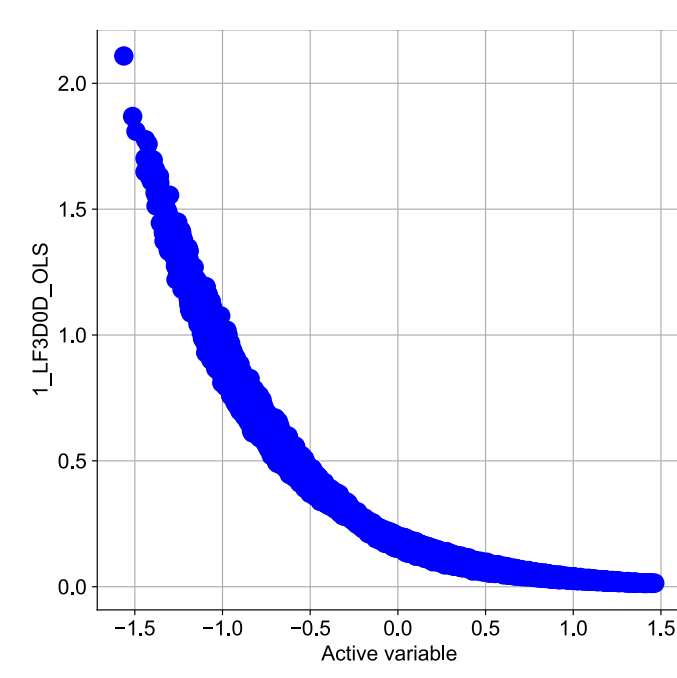
Active Subspaces



3D Model

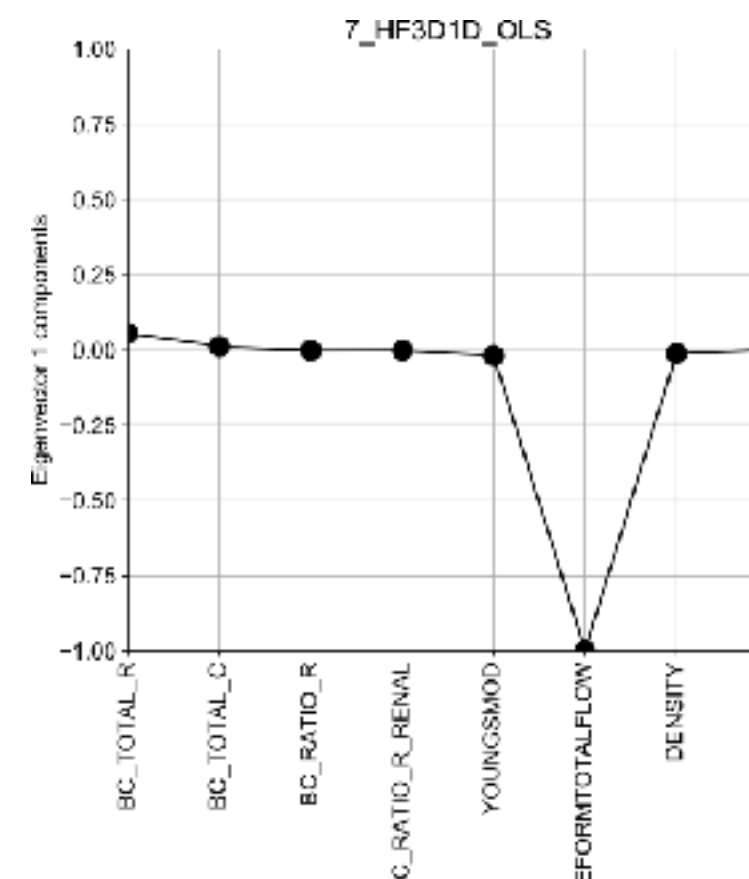


1D Model



0D Model

Sensitivity Analysis



	Pre AS	Post AS
Flow	0.9961	0.9994
Pressur	0.9439	0.9991
WSS	0.8931	0.9922

AS Correlation Improvement