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Interventional and Structural

REAL-TIME COMPUTATIONAL MODELING FOR DEPLOYMENT OF TRANSCATHETER AORTIC VALVE PROSTHESES VIA REDUCED ORDER MODELS

Poster Contributions
Hall B4-5
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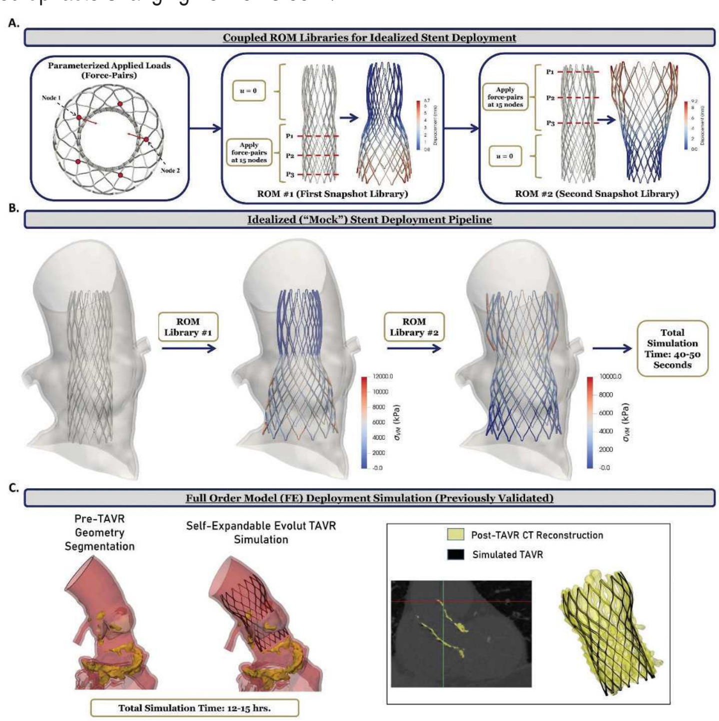
Background: Computational modeling has become a critical tool for pre-operatively optimizing transcatheter aortic valve replacement (TAVR) procedures. However, traditional Finite Element (FE) models of TAVR deployment are extremely computationally expensive. To this end, a reduced order modeling (ROM) framework is introduced for real-time idealized deployment simulations of the Evolut R valve.

Methods: The ROM is constructed in a two phased approach. In the *offline* phase, 105 FE simulations are performed with parameterized applied loads. The generated *snapshot* library is reused in the *online* phase via the Proper Orthogonal Decomposition approach. Idealized deployment simulations are performed in a patient-specific aortic root to mimic expansion of the crimped valve. The process is captured via separate ROMs for deformation of each part of the stent frame (Fig. 1A).

Results: Stress distributions as the valve is deployed are shown (Fig. 1B), where the ROM simulation requires 40-50 seconds to complete. Compared to previously validated FE-based TAVR simulations which require 12-15 hours (Fig. 1C), the ROM successfully reduces the computational costs with speed-up factors ranging from 92.8-99.7%.



Conclusion: The proposed ROM significantly reduces the computational costs of idealized TAVR deployment scenarios. Further refinements are underway to capture the contact of the stent frame with the surrounding anatomy, allowing for high-fidelity simulations of the entire implantation process.