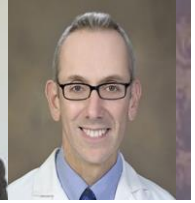
MULTISCALE MODELING OF BLOOD FLOW AND PLATELET MEDIATED THROMBOSIS





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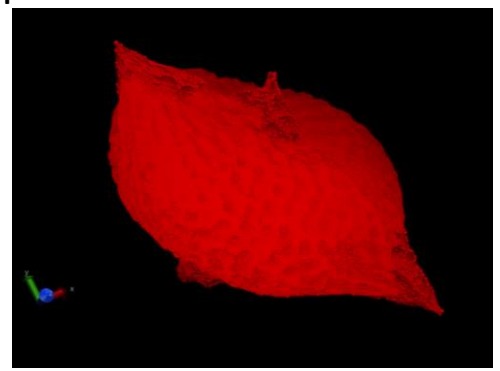
The model: We developed a multiscale model for simulating platelet activation, aggregation, and adhesion in viscous blood flow. This model incorporates **Dissipative Particle Dynamics (DPD)** of viscous flow that interfaces with **Coarse Grained Molecular Dynamics (CGMD)** of mechanobiology-based platelets to simulate their activation via mechanotransduction pathways, and their aggregation and adhesion to platelets or coagulation proteins deposited onto a blood vessel wall. **Machine Learning** methods validate model predictions with in vitro results and adapt temporal scales to diverse spatial scales for more efficient simulations.

What is new inside? Our approach is the first multiscale numerical method for simulating flow-mediated platelet activation, aggregation, and adhesion that includes receptors on the platelet membrane. Biophysical properties of a platelet are accurately described down to a *nm*-length and *ps*-time scale, and the viscous flow is described at a *μm*-length and *ns*-time scale.

How will this change current practice? Although platelets are less deformable than red blood cells, this work demonstrates that a rigidity assumption typically used for platelet simulations is erroneous. A mechanobiology-based deformable model allows the development of precise predictive models.

End Users The primary stakeholders are clinical and numerical experts in the flow-mediated thrombosis field who will use the model to predict risk of thrombus formation in cardiovascular diseases and devices. This method can be adapted to model a variety of platelet-based diseases by considering mechanical events triggering biochemical responses.



Activated Platelet with 5 Filopods