Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Wall shear stress indicators in abnormal aortic geometries LISA PRAHL WITTBERG, STEVIN VAN WYK, LASZLO FUCHS, KTH Mechanics, EPHRAIM GUTMARK, University of Cincinnati, IRIS GUTMARK-LITTLE, Cincinnati Children's Hospital — Cardiovascular disease, such as atherosclerosis, occurs at specific locations in the arterial tree. Characterizing flow and forces at these locations is crucial to understanding the genesis of disease. Measures such as time average wall shear stress, oscillatory shear index, relative residence time and temporal wall shear stress gradients have been shown to identify plaque prone regions. The present paper examines these indices in three aortic geometries obtained from patients whose aortas are deformed due to a genetic pathology and compared to one normal geometry. This patient group is known to be prone to aortic dissection and our study aims to identify early indicators that will enable timely intervention. Data obtained from cardiac magnetic resonance imaging is used to reconstruct the aortic arch. The local unsteady flow characteristics are calculated, fully resolving the flow field throughout the entire cardiac cycle. The Quemada model is applied to account for the non-Newtonian properties of blood, an empirical model valid for different red blood cell loading. The impact of the deformed aortic geometries is analyzed to identify flow patterns that could lead to arterial disease at certain locations.

Lisa Prahl Wittberg
KTH Mechanics

Date submitted: 31 Jul 2015 Electronic form version 1.4