Boulder Fluid and Thermal Sciences Seminar Series

Friday, July 19, 2019
2:30pm-3:30pm (refreshments at 2:15pm)
Clark Conference Room ECAD 109 in the Engineering Center
University of Colorado, Boulder

Flow Mediated Causes of Thrombosis in Transcatheter Heart Valves

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The recent unexpected discovery of thrombosis in transcatheter heart valves (THVs) has led to increased concerns of long-term valve durability. Based on the clinical evidence combined with Virchow's triad, the primary hypothesis is that low-velocity blood flow around the valve could be a primary cause for thrombosis. Using a combination of medical image data analysis and novel single-camera volumetric velocimetry technique, the flow mediated causes for thrombosis in THVs was investigated. Patient data analysis revealed that the occurrence of thrombosis was significantly correlated to valve implantation depth. Preliminary in-vitro flow studies showed that a change in valve implantation depth can lead to a 7-fold decrease in flow stagnation zone size. Advanced three-dimensional velocimetry demonstrated that large volumetric regions of flow stagnation were observed in the vicinity of the THV throughout the cardiac cycle. The volumetric scalar viscous shear stress quantified via the three-dimensional shear stress tensor was within the range of low shear-inducing thrombosis observed in the literature. Such high-fidelity volumetric quantitative data and novel imaging techniques used to obtain it will enable fundamental investigation of heart valve thrombosis in addition to providing a reliable and robust database for validation of computational tools.

Biography: Dr. Vrishank Raghav is an Assistant Professor in the Department of Aerospace Engineering at Auburn University. Previously he was an American Heart Association Postdoctoral Fellow at Emory University and Georgia Institute of Technology, where his work was on understanding the effect of hemodynamics on the progression of congenital heart valve disease. Before diversifying into biological flows, he obtained his Ph.D. in the School of Aerospace Engineering at Georgia Tech in 2014. His dissertation was focused on understanding the three-dimensional nature of unsteady flow separation occurring on rotor blades and was chosen by Sigma-Xi, the Scientific Research Society as the 2015 Best Georgia Tech Ph.D. Thesis.