Biomedical Research Seminar Series

Speaker Announcement

Friday, April 27, 2018 @ 3:30 pm

Domenici Hall, Room 109

(Refreshments served at 3:00)

Fangjun Shu, PhD

Associate Professor
Department of Department of Mechanical and Aerospace Engineering
New Mexico State University

Fluid Dynamics in Blood-Wetted Medical Devices

Rotodynamic blood pumps are commonly used as ventricular assist devices (VADs). Fluid dynamic analysis of VADs is often conducted in vitro under steady flow conditions. However, clinical applications for VADs involves unsteady, pulsatile flow—due to the residual contractility of the native heart. This study investigated the influence of this unsteady flow upon the internal flow of a centrifugal blood pump. The flow field was visualized with a 2D particle image velocimetry (PIV) using a transparent replica of the LevacorTM VAD. The replica was inserted in a dynamic cardiovascular simulator to simulate the implanted VAD. PIV was used to quantify the velocity field in the outlet volute and in between the impeller blades. As compared to steady flow, pulsatile conditions produced periodic, transient recirculation regions within the impeller and separation in the outlet diffuser. Deceleration of flow was found to promote separation within the outlet diffuser, while acceleration served to stabilize the velocity field. The notable differences between the acceleration and deceleration phases illustrated the prominence of unsteady effect. Dimensional analysis revealed that the flow characteristics could be uniquely described by the flow coefficient (Φ) and acceleration coefficient ($\Phi^{\cdot}$), thereby eliminating impeller speed from the experimental matrix. Four regimes within the Φ-$\Phi^{\cdot}$ plane were found to classify the flow patterns, well-attached or disturbed. These results and methods can be generalized to provide insights for both design and operation of VADs for safety and efficacy.

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For more information or to meet with the speaker please contact Ryan Ashley at ryashley@nmsu.edu