Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Vorticity dynamics of Bi- and Trileaflet Prosthetic Heart Valves LAKSHMI DASI, D.W. MURPHY, HELENE SIMON, LIANG GE, FOTIS SOTIROPOULOS, AJIT YOGANATHAN — Fluid flow through prosthetic heart valves is associated with spatio-temporal complexity that may relate to clinical performance. We present PIV results of the instantaneous vorticity field in the wake of a bileaflet mechanical valve and a trileaflet polymeric valve in an idealized aorta model. For the bileaflet valve, the shear layer formed at the valve housing was observed to roll up into the sinus expansion during the acceleration phase while inducing vorticity of opposite sign near the sinus boundary. The fine structure of the shear layer roll up was influenced by a constellation of karman vortices that formed in the wake of the leaflets. During peak flow secondary instabilities created a more turbulent vorticity field downstream of the valve. The vorticity field during the deceleration phase was in general disorganized. In contrast, the large scale vorticity structure for the trileaflet valve differed drastically. The stability of the shear layer between the central jet and the surrounding fluid was found to govern the vorticity dynamics in the sinus and the downstream regions. Ensemble averaging revealed strikingly symmetric and smooth vorticity fields void of the rich instantaneous dynamics. Comparison with state of the art CFD simulations produced a complete thee-dimensional picture of the vorticity fields.

Liang Ge

Date submitted: 03 Aug 2006 Electronic form version 1.4