Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Dynamic Energy Loss Characteristics in the Native Aortic Valve
CHOON HWAI YAP, Georgia Institute of Technology, LAKSMI P. DASI, Colorado State University, AJIT P. YOGANATHAN, Georgia Institute of technology
— Aortic Valve (AV) stenosis if untreated leads to heart failure. From a mechanics standpoint, heart failure implies failure to generate sufficient mechanical power to overcome energy losses in the circulation. Thus energy efficiency-based measures are direct measures of AV disease severity, which unfortunately is not used in current clinical measures of stenosis severity. We present an analysis of the dynamic rate of energy dissipation through the AV from direct high temporal resolution measurements of flow and pressure drop across the AV in a pulsatile left heart setup. Porcine AV was used and measurements at various conditions were acquired: varying stroke volumes; heart rates; and stenosis levels. Energy dissipation waveform has a distinctive pattern of being skewed towards late systole, attributed to the explosive growth of flow instabilities from adverse pressure gradient. Increasing heart rate and stroke volume increases energy dissipation, but does not alter the normalized shape of the dissipation temporal profile. Stenosis increases energy dissipation and also alters the normalized shape of dissipation waveform with significantly more losses during late acceleration phase. Since stenosis produces a departure from the signature dissipation waveform shape, dynamic energy dissipation analysis can be extended into a clinical tool for AV evaluation.

Choon Hwai Yap
Georgia Institute of Technology

Date submitted: 16 Sep 2009 Electronic form version 1.4