Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Intrinsic Frequency Method for Noninvasive Diagnosis of Left Ventricular Systolic Dysfunction NIEMA PAHLEVAN, DEREK RINDERKNECHT, PEYMAN TAVALLALI, DANNY PETRASEK, California Institute of Technology, RAY MATTHEWS, University of Southern California, Keck School of Medicine, MORTEZA GHARIB, California Institute of Technology —
We have recently developed a new mathematical method, intrinsic frequency (IF) method, that views the left ventricle-arterial system as a coupled dynamic pumping system which is decoupled upon the closure of the aortic valve. Utilizing this method, given an arterial blood pressure waveform we are able to extract two intrinsic frequencies (ω_1 and ω_2) correlating to systole when the left ventricle (LV) and aorta (vasculature) act as a coupled dynamic pumping system and diastole where the dynamics of the LV is removed. Each of these dynamical pumping states has an inherent frequency of operation (ω_1 and ω_2) which gives information about LV systolic function (ω_1) as well as arterial dynamics (ω_2). IF methodology extracts ω_1 and ω_2 from the pressure wave. This method was applied to invasive aortic pressure waveforms and noninvasively measured carotid pressure waveforms. Our results shows that ω_1 is elevated in patients with LV systolic dysfunction (LVSD). However, ω_1 remains relatively constant under healthy conditions as age advances. Our results indicate that IF methodology can be used to detect LVSD from a single pressure waveform. One unique advantage of the IF method is only the shape of the waveform is required. Therefore, ω_1 can be easily derived from noninvasive measurements and monitored continuously.

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Date submitted: 23 Jul 2014 Electronic form version 1.4