Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Optimum heart rate for brain-heart hemodynamic coupling and its clinical relevancy for neurodegenerative diseases[1] ARIAN AGHILINEJAD, FAISAL AMLANI, Department of Aerospace and Mechanical Engineering, University of Southern California, Los Angeles, CA, USA, KEVIN KING, Huntington Medical Research Institutes, Advanced Imaging Center, Pasadena, CA, USA, NIEMA PAHLEVAN, Department of Aerospace and Mechanical Engineering, University of Southern California, Los Angeles, CA, USA — Neurodegenerative diseases such as Alzheimer's dementia have reached an epidemic proportion with a significant impact on public health. Disproportionate age-related stiffening of the aorta compared with the carotid arteries is theorized to reduce the protective impedance mismatch at the aorta-carotid interface and affect the regulation of cerebral hemodynamics. Recent clinical data has indicated the existence of a potential link between arterial stiffening, as measured by arch pulse wave velocity (PWV), and Alzheimer's disease. In this study, we used an energy-based analysis of hemodynamic waves to quantify the effect of aortic arch stiffening on pulsatile hemodynamic transmission to cerebral vasculature. A one-dimensional blood flow model of the human vascular network was used to simulate pressure and flow wave propagations in the systemic circulation. Our results show there exists an optimum wave condition—occurring near normal human heart rates—that creates an optimum hemodynamic state for heart-brain coupling and minimizes pulsatile energy transmission to the brain. This is clinically important since excessive pulsatile energy transmission to microvasculature causes end-organ damage that may promote progression of neurodegenerative disease such as Alzheimer's dementia.

[1]Arian Aghilinejad gratefully acknowledges Viterbi School of Engineering fellowship support from the University of Southern California (USC).

Arian Aghilinejad
Dept of Aerospace and Mechanical Engineering, Univ of Southern California

Date submitted: 01 Aug 2019 Electronic form version 1.4