Structural Engineering Seminar Series

CEE 595 S

Relation between blood pressure and pulse wave velocity for human arteries

Yonggang Huang

Walter P. Murphy Professor of Civil and Environmental Engineering and Mechanical Engineering (by courtesy)

Materials Science and Engineering

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Abstract:

Continuous monitoring of blood pressure, an essential measure of health status, typically requires complex, costly, and invasive techniques that can expose patients to risks of complications. Continuous, cuffless, and noninvasive blood pressure monitoring methods that correlate measured pulse wave velocity (PWV) to the blood pressure via the Moens−Korteweg (MK) and Hughes Equations, offer promising alternatives. The MK Equation, however, involves two assumptions that do not hold for human arteries, and the Hughes Equation is empirical, without any theoretical basis. The results presented here establish a relation between the blood pressure P and PWV that does not rely on the Hughes Equation nor on the assumptions used in the MK Equation. This relation degenerates to the MK Equation under extremely low blood pressures, and it accurately captures the results of in vitro experiments using artificial blood vessels at comparatively high pressures. For human arteries, which are well characterized by the Fung hyperelastic model, a simple formula between P and PWV is established within the range of human blood pressures. This formula is validated by literature data as well as by experiments on human subjects, with applicability in the determination of blood pressure from PWV in continuous, cuffless, and noninvasive blood pressure monitoring systems.

Bio:

Yonggang Huang is the Walter P. Murphy Professor of Mechanical Engineering, Civil and Environmental Engineering, and Materials Science and Engineering at Northwestern University. He is interested in mechanics of stretchable and flexible electronics, and mechanically guided deterministic 3D assembly. He is a member of the US National Academy of Engineering, a foreign member of European Academy of Sciences and Arts, of Academia Europaea, and of Chinese Academy of Sciences. His research awards include the Richards Award in 2010, Drucker Medal in 2013, Nadai Medal in 2016, and Thurston Lecture Award in 2019, all from American Society of Mechanical Engineers (ASME); Prager Medal in 2017 from the Society of Engineering Sciences; International Journal of Plasticity Medal in 2007; Guggenheim Fellowship from the John Simon Guggenheim Foundation in 2008; Bazant Medal in 2018 and von Karman Medal in 2019 from the American Society of Civil Engineers. His recognitions for undergraduate teaching and advising include the Most Supportive Junior Faculty Member from the Department of Aerospace and Mechanical Engineering, University of Arizona in 1993; on the “Incomplete List of Teachers Ranked as Excellent by Their Students”, University of Illinois at Urbana-Champaign in 2003, 2004, 2005, 2006, and 2007; Engineering Council Award for Excellence in Advising from the College of Engineering, University of Illinois at Urbana-Champaign in 2007; Cole-Higgins Award for Excellence in Teaching, McCormick School of Engineering, Northwestern University in 2016; and on the Associated Student Government Faculty and Administrator Honor Roll, Northwestern University, 2018-2019. He is the Editor of Journal of Applied Mechanics (Transactions of ASME), Chairman of the Executive Committee of the ASME Applied Mechanics Division (2019-2020), member of the ASME – Pi Tau Sigma Awards Committee, member of US National Committee of Theoretical and Applied Mechanics, and was the President of the Society of Engineering Science in 2014, and members of the Awards Committee and Nomination Committee of the Engineering Mechanics Institute of American Society of Civil Engineers.

Monday, February 10th, 2020 4:00 – 5:00 p.m.

1310 Yeh Student Center