SEMINAR 887

题　目： Relation between blood pressure and pulse wave velocity for human arteries

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摘 要 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.

黄永刚 1984 年获北京大学学士， 1990 年获哈佛大学博士。现任美国西北大学冠名讲席教授。2010 年当选欧洲科学与艺术院院士， 2017 年当选美国国家工程院院士和欧洲科学院院士。他是美国固体力学领域 75 岁以下科学院或工程院院士中文章引用率最高的学者；是二十年来(1998-2017)世界固体力学领域文章引用率最高的学者;是迄今为止世界固体力学领域文章引用率最高的华人学者。 2017 年当选为中国科学院外籍院士。

黄永刚研究材料和电子器件的力学行为，主要科技成就包括: 1) 开创了可延展无机电子器件领域：可延展电子器件能更好适应下一代电子产品便携性、形状可变性、人体适用性等需求，在健康医疗、军事国防等领域有战略性应用，是现代信息领域革新性发展方向。无机微电子材料虽可突破有机半导体材料性能瓶颈，但受变形易损和刚性基底制备的限制，使其可延展化极具挑战。 基于力学原理原创出可延展无机电子器件的分形互联导线、硅应变隔离设计等新概念，创立定量化设计理论和制备方法，使功能无机材料在器件大变形时保持很小应变，实现超过 300%的器件延展率，极大拓展了器件应用范围，开辟出电子眼相机、表皮电子等多种全新器件，相关专利被工业界用于研发生产多种柔性健康监测产品。 2) 创立了基于微观机制的应变梯度理论：传统塑性理论无法解释材料硬度在微纳米尺度的变化。他创立基于微观机制的应变梯度理论体系，成功解释纳米压痕实验尺度效应，成为该类实验的技术标准，被来自 54 个国家几百所大学、研究机构和公司所采用并广泛应用于微纳米力学性能测定。上述成果奠定并拓展了现代力学研究前沿，产生广泛而重要的学术影响。

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