附：报告摘要与专家介绍

Patient-Specific MRI-Based 3D FSI Anisotropic Multi-Layer RV/LV/Patch Models for Pulmonary Valve Replacement Surgery Optimization

Dalin Tang (Worcester Polytechnic Institute, USA)

A patient-specific right/left ventricle and patch (RV/LV/Patch) combination model with fluid-structure interactions (FSI) was introduced to evaluate and optimize human pulmonary valve replacement/insertion (PVR) surgical procedure and patch design. Cardiac Magnetic Resonance (CMR) imaging studies were performed to acquire ventricle geometry, flow velocity and flow rate for healthy volunteers and patients needing RV remodeling and PVR before and after scheduled surgeries. CMR-based RV/LV/Patch FSI models were constructed to perform mechanical analysis and provide accurate assessment for RV mechanical conditions and cardiac function. These models include a) fluid-structure interactions, b) isotropic and anisotropic material properties, c) two-layer construction with myocardial fiber orientation, and d) active contraction. Both pre- and post-operation CMR data were used to adjust and validate the model so that predicted RV volumes reached good agreement with CMR measurements (error < 2%). Two RV/LV/Patch models were made based on pre-operation data to evaluate and compare two PVR surgical procedures: i) conventional patch with little or no scar tissue trimming; ii) small patch with aggressive scar trimming and RV volume reduction. Our modeling results indicated that: a) patient-specific CMR-based computational modeling can provide accurate assessment of RV cardiac functions; b) PVR with a smaller patch and more aggressive scar removal led to reduced stress/strain conditions in the patch area and may lead to improved recovery of RV functions. More patient studies are needed to validate our findings.

Dalin Tang received his Ph.D from University of Wisconsin-Madison in 1988. He has been a faculty member at Worcester Polytechnic Institute since 1988 and is now a Professor of Mathematics and Biomedical Engineering. He was named John E. Sinclair Professor of Mathematics in 2003-2006. He received WPI Trustee's award for Outstanding Research and Creative Scholarship in 2010, the highest honor for faculty research at WPI. He was elected Fellow of American Heart Association in 2011, Fellow of ASME 2016. He became a member of US National Academy of Inventers in 2016. He has been conducting research for cardiovascular modeling in the past 30 years and has made various contributions, especially in using image-based modeling for human ventricles and vulnerable plaque progression and rupture investigations. He serves as Editor-in-Chief for Molecular and Cellular Biomechanics, academic editor for PLOS One, and an editorial board member for BioMedical Engineering OnLine.

Formation Mechanism of Blood Pressure Waveforms

Dan Hu (Shanghai Jiao Tong University, China)

Pulse taking is an important diagnosis method in traditional Chinese medicine. Digital researches have also demonstrated correlations between particular diseases and the waveforms of blood pressure in radial artery on the wrist. It is of interest to explore the scientific basis of pulse taking. In this talk, mathematical models on the interaction between blood flow and elastic blood vessel walls are used to study the wave propagation in large blood vessel systems. Numerical studies are used to explain the formation of waveform characteristics. Further studies are also used to demonstrate the correlations between human diseases, such as hypertension, and particular waveforms, such as wiry pulse.

胡丹，理学博士，教授，博士生导师。北京大学学士（2002）和博士（2007），美国纽约大学库朗研究所博士后。2010 年 1 月进入上海交通大学自然科学研究院/数学科学学院工作至今。他在物理和生物体系的建模、模拟和分析等方面有广泛的兴趣，研究内容主要包括血液流动与脉搏波传播、血管的自适应生长和稀有事件自由能计算方法及应用。他在生物输运网络、脉搏波和生物膜与抗菌肽相互作用等方面的科研工作发表于 Physical Review Letters，PLoS Biology，Nature Communications 等国际顶尖杂志。其中发表于 PLoS Biology 的文章被 Nature Highlight 选为亮点工作，被 F1000选为必读文章。入选2017年度“长江学者奖励计划”青年学者项目。

On the interaction between fluids and nonlinear plates

Srdan Trifunovic (Shanghai Jiao Tong University, China)

Here, I will talk about interaction problems between fluids and thin elastic structures (plates or shells). Examples of physical models described by such problems include bridges or airplanes under the effect of air flow, blood flow through arteries etc. I will give a brief introduction about physical background, introduce the mathematical model and its main difficulties and talk about the research I have done so far in this field which concerns existence of weak solutions for the interaction problems between incompressible/compressible fluids and nonlinear elastic/thermoelastic plates (Joint work with Prof. Ya-Guang Wang).

当医学遇见数学：动脉粥样硬化的几个数学问题
When medicine meets math: several math problems in atherosclerosis

Hui Huang (Affiliated Hospital of Nanjing University of CM, China)

以动脉粥样硬化（AS）为基础的心脑血管疾病已经被 WHO 视为首要的人类健康问题，并成为一个全球性的亟待解决的严重社会问题。早期精准化发现及评估 AS 已成为当前的研究热点。突破瓶颈，跨学科合作，是对疾病的精准化诊疗的一个新方向。本报告将介绍 AS 的医学背景及当前的关键技术，并列举若干期待解决的数学问题。

黄辉，副主任医师，现任江苏省医学会超声分会委员，江苏省中医院超声医学科亚专业血管组组长，江苏省六大人才高峰高层次人才，主要从事血管超声诊断工作及新技术应用方面的研究。主持省厅级课题《应用超声造影技术评价颈动脉易损斑块的临床研究》、《基于极速脉搏波技术的高血压相关代谢障碍中医药干预的动脉弹性功能研究》、《潜阳育阴颗粒改善阴虚阳亢型高血压患者血管功能的临床研究》以及厅局级课题《极速脉搏波技术定量评估老年高血压患者颈动脉弹性功能变化》。