Engineering / Physics Seminar

Wednesday 10/31/2007, 4:30 pm
Science & Engineering Building Auditorium

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Computer Simulation of Human Vascular Problems. CFPD and VP in Biomedical Engineering

It is widely accepted that abnormal hemodynamics events due to non-uniform and disturbed flows play a major role in a cascade of intricate physico-biological processes of arterial diseases, e.g., the onset and development of atherosclerosis, myointimal hyperplasia, and/or thrombosis, and in post-operative complications including restenosis, endo-leak, graft migration, and rupture. Other factors contributing to these degenerative diseases include the individual's genetic make-up, diet, and life style. During several decades, engineering-oriented investigators have studied abnormal hemodynamics events such as wall shear stress levels and their variations (e.g., OSI, WSSG, and WSSAD, etc.), high particle residence times near the arterial wall, excessive arterial wall stresses and strains, and wall compliance mismatches using theoretical analyses, computational simulations and analyses, and experimental measurements. Abnormal hemodynamics indicators that favor the abnormal physico-biological processes are mainly dependent upon arterial geometries, such as curved stenosed arteries (e.g., coronary arteries), bifurcations (e.g., carotid artery, coronary artery, and iliac bifurcations) and branches (e.g., abdominal aorta branches), non-Newtonian whole blood viscosity, and transient blood flow waveforms through the arteries.

The identification of normal and abnormal hemodynamic events using precise and accurate computational particle hemodynamic modeling and simulation techniques and image-based reconstruction of arterial systems is crucial to the establishment of the advanced patient-specific surgical planning. Three-dimensional patient-specific, image-based reconstruction of arterial system is accomplished using SimpleWare software (i.e., ScanIP). Realistic computational particle hemodynamics modeling and simulations including non-Newtonian blood viscosity model (i.e., Carreau-Yasuda model) using ANSYS CFX have been applied to compute characteristics of local hemodynamics, e.g., velocity, pressure, and wall shear stresses including their variations, for the pre- and post-surgical patient-specific three-dimensional arterial systems.

Please join us for light refreshments at 4:15pm outside SEB 203.