MECHANICAL ENGINEERING

The Department of Mechanical Engineering presents:

The Ph.D. Dissertation Defense of

Shujuan Wang

Friday, October 2, 2015, 11AM
in Bourns Hall A341

Analysis of Curvature and Stent Emplacement in Modeling Arterial Transport and a Theoretical Model for Carbon Dioxide Sequestration in Tilted Aquifers

Doctor of Philosophy, Graduate Program in Mechanical Engineering
University of California, Riverside, October 2015
Dr. Kambiz Vafai, Chairperson

A major contributor of Cardiovascular Diseases (CVD), atherosclerosis is caused by the abnormal accumulation of macromolecules, such as low-density lipoprotein (LDL), within the arterial wall. To elucidate the mechanism and the effect of LDL concentration on the thickening of intima in both straight and curved artery, LDL transport in each layer of the arterial wall is studied analytically. A comprehensive concentration distribution expression of LDL in each layer of the arterial wall is derived analytically for the first time in the literature along with the characterization and estimation of the effect of curvature on the growth of atherosclerosis within the arterial wall. The effect of curvature on species concentration distribution is analyzed and the results are thoroughly benchmarked against prior pertinent works. The effect of stent compactness on LDL concentration along the lumen flow direction as well across the different layers is also established analytically for the first time. This work provides essential fundamental information for macromolecular transport within an artery with or without the presence of a stent and the curvature effect.

Also, a theoretical model for carbon dioxide injection and migration in tilted aquifers with groundwater flow into a geological formation is presented. Analytical results for the carbon dioxide sequestration are presented for the first time in the literature. Capillary force for the flow of two immiscible fluids in a porous medium creates a saturation transition zone, where the saturation changes gradually. The effects of sloped angle and an incoming ground water are studied. The asymmetrical distribution is fully incorporated in our analysis, which provides essential information for injection period and reservoir capacity. For the first time in the literature, we account for the injection velocity and the saturation transition zone as well as the slope effect of the incoming groundwater flow.