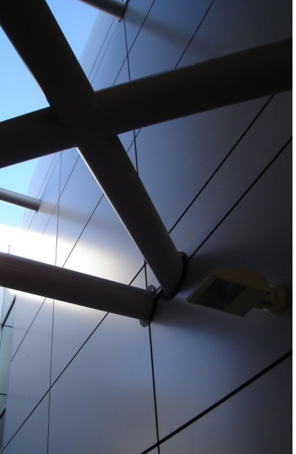

MECHANICAL ENGINEERING

THESIS DEFENSE

The Department of Mechanical Engineering presents:

The Master's Thesis Defense of

Sanika Nishandar

Monday, March 11, 2019,
2-4PM in Bourns Hall A171

Master of Science, Graduate Program in Mechanical Engineering
University of California, Riverside, March 2019
Dr. Masaru Rao, Chairperson

Flow diverting stents are being increasingly used as an option of treatment for intracranial aneurysms. These devices are deployed endovascularly along the parent artery where an aneurysm is located. It takes advantage of the intra-aneurysmal hemodynamics to occlude the aneurysm by reconstructing the parent artery over time, replacing diseased tissue with new healthy tissue. Although these minimally invasive, low porosity devices are being widely used for aneurysmal treatment, there are concerns around device efficiency associated with the high level of curvature in cerebral arteries. Some studies suggest that the inertia driven flow in tortuous arteries compared to the shear driven flow in the straight artery is the cause of inconsistent device performance. Previous research in our lab has indicated the potential of a novel microfabricated, solid construct balloon-deployable flow diverter within the posterior cerebral circulation. Presented herein, we demonstrate the effectiveness of these novel devices in tortuous parent arteries using computational fluid dynamic studies. We computed and compared the intra-aneurysmal hemodynamics for the stented and unstented cases of the tortuous geometry using ANSYS Fluent 18.2. The numerical results indicate higher flow velocities and wall shear stress inside the aneurysmal sac as the tortuosity of the parent artery increases. Increase in the area of wall shear on the distal end with increasing tortuosity, highlights the role of inertial flow in increasing the risk of aneurysm rupture. Reduction of intra-aneurysmal velocity and wall shear stress are considered key hemodynamic parameters enabling this therapy. Results after implantation of stents displayed substantially reduced values of inflow velocity and wall shear stress inside the aneurysm sac for all the studied models. Significant reductions were seen when high aspect ratio struts were computed at lower porosities in the straight as well as tortuous models. Values of velocity and wall shear stress reduction as high as 95% were observed with high aspect ratio struts at lower porosities indicating potential for high aspect ratio struts as a solution for inertial driven flow regimes. This potential is encouraging and shows the need to further explore high aspect ratio device design in more variations of aneurysm and parent vessel geometries.