The rotary Left Ventricular Assist Device (LVAD) is a mechanical pump surgically implanted in patients with end-stage congestive heart failure to help maintain the flow of blood from the sick heart. The rotary type pumps are controlled by varying the impeller speed to control the amount of blood flowing through the LVAD. One important challenge in using these devices is to prevent the occurrence of excessive pumping of blood from the left ventricle (known as suction) that may cause it to collapse due to the high pump speed. The development of a proper feedback controller for the pump speed is therefore crucial to meet this challenge.

In this thesis, some theoretical and practical issues related to the development of such a controller are discussed. First, a basic nonlinear, time-varying cardiovascular-LVAD circuit model that will be used to develop the controller is reviewed. Using this model, a suction index is tested to detect suction. Finally we propose a feedback controller that uses the pump flow signal to regulate the pump speed based on the suction index and an associated threshold. The objective of this controller is to continuously update the pump speed to adapt to the physiological changes of the patient while at the same time avoiding suction. Simulation results are presented under different conditions of the patient activities. Robustness of the controller to measurement noise is also discussed.

Major: Electrical Engineering

Educational Career:
Bachelor’s of Electrical Engineering, BS, 2004, Dalian University of Technology
Master’s of Electrical Engineering with Technology, MS, 2007, Southern Polytechnic State University

Committee in Charge:
Dr. Marwan A. Simaan, Chair, Electrical Engineering & Computer Science
Dr. Zhihua Qu, Electrical Engineering & Computer Science
Dr. Eduardo Divo, Engineering Technology

Approved for distribution by Dr. Marwan A. Simaan, Committee Chair, on June 16, 2010.

The public is welcome to attend.