In the treatment of heart patients, as a bridge to recovery, the challenge currently in using a continuous-flow left ventricular assist device (LVAD), is to provide a method to monitor the recovery of the heart. This dissertation addresses the hypothesis that continuous monitoring of the ejection fraction of a patient implanted with an LVAD should be to examine the progress of the patient without the need for excessive in vivo measurements. Also, the ejection fraction can be used to provide a control mechanism for the pump depending on the requirements of each patient. In this dissertation, the left ventricle in the presence of the LVAD was studied using hemodynamic data obtained from a well-established computer simulation model of the left ventricle supplemented with a generic pump.

It is evident from the model that the presence of the pump alters the dynamics of the left ventricular volume curve because of the changes in the dynamics of the aortic valve. As a result, there rises the necessity to define ejection fraction in the presence of an LVAD. Interestingly, a sharing of blood between the ventricle and the pump was observed irrespective of the input of the pump, up until the point where the aortic valve permanently shuts down.

An appropriate definition of ejection fraction in the presence of an LVAD is the ratio of the volume of blood ejected from the ventricle through the aortic valve to the amount of blood available in the ventricle just before ejection begins. The simulations in this study proved that ejection fraction defined as stated, removing the effects created by the pump. This provides the necessary information to monitor the recovery of the heart, and also information about the sharing of blood, which helps understand the cost of providing a feedback control mechanism to control the pump, thus the hypothesis.

Major: Electrical Engineering

Educational Career:
Bachelor's of Electrical and Electronics Engineering, BS, 2008, National Institute of Technology, Tiruchirappalli, India
Master's of Biomedical Engineering, MS, 2010, Indian Institute of Technology, Madras, India

Committee in Charge:
Marwan A. Simaan, Chair, Electrical and Computer Engineering
Zhihua Qu, Electrical and Computer Engineering
Chinwendu Enyioha, Electrical and Computer Engineering
Alain Kassab, Mechanical and Aerospace Engineering
Timothy Maul, Electrical and Computer Engineering
Peter Wearden, Electrical and Computer Engineering

Approved for distribution by Marwan A. Simaan, Committee Chair, on March 16, 2020.

The public is welcome to attend.