TECHNISCHE UNIVERSITÄT WIEN
Vienna | Austria

INSTITUT FÜR MECHANIK UND MECHATRONIK
Mechanics & Mechatronics

Diploma Thesis

in cooperation with the Medical University of Vienna

Recovery failing hearts by mechanical unloading

The challenge: Improvement of therapy in patients with advanced heart failure

Durable left ventricular support with implantable rotodynamic blood pumps became a standard therapy for bridge to transplantation or destination therapy in patients with advanced heart failure (Figure 1). In a small sub-group of patients, it has been clinically observed that failing hearts can even recover during mechanical unloading with such pumps. It is hypothesized that a combination of defined unloading ("rest" the heart) and subsequent loading ("exercise" the heart) may increase the recovery rates of heart failure patients supported with such pumps.

Figure 1. Schematic diagram of an implanted rotodynamic blood pump.

Content: Development of a control strategy to restore the state of optimal cardiac efficiency

A healthy cardiovascular system matches ventricular and vascular properties to operate in a state of high cardiac efficiency. By contrast, a failing cardiovascular system loses the ability to operate with high cardiac efficiency. The aim of this diploma thesis is to develop a control algorithm that adapts the pump output to restore the state of optimal cardiac efficiency. Such an approach will result in optimal loading of the failing heart and may thereby enhance cardiac recovery rates. Therefore, this project may constitute the first step towards a curative treatment for terminal heart failure patients (Fig. 2).

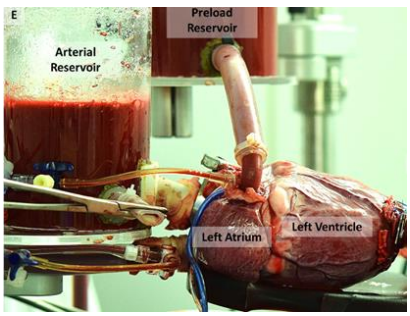

Figure 2. The developed control strategy will be investigated in an ex-vivo isolated beating heart model.

Work Packages

- Optimize an existing 0D model (Matlab/Simulink) to reflect the hemodynamics of a healthy and failing cardiovascular system.
- Develop an optimal control strategy of the blood pumps´ output to achieve a state of high cardiac efficiency
- Assess the strategy in a hardware-in-the-loop experimental setup and/or in an isolated beating heart (Figure 2).

Requirements

- Knowledge of MATLAB and programming skills
- Knowledge of modelling, system identification and control theory
- Sound English communication

Contact

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