TECHNISCHE UNIVERSITÄT WIEN
Vienna | Austria

INSTITUT FÜR MECHANIK UND MECHATRONIK
Mechanics & Mechatronics

Diploma Thesis

in cooperation with the Medical University of Vienna

Development of a physiologic control system for “artificial hearts”

The Challenge: Control of cardiac assist pumps for children

Durable left ventricular support with implantable rotodynamic blood pumps became a standard therapy for bridge to transplantation or destination therapy in adult patients with advanced heart failure. The lack of similar technologies for the pediatric population may be explained by the complexity of the patient-device interaction in small patients/hearts. Within this project, we will investigate and optimize this patient-device interaction to pave the way for a new and safe therapy for pediatric patients.

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

Content: Development of a control of cardiac assist pumps for children

A healthy cardiovascular system adapts the cardiac output to meet the oxygen requirement of peripheral organs. In contrast, state-of-the-art rotodynamic blood pumps are driven at constant speed without continuous adaptation of pump output to the need of the patient. This limited adaptation to the patient’s need results in reduced quality of life (e.g. low exercise capacity) and adverse events related to over- and under-pumping (e.g. right heart failure). The aim of this diploma thesis is to develop a control algorithm that mimics the native heart function and automatically adapts the pump output to the need of the patients based on appropriate feedback information (Figure 2).

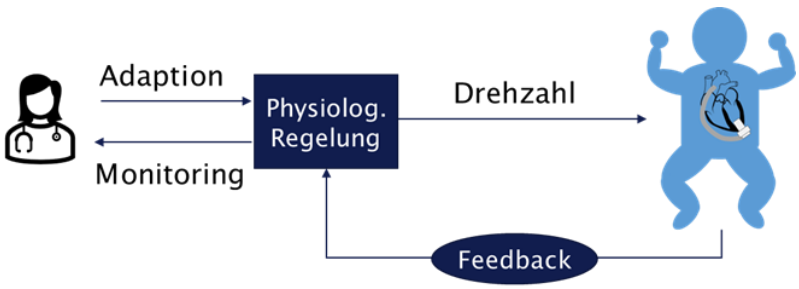

Figure 2. Schematic Diagram of a physiologic control system.

Work Packages

- Adapt and optimize existing 0D numerical models of the cardiovascular system (Matlab/Simulink) to reflect hemodynamics of pediatric patients.
- Systematically investigate optimal feedback information (from pump signals and/or hemodynamic sensors) to permit observability and controllability of the system (cardiovascular system and pump).
- Design closed loop control systems to automatically adapt the pump output to the need of the patient
- Assess the developed physiologic control system in a hardware-in-the-loop experimental setup and/or in animal models.

Requirements

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

Contact

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