TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

INSTITUT FÜR MECHANIK UND MECHATRONIK
Mechanics & Mechatronics

Diploma Thesis

An intraventricular balloon system to control the pressure-volume relationship in small animal hearts

Content of the proposed diploma thesis in coorperation with The Medical University of Vienna:

The adverse remodeling of the failing heart (increase in volume) is primarily triggered by pressure- or volume-overload. Recent studies suggest that ventricular unloading with ventricular assist devices (VADs) is one of the main stimuli that stops adverse remodeling, while partially reversing these changes. However, the exact mechanisms are not well understood, which may be attributable to the lack of appropriate animal models: On the one hand, in large animal models the VAD can be implanted, however, such experiments are expensive and cumbersome. On the other hand, small animal experiments are less costly, however, the effect of VADs on the cardiac pressure-volume relationship cannot be replicated.

The aim of this master thesis is to optimize and test a system which accurately controls the pressure-volume relationship in small animal hearts (Figure 1 left) by means of a balloon system. An experimental system which mimics the small animal heart based on an available voice coil system (Figure 1 right) has been developed. In a next step, strategies to control the pressure-volume relationship by means of the balloon (Figure 1 right) will be optimized and tested in-vitro. Ultimately, the typical pressure-volume relationships during VAD support will be replicated in an isolated small animal heart and its cardiac mechano-energetics (workload and oxygen consumption) assessed.

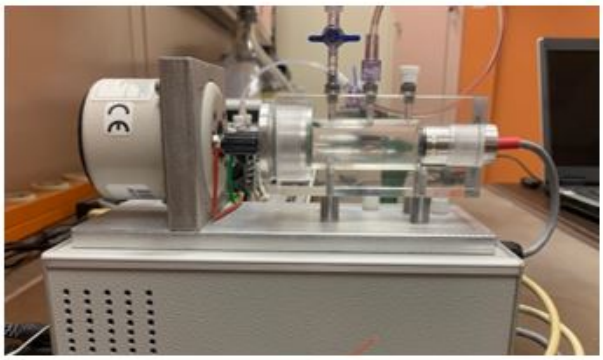

Figure 1 Left: Isolated small animal heart. Figure 2 Right: The experimental voice coil setup to mimic a small animal heart and control its pressure-volume relationship by the balloon system.

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In the thesis the following workpackages have to be tackled:

- Optimize and evaluate strategies to control the cardiac pressure-volume relationship in-vitro
- Evaluate the most promising approach in an available isolated small animal heart

Requirements:

- Knowledge of MATLAB and programming skills
- Knowledge of modelling and system identifikation
- Sound English communication

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