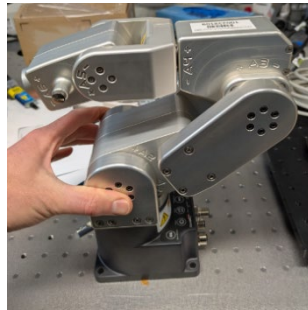
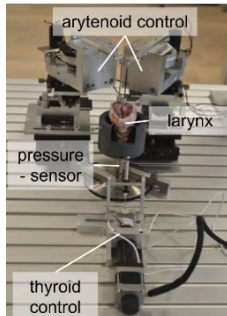


Master Thesis

Development and Evaluation of Trajectory Planning and Control Strategies for two 6-Axis Robotic Arms in an Ex-Vivo Larynx Environment



In the Division of Phoniatics and Pediatric Audiology at the University Hospital Erlangen, the fundamentals of human voice production are investigated experimentally. For this purpose, the vocal folds of excised animal and human cadaver larynges are stimulated to vibrate under controlled laboratory conditions. One of the key objectives is to reproduce the positioning of the cartilage apparatus as realistically as possible. The essential components are the arytenoid cartilages, which control movement and positioning of the vocal folds during phonation. The aim of

this work is to develop an automated system for controlling arytenoid cartilage movement and generating three-dimensional trajectories using two robot arms.

The master thesis will be supervised in collaboration with the Phoniatics Division of the ENT Clinic (Dr. rer. nat. Helena Vulić). Experimental validation and measurements will be conducted on porcine larynges.

Task Description

1. Literature Research
2. Robot Setup
 - a. Analysis of capabilities and constraints
 - b. Mechanical interface of the robot to control the laryngeal tissue
 - c. Integration of a sensor to measure forces and torques at the interface
3. Software
 - a. Generating physiologically inspired trajectories
 - b. Motion and force/torque control design and implementation
4. Evaluation
 - a. Validation experiment with ex-vivo animal larynges
 - b. Measurement of tissue vibration, aerodynamic driving pressure, and acoustics
5. Documentation and presentation of results.

Prerequisites

- Studying mechatronics, medical engineering, computational engineering, electrical engineering, autonomy technologies, or similar
- Good Python skills and knowledge of robotics

References

Döllinger et al.: *Experiments on Analysing Voice Production: Excised (Human, Animal) and In Vivo (Animal) Approaches*. Current Bioinform, vol. 6(3), pp. 286-304, <https://doi.org/10.2174/157489311796904673> 2011.

Gashi A.: *Implementation of a 6-Axis Robotic Arm in an Experimental Ex-Vivo Larynx Setup*. Master thesis, 2026.

Siciliano: *Robotics - Modelling, Planning and Control*. Springer, <https://doi.org/10.1007/978-1-84628-642-1>

Mecademic, "mecademicpy," GitHub repository. [Online]. <https://github.com/Mecademic/mecademicpy>.

Registration: August

Submission: tbd

Examiner: Prof. Dr.-Ing. habil. Philipp Beckerle

Supervisor: Dr. rer. nat. Helena Vulić

Co-Supervisor: Martin Rohrmüller