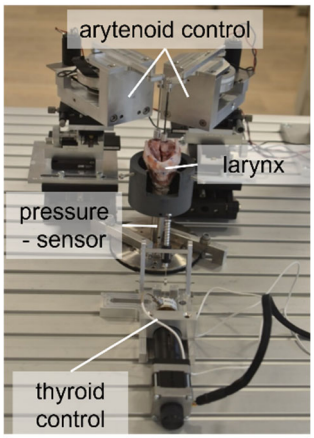
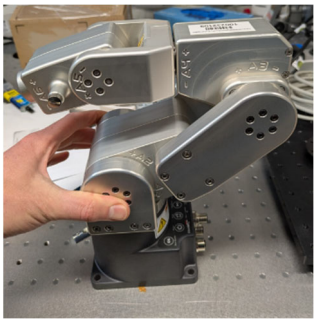
Friedrich-Alexander-Universität
Institute of Autonomous Systems and Mechatronics | ASM

31.03.2025

Master Thesis

Integration and control of robot arms for an experimental larynx setup





In the Division of Phoniatrics and Pediatric Audiology at the University Hospital Erlangen, the fundamentals of human voice production are experimentally investigated. For this purpose, the vocal folds of excised cadaver animal and human larynges are experimentally stimulated to vibrate. The positioning of the cartilage apparatus should be simulated as realistically as possible. The essential components are the arytenoid cartilages, which serve to move the vocal folds (commonly known as vocal folds) in the phonation position to produce the human voice. The aim of this work is to enable the automated control of the arytenoid cartilage movement using two robot arms and to integrate these into the existing computer-controlled experimental setup. The master thesis will be supervised in collaboration with the Phoniatrics Division of the ENT Clinic (PD. Dr.-Ing. Stefan Kniesburges). Test measurements will be conducted on porcine/calf larynges.

Task Description

1. Literature Research
2. Hardware Setup
    a. Mechanical interface of the robot to control the laryngeal tissue
    b. 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.

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.

Birk et al.*: Automated Set-up for Ex-vivo Larynx Experiments*. J Acoust Soc Am, vol. 141(3), pp. 1349-1359, https://doi.org/10.1121/1.4976085, 2017.

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

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