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MASTER THESIS

To students within
Medical Engineering / Medizintechnik,
Computer Science/ Informatik / Artificial Intelligence,
Data Science, Computational Engineering

05.08.2026

Title: Machine learning based recognition and differentiation of animal vocalization (pig squeals)

Background: Animal models are needed and indispensable to investigate medical procedures such as surgery techniques or implants. In our clinical daily routine, we often deal with laryngeal cancer being positioned on and within the vocal folds. The vocal folds are positioned in the larynx and oscillate during speech, producing the basic audio signal that is then modulated in the vocal tract and being emitted from the mouth. Hence, without vocal folds, speaking will be rather impossible. **Our overall Goal is to develop new and better cell based vocal fold implants** that enable patients to speak normally after partial / full vocal fold resection. As a first step, and before transferring our methods to humans, we have to test and validate the developed methodologies within animal models (i.e. Yucatan mini-pigs).
Current state: 96-hours acoustic recordings have been obtained from each of the 24 pigs undergoing vocal fold surgery (12 male and 12 female), either control vocal fold resection alone or resection with implantation. Two pigs of the same sex and treatment stage are housed together in a pen, and their vocalizations cannot be distinguished, producing n=12 effective subjects. Recordings are collected pre-operatively, and at timepoints about monthly up to 6 months post-operatively. Individual squeals have been manually identified and clipped from the recordings, with over 500 pre-surgical and nearly 2000 post-surgical individual squeal event audio recordings currently available. Additional recordings are ongoing, in 2 pairs of pigs up to 1 year post-op. In a previous Master's thesis we determined parameters reflecting voice quality that changed permanently post-surgery and parameters that returned to normal pre-surgery quality (temporarily change). Hence, the **next consequent research** questions are:
(1) Is it possible to automatically and accurately extract squeals from the raw acoustic data, eliminating background noises and grunts (non-laryngeal pig noises)? (2) At longer time points up to 1 year, does the post-surgical voice quality stabilize or continue to change? (3) Do preop or postop pig-squeals differ between sex as for humans (e.g. do pitch or other acoustic features distinguish females and males)? (4) At long time points (6-12 months after surgery), do the implanted pigs' voices acquire more acoustic similarity with human voices?

Methods & tasks:

1. Become familiar with laryngeal biomechanics, acoustics, related literature and previous work [1,2,3,4];
2. Investigate current acoustic data and use Machine learning to isolate squeal events from raw recordings
3. Explore different ML architectures and features to investigate/classify ongoing changes in voice quality with time post-surgery and between sexes
4. Using machine learning with publicly available human voice datasets, identify acoustic features that distinguish pig squeals and human vocalizations, and assess the change in these features over time after surgery

Goal: Use ML-based models to characterize the long-term voice changes occurring after vocal cord implant in pigs.

The work will be supervised by **Prof. Dr.-Ing. Michael Döllinger** (Member of Department Informatics & AIBE)**.** The thesis is in close **cooperation with Prof. Jennifer Long, PhD, MD** (University of California Los Angeles, UCLA) who will co-supervise the student.

We search for a dedicated and motivated student with

- experience in programming language (Python)
- Good Mathematical understanding
- Good background and knowledge in Machine Learning
- Good written and verbal communication skills in English (cooperation partner is English speaking)
- Very good grades

Contact person: **Please send CV and current transcripts**

Prof. Dr.-Ing. Michael Döllinger (michael.doellinger@uk-erlangen.de)

References:

[1] Schlegel P, Wong K, Aker M, Alhiyari Y, Long J. Objective Assessment of Porcine Voice Acoustics for Laryngeal Surgical Modeling. Appl Sci (Basel). 2021 May 14;11(10):4489. PMID: 35495360; PMCID: PMC9047298.

[2] Schlegel P, Yan K, Upadhyaya S, Buyens W, Wong K, Chen A, Faull KF, Al-Hiyari Y, Long J. Tissue-engineered vocal fold replacement in swine: Methods for functional and structural analysis. PLoS One. 2023 Apr 21;18(4):e0284135. doi: 10.1371/journal.pone.0284135. PMID: 37083641; PMCID: PMC10120936.

[3] K. Zhang, G. Crane, M.R. Alvarez, A. Klomhaus, Y. Alhiyari, M. Döllinger, J. Long. Vocal outcomes after cell-based outer vocal fold replacement (COVR) in a porcine model of bilateral vocal fold resection. Laryngoscope, EPub-online, 07/2026.

[4] Ruiz A. Mateo (07/2026) *Machine learning-based recognition and differentiation of porcine voice acoustics for longitudinal assessment of laryngeal surgical outcomes.* Masterarbeit, Studiengang Artificial Intelligence, Technische Fakultät FAU.