# Feasibility of Preterm Esophageal Signal Recording and Processing

**Background** Preterm infants (birth weight <2000 g) are routinely monitored within neonatal intensive care units (NICU). Among other signals, the NICU continuously measures the electrocardiogram (ECG) and the thoracic impedance using surface skin electrodes to determine the heart rhythm and to control the respiration function, respectively. However, standard Ag/AgCl electrodes suffer from motion artifacts and cause skin irritation that requires their frequent replacement. On the other side, preterm infants are fed through nasogastric tubes that are permanently placed in the esophagus as coordination of breathing and swallowing is not fully matured before due date.
As a promising alternative, esophageal electrodes placed on an enteral tube can be used. Due to the close vicinity of the esophagus to the heart and the diaphragm, high-quality esophageal ECG and EMG signal might be recorded in preterm infants. Moreover, low-frequency electrode motions caused by respiration motion or esophageal peristalsis might be measurable as electrical signals (see figure) as well. Such signals might be indicative for the progress of higher neurological functions in preterm infants [1]. So far, data about high quality esophageal signal recording in preterm infants are lacking.

**Aim** The focus of this master's thesis is to investigate the feasibility of esophageal ECG and EMG signal recording and adequate processing in preterm infants.

**Tasks**

- Familiarize with (esophageal) ECG / EMG signals
- Build up a dedicated test-setup that can be used in a clinical trial including certified tubes and amplifier
- Develop firmware / software for the clinical setup
- Analyze recorded (esophageal) ECG / EMG signals
- Investigate dedicated signal processing algorithms to pre-process the esophageal signals and to extract electrode motion signals (respiration, esophageal peristalsis)

**Nature of the Thesis**
Experimental test-setup: 20%
Software development: 30%
Signal analysis / processing: 50%

**Requirements**
Basic understanding of biopotential signals
Interest in signal acquisition / processing
Programming knowledge (MATLAB/Simulink)

**Supervisors**
Dr. med. et phil. Andreas Häberlin
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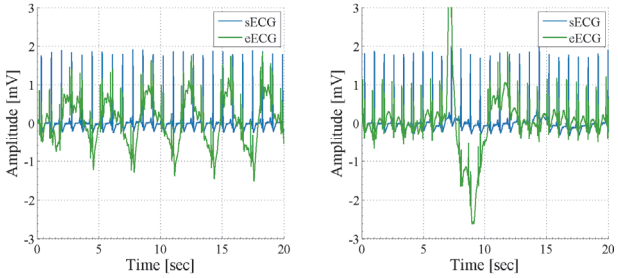


*Figure: esophageal ECG perturbations caused by respiration motion (left) and esophageal peristalsis (right) measured in an adult patient.*

**Institutes**
ARTORG Center for Biomedical Engineering Research, University of Bern
Institute for Human Centered Engineering - microLab, Bern University of Applied Sciences
Department of Neonatology, University Children's Hospital Basel (UKBB)

**References**
[1] J. Slattery, A. Morgan, and J. Douglas, "Early sucking and swallowing problems as predictors of neurodevelopmental outcome in children with neonatal brain injury: a systematic review," *Dev. Med. Child Neurol.*, vol. 54, no. 9, pp. 796–806, Sep. 2012.

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