Nonlinear Methods of Analyzing Respiratory Waveform Variability during Oral Feeding in Preterm Infants

Beiwen Jia, Guanhong Liu, Fangyan Dong, Qing Huang, Tianyu Zhao
Professor William C. Tang
Department of Electrical Engineering and Computer Science

Purpose

This project intends to create a biomedical system that uses respiratory waveform variability to develop clinical algorithms based on respiration that guides clinical care in the feeding of infants in the NICU.

Background

Immature coordination of swallowing with respiration might have some bad affects for the preterm infant as feeding requires integration with neuromotor control and cardiorespiratory stability. During infant feeding, swallow influences respiratory efforts, as respiration is inhibited centrally during pharyngeal swallowing. Therefore, precise coordination of sucking, swallowing, and breathing is necessary during bottle feeding. The clinical application of monitoring respiratory wave patterns may be helpful in identifying infant's readiness to initiate and progress feeds orally.

References

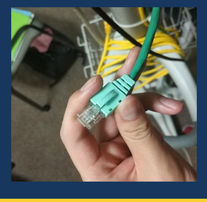
Barrington KJ, Finer NN. Periodic breathing and apnea in preterm infant. Pediatric research. 1990; 27(2):118-121. [PubMed: 2314939]

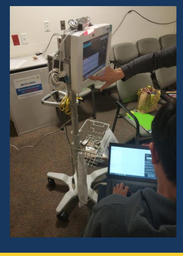
Ben-Tal A, Smith JC. Control of breathing: Two types of delays studied in an integrated model of the respiratory system. Respiratory physiology & neurobiology. 2010; 170(1):103-112. [PubMed: 19853063]

Hardware

For the hardware part, since we need to find the applicable cable to the patient monitor, we did a lot of survey to confirm the parameters among various kinds cable. Its principles are very simple. The cable contains two parts: the first one is RJ45-RS232 and the other is RS232-USB.

Monitor: Philips MP50
Cable:
1. the green cable is RJ45-RS232 (the special cable which might has different pin definition)
2. the white one is a normal convector RS232-USB.





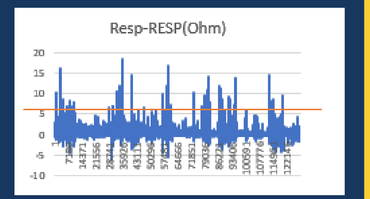
Prediction Algorithm:

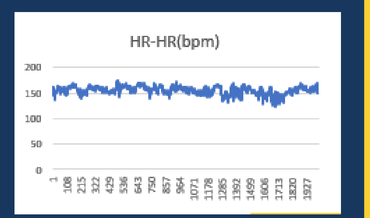
We are working with doctors to develop prediction algorithms. Because we need to understand the expertise in clinical applications and the need to obtain approval from hospitals and family members to collect clinical data from infants, we have not accumulated enough data to analyze. But we have begun to study the methods of data analysis by interviewing many medical staffs and plan to use multi-linear regression to analyze our data.

Auto-clipping

For the auto-clipping part. We came up with several ideas about clipping out the disturbed data time, one of which is conducting the wavelet transform and use a coordinated filter, then rebuild the signal. However, this method is unacceptable because the reconstruction signal loses the time axis. Besides, this transform will result in distortion slightly. This distortion reduces the accuracy in the following entropy calculating undoubtedly.

However thresholding comes with its outstanding features to solve this problem. The threshold module can finish the auto-clipping precisely and fast. We set up two levels of thresholds and used the variation of the data to automatically adjust the values of thresholds. Then we could clip out the data which corresponds to burping period of infants. Thresholds can slightly change in order to fit in processing more universal data.





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