Detecting Cardio-Respiratory Instability in Neonates

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Issue

Sudden Infant Death Syndrome (SIDS) is the leading cause of death among infants, and claims the lives of about 2,500 each year in the United States. Public hospitals spend billions of dollars annually on cardio-respiratory monitoring of at-risk infants. While such monitoring can be used to identify unusual events, they are not able to predict the likelihood of events at a later time.

Goal

In this project we are devising a technique that takes a digital signal from a standard hospital cardio-respiratory monitor and uses it to predict the likelihood of a subsequent event.

Current Progress

We are using a dataset obtained from typical hospital monitoring systems which consists of various lengths of heart rate and respiration signals of healthy infants and also infants housed in the NICU.

We have designed and implemented algorithms in MatLab that extract key features of the heart rate and respiration in the frequency domain.

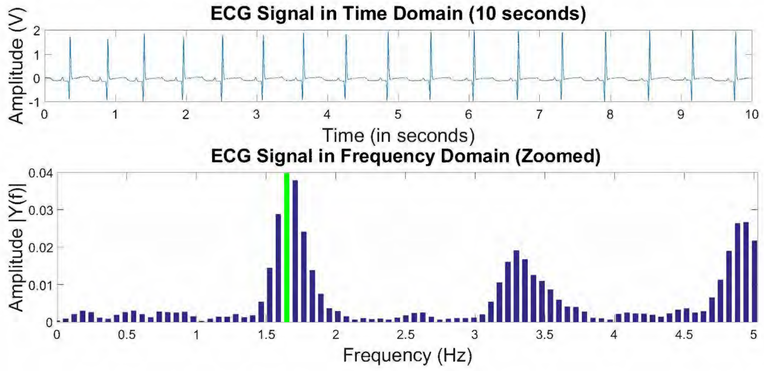
Dataset

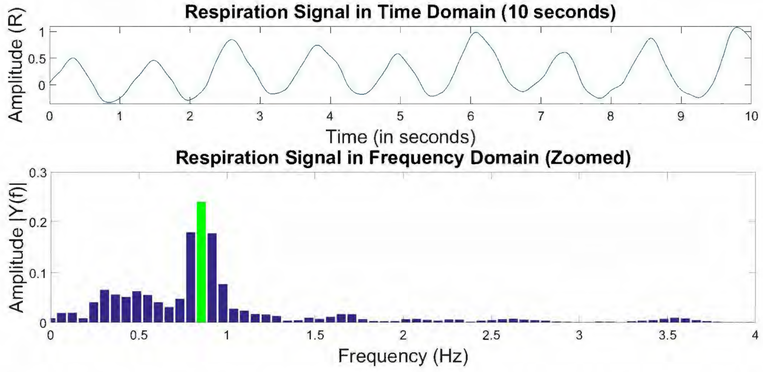
Our dataset was obtained from University of Arizona. One class was obtained from healthy infants, while the other class was obtained from infants housed in NICU

Each instance has 7 to 24 minutes of ECG and respiration signals. After removing instances which were incomplete, the final instance count was 12 normal instances and 18 NICU instances. The sampling rate of the ECG signal is 250Hz and the sampling rate of the respiration signal is 62.5Hz.

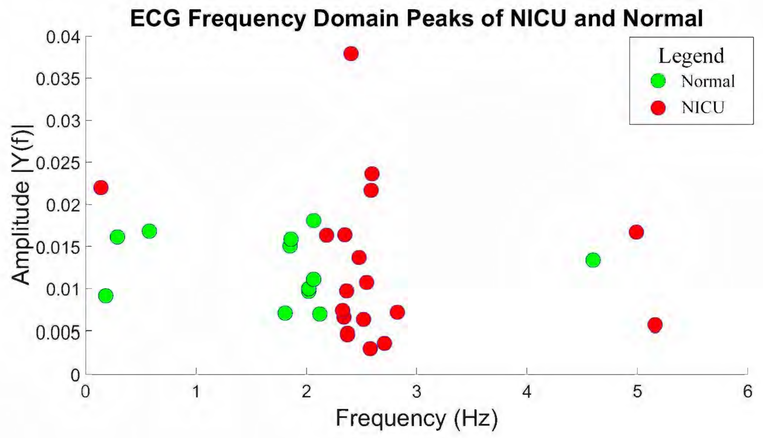
Results

The two following graphs display an ECG and respiration signal in the time and frequency domains. These are provided for reference

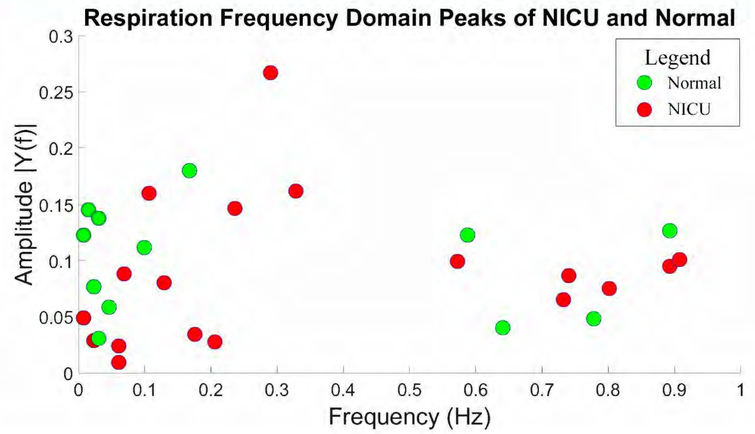




The two following graphs demonstrate the one of the extracted features in the frequency domain, the frequency peak.



Results – Contd.



Current Conclusions

From our initial results, it has been determined that frequency domain peaks alone are not enough to differentiate between these two classes. The respiration frequency peak graph is very scattered and does not tell us much about the classes on its own. The ECG frequency peak graph does, however, seem to show somewhat of a trend. Combined with future feature extractions, I am confident that we could design an accurate classifier.

Continued Work

I intend to continue my work on this project after graduation. The next step is to extract more features of the ECG and respiration signals in the time domain and frequency domain.

After feature extraction is complete, we will use a percentage of the extracted feature sets as a training set in Waikato Environment for Knowledge Analysis (WEKA) to obtain a classifier. The accuracy of our classifier will be tested with the remaining extracted feature sets.

I also plan to donate the code I have written so far so that other students may try additional methods in the future without having to start with nothing.