Detection of fetal heart rate from single channel fetal electrocardiogram using filtering methods

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Fetal ECG (FECG) signal contains information that could assist clinicians in making appropriate and timely decisions during pregnancy and labor. However, the signals recorded from electrodes are dominated by maternal ECG (MECG) as well as electrical noise due to relatively weak FECG signals. The objective of this study is to detect the Fetal Heart Rate (FHR) using only a single channel of FECG recordings. The PhysioNet database which consists of 55 multi-channel abdominal FECG recordings at 21 to 40 weeks of pregnancy was used in this study. Every recording consists of five or six signals (two thoracic signals and three or four abdominal signals) with 1-kHz sampling frequency and 16-bit resolution. First, a 50 Hz notch filter is applied to the FECG signal to remove the electrical noise. Then, the signal is bandpass filtered (cut-off frequencies of 35 and 80 Hz) to decrease the MECG QRS complex amplitude and thus enhance the FECG QRS complex. Finally, the autocorrelation function is applied to the signal to obtain the FHR. Using this algorithm, the FHR could be found from 29 of the FECG recordings which is comparable to another recent study (found FHR from 34 FECG recordings) that used a more complicated algorithm (Adaptive comb filter). The proposed algorithm faces difficulty when the MECG and FECG fully overlap or the FECG amplitude is too small as compared to the MECG. The single-lead FHR detection is desirable from the comfort point of view of the patient, especially during long-term monitoring.

\textbf{Keywords:} Fetal Electrocardiogram, Fetal Heart Rate detection