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Fetal heart rate extraction from abdominal electrocardiograms through multivariate empirical mode decomposition

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Assessment of fetal heart rate (FHR) and fetal heart rate variability (fHRV) reveals important information about fetal well-being, specifically in high risk pregnancies. Abdominal electrocardiogram (abdECG) recording is a non-invasive method to capture fetal electrocardiograms. In this paper, we propose a methodology to extract FHR (fetal RR time series) from the abdECG recordings using the recently introduced multivariate empirical mode decomposition (MEMD) technique. MEMD breaks a signal into a finite set of intrinsic mode functions (IMFs). First, elimination of the noisier abdECG channels, based on comparison of similar indexed IMFs that were obtained through the MEMD technique, is conducted. Thereafter, denoising of the remaining abdECG channels is performed by eliminating certain similar indexed IMFs. The unwanted mother QRS complexes are removed from these noise-free abdECG channels and the candidate fetal R-peaks are detected through a wavelet based approach. The proposed methodology is validated using an open source real-life clinical database. The proposed technique resulted in a high value (0.983) of cross correlation between the detected and true FHR signals.

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