Employing Support Vector Machine Regression to Estimate the Fetal Gestational Age

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The accurate estimation of the Gestational Age (GA) in fetal development studies has the potential to detect health issues related to the fetus at early stages of pregnancy, which could possibly reduce obstetric interventions, morbidity and cost. In this article, we adopt the Support Vector Machine (SVM) tool to investigate whether fetal gold standard Gestational Age (GA) can be reliably estimated by using maternal as well as fetal Heart Rate Variability (HRV) features. The study considered Electrocardiogram (ECG) signals from 60 healthy pregnant women with no records of fetal abnormalities. Maternal and fetal HRV parameters were calculated, and SVM regression with the linear kernel function was utilized to produce a robust estimate of fetal age. Cross-validation performances were evaluated by the mean square root of the average of squared errors (mRMSE) between age values estimated by the proposed models and gold standard GA identified by Crown-Rump Length (CRL). We found that maternal electrophysiological parameters contribute to the correct estimation of the GA. Results showed that the linear kernel maintains better performance over the radial basis function kernel in the SVM-based regression models. Compared with gold standard GA identified by CRL, the proposed model resulted in mRMSE of 5.11 weeks, Bland–Altman estimated bias of -0.31 weeks and limits of agreement of 8.97 and -9.59 weeks, and Pearson correlation coefficient of 0.63. In conclusion, it can be speculated that the fetal GA can be more reliably estimated when incorporating maternal along with fetal HRV parameters using 1 min of ECG signals.