Fetal arrhythmia: Deep learning and Clustering techniques, analysis through permutation entropy and genetic algorithms in its early diagnosis

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Fetal arrhythmias are a condition present in 1-2% of pregnancies. This is understood as the presence of any irregular fetal heart rhythm, evidenced as a value outside of the established reference, which is usually between 100 to 200 beats per minute (bpm). This condition can be diagnosed as benign in most cases due to its subsequent natural regularization, but 10% of the registered cases indicate that the presence of irregularities in the fetal heart rhythm can trigger morbidity, fetal hydrops or even imminent death of the fetus. In this context, early diagnosis is important for the treatment of the reported condition (usually treated with non-invasive antiarrhythmic therapy). Therefore, ensuring the precision, speed and efficiency in this is an important necessity in order to reduce the incidence of fetal death reported annually by this condition. In this way, a deep learning model is proposed based on a classifying neural network trained with an ECG database of 4 to 5 channels (both fetal and maternal) accompanied by an intelligent arrangement of clustering techniques, analysis by permutation entropy and data augmentation based on genetic algorithms that ensure the correct performance in the classification of the presence of fetal arrhythmia. This set of techniques aims to form an effective system for the rapid diagnosis of heart rhythm irregularities present in fetuses, ensuring an overall accuracy greater than 88% in fetal arrhythmia risk stratification.