MORPHOLOGICAL FILTERS FOR THE AUTOMATED ESTIMATION OF THE INTRAPARTUM FETAL HEART RATE BASELINE

S. Cazares[1], M. Moulden[2], C.W.G. Redman[2], L. Tarassenko[1]

[1]Department of Engineering Science, Oxford University, Oxford, UK.
[2] Nuffield Department of Obstetrics and Gynaecology, John Radcliffe Hospital, Oxford, UK.

The FHR baseline is the mean FHR with accelerations and decelerations excluded. Systems for automated FHR analysis can fail to estimate accurately the intrapartum FHR baseline. The Oxford Sonicaid System 8000 uses a series of rules to estimate an FHR baseline. Although System 8000 is intended for the analysis of antenatal CTGs, a modified version has been designed for intrapartum analysis.

We use *morphological filters* (MFs) to estimate the intrapartum FHR baseline. MFs exclude or accentuate geometrical features of a signal in a manner that agrees with human intuition and perception *without* the use of rules. We use MFs to exclude accelerations and decelerations from the FHR. We then use a smoothing filter to calculate a running mean of the resulting trace.

An expert in CTG analysis used an electronic pad to draw by hand and digitise the baselines of 24 intrapartum FHR traces. Twelve traces led to abnormal outcomes, as defined by Apgar scores and blood gas analysis at delivery, while 12 led to normal outcomes.

Figure 1 shows 30 minutes of a typical intrapartum FHR trace (——) with three estimates of the baseline: the expert's (——), the modified System 8000's (------), and the MFs (-·-·-·-). The average correlation coefficients between the baseline estimates of the MFs and expert was 0.63, of System 8000 and the expert was 0.70, and of the MFs and System 8000 was 0.73. Even without the use of rules, the MFs perform almost as well as the modified System 8000. The correlation between the estimates of the MFs and the expert can be improved by applying a small number of rules similar to those of the modified System 8000, for example, those meant to cope with extended periods of bradycardia and sinusoidal traces.

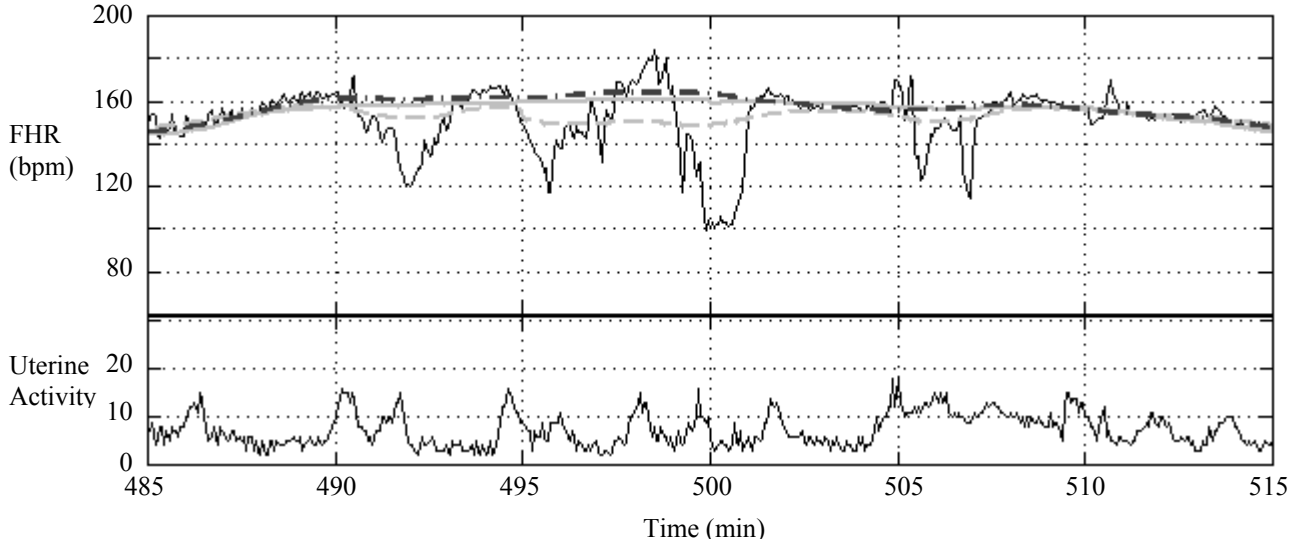

Figure 1: A 30-minute segment of an intrapartum CTG with three estimates of the FHR baseline, the expert's (——), the modified System 8000's (------), and the morphological filters' (-·-·-·-).