Estimating the error in spectral analysis of fetal heart rate variability
Warmerdam, G.J.J.; Vullings, R.; Bergmans, J.W.M.; Oei, S.G.

Gepubliceerd: 01/01/2015

Document Version
Uitgevers PDF, ook bekend als Version of Record

Please check the document version of this publication:

• A submitted manuscript is the author’s version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher’s website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

Citation for published version (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
ESTIMATING THE ERROR IN SPECTRAL ANALYSIS OF FETAL HEART RATE VARIABILITY

G.J.J. Warmerdam*, R.Vullings, J.W.M. Bergmans, and S.G. Oei

*Eindhoven University of Technology,
Den Dolech 2, 5612 AZ Eindhoven
The Netherlands
e-mail: g.j.j.warmerdam@tue.nl

ABSTRACT

The fetal heart rate (FHR) is regulated by the autonomic nervous system (ANS) and changes in FHR are related to changes in autonomic regulation. Valuable information about fetal distress during labor could thus be obtained from analysis of FHR variability. To monitor changes in sympathetic and parasympathetic activity of the ANS, spectral analysis can be used [1]. However, spectral analysis is often disturbed by artefacts in the FHR recordings. Although it is possible to correct for these artefacts by linear interpolation of heartbeats, the interpolation itself will also affect the spectral analysis. Therefore, information on the reliability of calculated spectral powers is required to use spectral analysis of FHR variability in clinical practice. However, it is currently unclear how artefact correction affects the spectral analysis.

In this study, an analytical expression is derived for the error in spectral analysis of FHR variability that is caused by artefact correction. The spectral analysis is based on the Continuous Wavelet Transformation (CWT), which provides simultaneous time and frequency information [2]. With the CWT it is possible to estimate the error in spectral power at each moment in time, using the temporal information on the location of interpolated heartbeats. From this instantaneous error, the total error in spectral power of a certain frequency band can be estimated.

To compare the estimated error in spectral power to the actual error, a set of 2500 FHR recordings is created with varying levels of artefact correction (ranging from 5% to 50%). Spectral powers are calculated for the low frequency band (LF, 0.04-0.15Hz) and the high frequency band (HF, 0.4-1.5Hz). Results are obtained as the difference between the actual and estimated error, relative to their theoretical power. The difference between actual and estimated error was -8±9% and -12±19% for LF and HF power, respectively. The negative sign indicates that the error is mostly overestimated and the estimation is on the safe side.

The presented method allows clinicians to assess the reliability of spectral analysis of FHR recordings that are corrupted by artefacts. The results show that the error in LF and HF power is estimated reasonably well. Future research should focus on how this information can be used in the clinic.

REFERENCES
