СЕКЦИЯ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ В МЕДИЦИНЕ

FAST FOURIER TRANSFORM FOR ECG SIGNAL

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Key words: Fourier transform, ECG

Research Relevance: in spite of the advent of modern technologies, ECG signal is still susceptible to 50 Hz mains interference (due to a number of geometrical constraints that prevent complete electrical-shielding). Thus, the search for new methods (in particular digital filtering) remains an important task, in order to be able to observe fine details of the wave (QRS complex, in particular the Q wave) — which are very important in cardiology, for early prevention.

Goal: to study the current data on filtering ECG-waves using the fast Fourier Transform.

Materials and Methods: analysis of bibliographic source from PubMed and Google Scholar for 2017–2022. We have used such keywords as «ECG», «Fourier transform», «digital filters», «50 Hz».

Results: power line interference noise has frequency of 50 Hz / 60 Hz and interferes with the ECG-waves, that makes their detection difficult [1]. In the 2020 study [2] that we performed, the Cooley-Tukey algorithm was oversampled by adding to the signal interval an additional 7 equal time intervals without signal. Due to the uncertainly principle this generated sampling in Fourier space 8 times denser, consequently it was possible to describe to maximum resolution (afforded by the length of the data-sample under the uncertainty principle) the ECG-wave. Additionally, instead of using Welch apodisation window, we proposed a Fourier-space apodisation method (which cancels exactly the Gibbs side lobes up to a given order). As a result, we obtained a very clear reconstruction of Q-wave — which is an important marker for myocardial necrosis — associated in most cases with vascular dysfunction.

Conclusion: fast Fourier transform is one of the most promising methods of obtaining high-level reconstruction of ECG-waves. Currently, further development of methods for filtering the ECG signal is necessary.

References:

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