ANALYSIS OF THE DYNAMICS OF EMG SIGNAL INDICATORS

Zhemchuzhkina T.V., Hany Eltaj Abdel Hameed Idris
Kharkiv National University of Radio Electronics, Kharkiv

Low back pain (LBP) is pain in back that can happen anywhere below the ribs and above the legs. The most common diagnostic tests for LBP include electromyography (EMG). To date, the classification of diseases based on the results of surface electromyography is carried out mainly using the methods of spectral-correlation analysis [1]. Signal stationarity is an important criterion for their application. It was found that the methods of spectral correlation analysis are advisable to apply only to certain short signal segments that are stationary, but the whole record of EMG signal is non-stationary [2]. Taking this into account, for the diagnosis of diseases based on the results of surface electromyography, it was proposed to use the methods of nonlinear dynamics [3], [4].

For the purposes of processing and analysis, it is often possible to consider the process as piecewise stationary. With such approach we processed 3 segments of EMG signal with duration 0.1 second: one from the start of the record, one – from the middle of the record and one from the end of the record. We calculated statistical and spectral indicators for each fragment and analyzed dynamics of their values from start to end of the record.

We analyzed EMG signals obtained by examining the long extensor of the trunk at the level of the lumbar spine (L4-L5 vertebrae) from 4 groups: 1 – healthy, 2 – healthy with pain, 3 – vertebrological, 4 – scoliosis. We analyzed dynamics of main statistical and spectral characteristics and can conclude that some parameters can be useful for analysis of EMG in dynamics: standard deviation, kurtosis, median frequency and low frequency.

Analysis of dynamics of each indicator for all groups was provided and it was concluded that 4 parameters: 2 statistical (standard deviation, kurtosis) and 2 spectral (median frequency, low frequency) may be useful for analysis of EMG in dynamics.

References:

1. Жемчужкина, Т.В., Носова, Т.В., Носова, Я.В., & др. (2015). Статистический анализ спектральных характеристик ЭМГ-сигнала с целью дифференцирования поясничных болей. Бионика интеллекта. №2(85). 105-108.
2. Шпакович, Ю.С., Жемчужкина, Т.В., Носова Т.В. (2017). К вопросу о применимости методов анализа электромиографических сигналов. Вестник НТУ ХПИ. №21 (1243). 117-123.
3. Zhemchuzhkina, T.V., etc. (2019). Application of EMG-signal phase portraits for differentiation of musculoskeletal system diseases. Proc. SPIE 11176, Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments. https://doi.org/10.1117/12.2537338.
4. Топчий, В.С., Жемчужкина, Т.В., Носова, Т.В. (2018). Статистический анализ показателей фазового портрета ЭМГ-сигнала с целью дифференцирования заболеваний опорно-двигательного апарата. Міжвузівський збірник "Наукові нотатки", Луцьк. № 64. 217-222.