

## **SECOND ORDER DIFFERENCE PLOT AS A TOOL FOR LOW BACK PAIN DIFFERENTIATION**

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In many countries chronic low back pain (LBP) is the most common cause of long term disability in middle age. Chronic LBP is resistant to treatment, and patients are often referred for multidisciplinary treatment. Reported lifetime prevalence varies from 49% to 70% and point prevalences from 12% to 30% are reported in Western countries.

The most common diagnostic test for LBP is electromyography (EMG). To date, the classification of diseases based on the results of surface electromyography is carried out by the methods of spectral, statistical and nonlinear dynamics analysis [1], [2].

Second Order Difference Plot (SODP) is a feature extraction method which is formed employing time domain information. The method of SODP can be used as an independent feature extraction tool as well as a supplemental technique to confirm the frequency domain results.

SODP features can help to identify changes in the slope of the EMG signal, which can provide information about the timing and strength of muscle activation. This information can be useful for distinguishing between different types of LBP, such as muscle spasm, muscle strain, or nerve root compression.

Some possible SODP features that could be used to differentiate LBP include: mean slope (differences in mean slope between patients with different types of LBP could indicate differences in the timing or strength of muscle activation); variability of slope (patients with muscle spasm or nerve root compression may exhibit higher variability in their SODP slope compared to patients with muscle strain); peak amplitude (differences in peak amplitude could indicate differences in the strength of muscle activation); time to peak (patients with muscle spasm may exhibit shorter time to peak compared to patients with muscle strain or nerve root compression).

Overall, SODP features can provide useful information for differentiating between different types of LBP using EMG signals. However, it is important to note that additional research and validation is necessary before these features can be used in clinical practice.

### **References:**

1. Zhemchuzhkina T., Nosova T., "Analysis of the dynamics of statistical and spectral indicators of electromyograms of the lumbar region," Scientific Collection "InterConf", (96): with the Proceedings of the 6th International Scientific and Practical Conference Scientific Community: Interdisciplinary Research (January 26-28, 2022). Hamburg, Germany: Busse Verlag GmbH, 2022. 1206 p., pp. 683-686.

2. 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>.