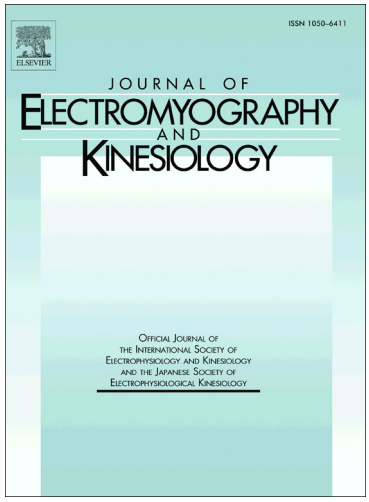

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PII: S1050-6411(16)30324-8
DOI: http://dx.doi.org/10.1016/j.jelekin.2016.12.006
Reference: JJEK 2040

To appear in: *Journal of Electromyography and Kinesiology*

Received Date: 27 May 2016
Revised Date: 23 November 2016
Accepted Date: 22 December 2016

Please cite this article as: N. Messaoudi, R.E. Bekka, P. Ravier, R. Harba, Assessment of the Non-Gaussianity and Non-Linearity Levels of Simulated sEMG Signals on Stationary Segments, *Journal of Electromyography and Kinesiology* (2016), doi: http://dx.doi.org/10.1016/j.jelekin.2016.12.006

Assessment of the Non-Gaussianity and Non-Linearity Levels of Simulated sEMG Signals on Stationary Segments

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Abstract

The purpose of this paper was to evaluate the effects of **the longitudinal single differential** (LSD), **the longitudinal double differential** (LDD) and **the normal double differential** (NDD) spatial filters, the electrode shape, the inter-electrode distance (IED) on non-Gaussianity and non-linearity levels of simulated surface EMG (sEMG) signals when the maximum voluntary contraction (MVC) varied from 10% to 100% by a step of 10%. The effects of recruitment range thresholds (RR), the firing rate (FR) strategy and the peak firing rate (PFR) of motor units were also considered.

A cylindrical multilayer model of the volume conductor and a model of motor unit (MU) recruitment and firing rate were used to simulate sEMG signals in a pool of 120 MUs for 5 seconds. Firstly, the stationarity of sEMG signals was tested by the runs, the reverse arrangements (RA) and the modified reverse arrangements (MRA) tests. Then the non-Gaussianity was characterised with bicoherence and kurtosis, and non-linearity levels was evaluated with linearity test.

The kurtosis analysis showed that the sEMG signals detected by the LSD filter were the most Gaussian and those detected by the NDD filter were the least Gaussian. In addition, the sEMG signals detected by the LSD filter were the most linear. For a given filter, the sEMG signals detected by using rectangular electrodes were more Gaussian and more linear than that detected with circular electrodes. Moreover, the sEMG signals are less non-Gaussian and more linear with reverse onion-skin firing rate strategy than those with onion-skin strategy. The levels of sEMG signal Gaussianity and linearity increased with the increase of the IED, RR and PFR.

Keywords: Detection systems, Firing rates, Gaussianity, Linearity, Stationarity, Surface EMG signal.