Erkennung von Signalen motorischer Einheiten im Elektromyogramm

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ERKENNUNG VON SIGNALEN
MOTORISCHER EINHEITEN
IM ELEKTROMYOGRAMM

Abhandlung
zur Erlangung des Titels eines
Doktors der technischen Wissenschaften
der
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ABSTRACT

A method for analyzing electromyographic signals is proposed, which estimates and detects potentials caused by active motor units in skeleton muscles and therefore allows the diagnosis of neurogenic and myogenic diseases (analysis of waveforms) as well as an investigation of the neuromuscular control-loop (analysis of point processes given by the activation of single motor units). The algorithm was developed - as an extension of existing methods - for improved performance at fairly high innervation levels, when different motor units frequently overlap. Motor unit potentials are determined empirically and continuously improved by decision-directed estimation. Linear filtering provides a preliminary separation of different waveforms and is followed by a nonlinear, final detection algorithm. Estimated motor unit potentials are characterized by a number of parameters. One- and two-dimensional probability density functions describe statistically the timing patterns (point processes) representing the activations of individual motor units. Detection error probability was measured and overall performance of the system tested with synthetic signals. Further, a few clinical applications and results are enclosed. The first chapter presents a physiological model to investigate the relation between geometrical structure and resulting waveform of a motor unit. It shows quantitatively the variation of a given waveform due to certain unstable mechanical and physiological parameters, which affects the performance of the system.