Analysis of Raw Microneurographic Recordings

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Microneurography is a method used to measure the activity in the sympathetic bundle of a mixed nerve. It is also used to estimate the sympathetic outflow. The method can be used to investigate the responsiveness of nociceptors to stimuli. In this procedure, a very fine needle (electrode) is inserted in the awake human into the sympatheic bundle of the peroneal nerve at the fibular head (knee). This particular experiment was done on 3 males and 2 females about 27 years old.

Normally, the raw neurogram is amplified, passed through a bandpass filter, and rectified. Then the base line noise is reduced with a threshold discriminator. Lastly, the signal is integrated with a time constant of 0.1sec. Thanks to breakthroughs in wavelet de-noising methods, background noise can be reduced using random Gaussian characteristics, improving the signal-to-noise ratio. In this paper, a new method, using wavelet transforms, is introduced. This method allows the study of individual and group neuronal discharges, without losing great amounts of data.

The method is comprised of a bandpass filter, a wavelet de-noising procedure, an action potential detector, and a waveform classifier.

The study was broken into 3 phases. In the first phase, actions were taken to determine 1) the frequency characteristics of the raw neurogram, 2) the optimum sampling rate, and 3) the characteristics of noise in filtered neurogram. (is it gaussian?)

In the 2nd phase, they 1) created simulated signals of action potential trains with various noise levels, 2) determined 3 methods for detecting the AP, 3) determined which method was the best, and 4) showed that a 5kHz sampling rate is ok for some AP detection methods.

In the last phase, they 1) demonstrated that direct measures of AP are similar to the present methods, and 2) classified the shapes of the detected action potentials.

The results were very encouraging. After determining that a bandpass filter from 700Hz to 2kHz was required, 10kHz is the optimum sampling rate, and noise has a Gaussian distribution, the study could continue to get excellent results which did correspond to the present accepted methods.

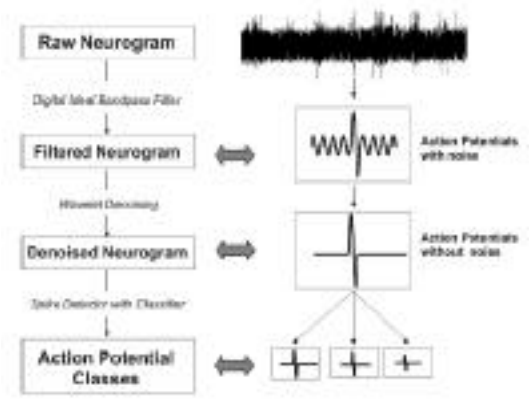

Fig. 2. Concept of digital signal processing of the raw neurogram based on a wavelet de-noising technique and spike detection and classification.

Analysis of Raw Microneurographic Recordings Based on Wavelet De-Noising Technique and Classification Algorithm: Wavelet Analysis in Microneurography
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