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# CLASSIFICATION OF ACTION POTENTIALS RECORDED FROM PERIPHERAL NERVES WITH CUFF ELECTRODES

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Abstract : In order to extract neural information, action potentials recorded with cuff electrodes from peripheral nerves were classified into unit activities. The classification was performed based on their waveforms, as it was considered that they were affected by the radius of nerve fiber and the distance between fiber and recording electrode. This study focused on automatic classification method. Action potentials were grouped into each unit by hierarchical cluster analysis and a new criterion. The method proposed in this study might be applicable to automatic classification of nerve action potentials, because it provided the reliable estimation of unit activities.

Keywords : classification of action potentials, nerve cuff recordings, criterion for grouping, hierarchical cluster analysis.

#### I. INTRODUCTION

Information of sensory and motor command is transmitted between mechanoreceptors or muscles and the central nervous system by neural activities. It is necessary to detect single-unit activity for extraction of neural information. The neuron and the mechanoreceptors which it innervates are commonly referred to as "unit". Action potentials were classified into some groups for detecting the unit activities, and the classification was performed based on their recorded waveforms as it was considered that they were affected by the radius of nerve fiber and the distance between fiber and recorded electrodes.

# **II. METHODS**

# A. Experimental Methods

Recordings of neural signal related to the angle changes of the metatarsophalangeal(MTP) joint of the forefinger were made with cuff electrodes from the tibial nerve of an anesthetized rabbit. The signals were amplified from 10,000 to 100,000 times, filtered by analogue bandpass filter(15Hz-3kHz) and then sampled at 10kHz.

#### **B.** Classification Methods

Nerve action potentials were characterized simply by using the digitized points. As a method for identifying groups which action potentials were classified into, hierarchical cluster analysis and a new criterion was used. We used cluster analysis for reduction in computations, and a criterion for identifying groups. The criterion proposed in this study was

$$\frac{\mathrm{tr}B/(k-1)}{\mathrm{tr}W/(n-k)}\cdot\frac{\mathrm{tr}B}{\mathrm{tr}T}$$

and the maximum hierarchy level was used for classifying. Where T, B and W terms are the total, between and pooled within group sum of squares and cross products matrices, and n and k are the number of recorded action potentials 0-7803-5674-8/99/ $10.00 \odot$  1999 IEEE



0 time(sec.) 5 Fig.1 An example of classification result of action potentials related to angle changes of the metatarsophalangeal(MTP) joint of the forefinger. From top to bottom, angle of the MTP joint and the series of point events for all action potentials and those belong to each groups are displayed.

and groups in the solution, respectively. This criterion was modified from VRC[1].

### III. RESULTS and DISCUSSION

Fig.1 shows classification result. Positive value of joint angle means extension. Recorded action potentials were classified into 7 groups. As each waveform of action potential belonged to the same group was similar, classification result was considered to be reliable. When best group into which action potentials classified is found, trW becomes minimum and trB becomes maximum. So the classification was performed successfully. The results showed unit in group1 was activated when MTP joint was extended, the one in group2 was activated when it was extended rapidly and the one in group3 was activated at the start of extension. Fig.1 suggests that there are various kind of stretch transducers in the muscle and neural information is coded by several kinds of mechanoreceptors.

#### IV. CONCLUSION

In order to extract some information from neural activities. the method for classification of action potentials into unit activities were proposed in this study. Classification was performed without operator's intervention and its result was reliable.

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# REFERENCES

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