SURFACE MYOELECTRIC SIGNAL ADJUSTMENT FOR UPPER LIMB PROSTHESIS CONTROL APPLYING RT SYSTEM

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ABSTRACT

Myoelectric controlled prosthetic hand has advantage of generating larger gripping force than the muscular force of the residual limb. This characteristic benefits small children to conduct tasks more easily. The hindrance of fitting myoelectric hand to small children is caused by the low reliability of myoelectric control at introduction due to low-reproducibility of non-adjusted myoelectirc sensor signal. The dialogical adjustment of the sensor applied to the schoolable child is not promising to younger children where basic assumption of repetitive concentrated muscle activations is questionable.

To overcome this problem, we propose on applying a realtime pattern recognition method, RT System, to myoelectirc sensor signal to skip the initial gain adjustment of the sensor amplifier. Recognition Taguchi (RT) system which is a modified strategy of Mahalanobis-Taguchi System is a statistical process that numerically scales the similarity of the sampled data cluster with the model data cluster by calculating two characteristic parameter, Signal-to-Noise ratio and sensitivity. The root-mean-square is computed from the two parameters generated from the groups of model data cluster and sampled data cluster. Then the root-mean-square distribution of the model data cluster is used to evaluate the difference of the sampled data.

As a pilot experiment, a conventional 3-pole dry electrode with analog filter and amplifier was used to sample raw myoelectric signal at 3kHz. A 60Hz-notch filter and 5-to-500Hz band-pass filter was applied digitally as pretreatment. Forearm extensor myoelectric signals of 2 male subjects, in their twenties, were recorded at the most suitable point and the most degraded point for 15s, respectively. For the RT system processed signal, series data of the first 0.33s window after discarding the initial 3s data of recording was set as the model data cluster in each collected sample. Ten seconds of the remaining collected data was processed as sample data. The RT system processed signal was compared to the conventional full-wave rectification, RMS-smoothing, envelope processed signal. While the conventional filtered data did not have clear contrast in degraded condition, RT system processed signal had muscle activation signals to be 200 times larger potentials compared to the signal at resting condition.

The RT system processed signal had superior amplification even for a subject with a thick subcutaneous fat that caused difficulty of operating an on-the-market myoelectric hand with conventional myoelectric sensor. However, the subject and experimental conditions were limited and further experiments are needed, especially with toddler, after safety concerns are cleared.