Estimation of Fatigue for Workers

(Asst. Prof. M. Sugi, Prof. J. Ota, Prof. H. Yokoi, and Prof. T. Arai)

Muscle fatigue is defined as the condition where the muscle is no longer able to maintain certain level of force. Monotonous or repetitive works as practiced by assembly workers are one of the risk factor for muscle fatigue. Long time exposure to muscle fatigue will cause injury to the workers. This problem can be prevented by monitoring the level of muscle fatigue. However, as muscle fatigue is not a physical value, it can only be measured indirectly by analyzing to the other measurable parameters. The commonly used parameter is the myoelectric signal, which is generated during muscle contraction. In terms of practicability, the surface Electromyography (SEMG) is preferred due to its non-invasive property, where sensors are attach on the surface of the muscle.

We propose a dual frequency-band wavelet analysis technique, which able to monitor the level of force and the degree of muscle fatigue simultaneously [1]. Two endurance handgrip tasks (static and dynamic muscle contraction) are performed in order to evaluate the effectiveness of this technique. The SEMG signal is recorded from Flexor Carpi Radialis (FCR) muscle. From the observation, it can be concluded that the Root Mean Square (RMS) of high frequency band, 65Hz - 350Hz, is correlated to the force level (Fig. 1). Since both tasks are performed until exhausted, it is assumed that the degree of muscle fatigue will increase throughout the experiment. Therefore, we conclude that the RMS of low frequency band can be used to represent muscle fatigue.

Keywords: electromyography, muscle fatigue

References

1) Y. Soo, M. Sugi, H. Yokoi, T. Arai, T. Nakamura, R. Du and J. Ota, "The relationship between changes in amplitude and instantaneous frequency at low and high frequency bands during dynamic contraction," to be appeared in 2nd International Conference on Bioinformatics and Biomedical Engineering, May 2008.

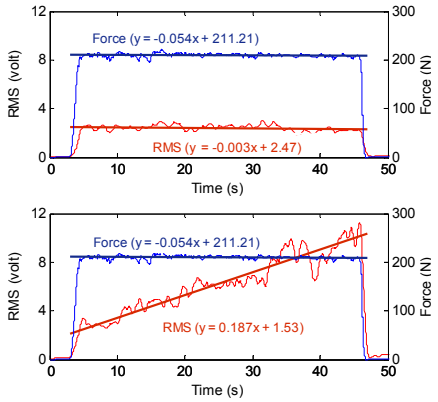

Fig. 1 The RMS (red color) and force level (blue color) of HF (top) and LF (bottom) of FCR muscle. The data is captured during static contraction experiment and is fitted with a linear regression line.

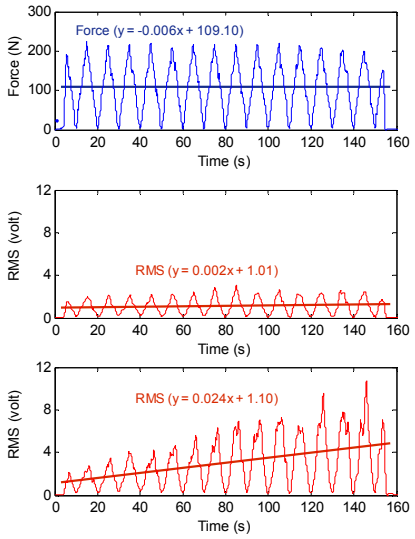

Fig. 2 The results of cyclic dynamic contraction and the changes of force level (top) from FCR muscle of one subject. The RMS of HF (middle) and LF (bottom) calculated and fitted with a linear regression line.