New Human Interface using surface EMG signals

❍ Y. Koike[1,2], K. Yagishita[2], K. Nakayama[2], A. Katayama[2], J. Kim[2], M. Sato[2]

1. CREST. JST 2. Tokyo Institute of Technology, Japan

1 Introduction

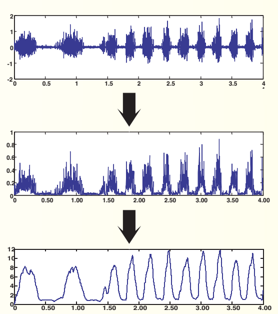
We usually use some devices for controlling a computer, a robot or for capturing the motion of the arm. The delay is existed between the movement and the measurement result. It becomes hard to use to this delay for the interface.

EMG signal reflects the muscle tension. We have been developing to estimate the joint torque, equilibrium point and joint stiffness from the EMG signals [1,2,3]. In this paper, we propose the human interface for controlling the robot and playing music.

2 Method

We measured some EMG signals for each joint to estimate an equilibrium posture or torque. Measure EMG signals are rectified and filtered with low cut off frequency. An equilibrium posture or torque was estimated from this filtered EMG signals.

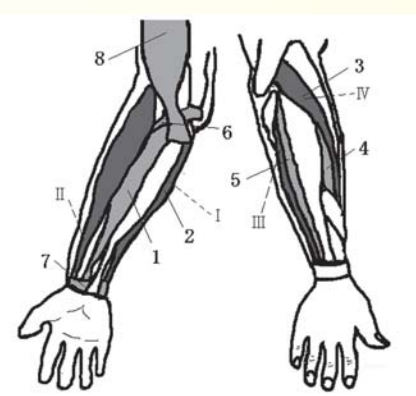
Signal processing



raw EMG signal

full rectified signal

Law-pass filtered signal



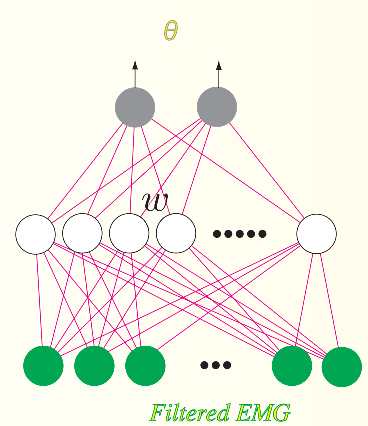
Muscle

1. Flex. Carpi Radialis (II)
2. Flex. Carpi Ulnaris (I)
3. Ext. Carpi Radialis Longus (IV)
4. Ext. Carpi Radialis Brevis
5. Ext. Carpi Ulnaris (III)
6. Pronator Teres
7. Quadratus
8. Biceps Brachii

System Configuration

1. Laptop computer
2. EMG system (Bagnoli-16)
3. A/D converter (PC Card)

Training



Neural Network

$$\tau = f(w, EMG, \theta)$$

At the equilibrium point

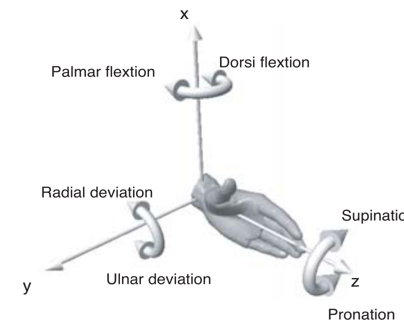
$$0 = f(w, EMG, \theta_{eq})$$

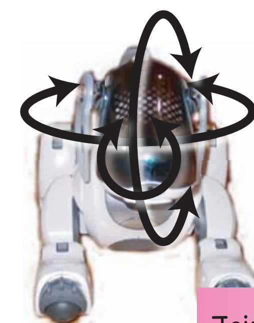
$$\theta_{eq} = g(w, EMG)$$

3 Robot control using EMG signals

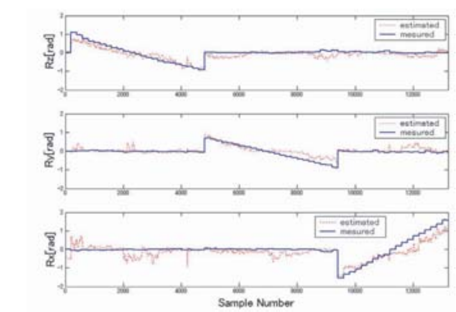
Joint angle to joint angle

Wrist joint angles are estimated from only the EMG singals and robot head is controlled by the wrist movement.

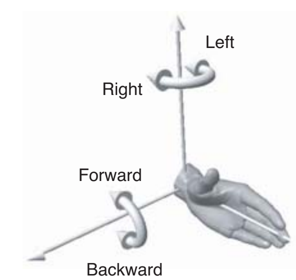


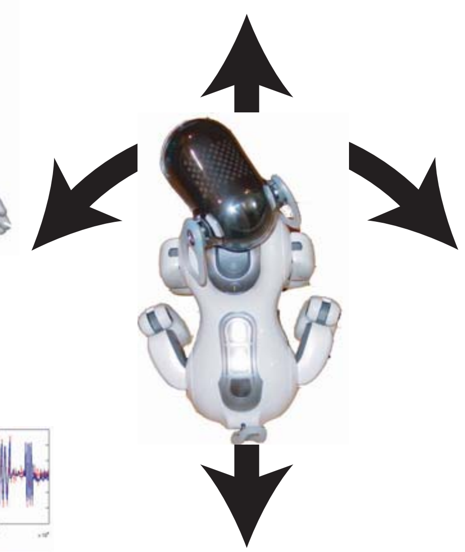


Training result



Joint angle to Command





Test Pattern