

## Evolutionary Robotics: Coupled Evolution of Controller and Morphology for Dynamically Stable Locomotion (Prof. H. Yokoi and Prof. T. Arai)

Recently, there have been a lot of research efforts on the development of various assistive devices for replacement of motor function attuned to patient's needs and body. However, when patients use most of these assistive devices, they are required to receive long training to use them. These generate unnecessary burden on the users. To reduce the burden we propose an interface that can directly catch users' motion intention. One challenge we face is that humans are likely to change their motion features while using the assistive devices. If the assistive devices could not follow the motion feature changes, it would be difficult to replace motor function stably by the assistive devices. Therefore, in order to develop useful assistive devices, we should analyze the changes in the user's motion patterns and let the devices change their features accordingly.

In this research, we measured EMG signals during motion, extracted useful information about motion and analyzed skill acquisition process to develop a system where users and devices adapt to each other for restoration of motor function (Fig.1, Fig.2). Which information about motion should be extracted from EMG is also a problem to be solved, so we develop the frequency extraction method (Fig.3). And not only skill acquisition but also muscle fatigue may cause changes of motion pattern, thus we analyze muscle fatigue using EMG signals.

*Keywords:* Mutual adaptation, EMG, motor learning, Frequency analysis, Muscle fatigue

### References

- 1) Kahori Kita, Ryu Kato, Hiroshi Yokoi and Tamio Arai: "Analysis of Skill Acquisition Process - A Case Study of Arm Reaching Task -", Intelligent Autonomous Systems 9, IOS Press, ISBN 1-58603-595-9, pp.991-998, 2005.
- 2) Kahori Kita, Ryu Katoh, Wenwei Yu (Chiba University), Hiroshi Yokoi, Yukinori Kakazu (Hokkaido University): "Using Electromyogram to Analyze Skill Acquiring Patterns in Reaching Tasks", Proc. of International Conference on the Advanced Mechatronics(ICAM'04), MA1-A-4 (CD-ROM), 2004.
- 3) Kahori Kita, Ryu Katoh, Wenwei Yu(Chiba University), Hiroshi Yokoi, Yukinori Kakazu (Hokkaido University): "Analysis of Skill Acquiring Pattern Using Electromyogram and Performance Evaluation, The 8th World Multi-Conference on SYSTEMICS, CYBERNETICS AND INFORMATICS", Vo.1, pp.512-517, 2004.

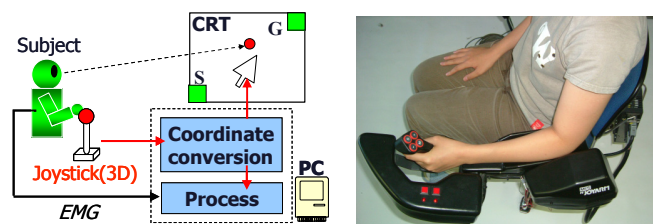


Fig. 1 Experimental System

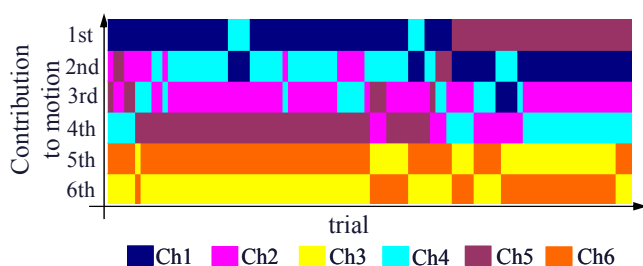


Fig. 2 Each muscle's contribution to arm reaching motion

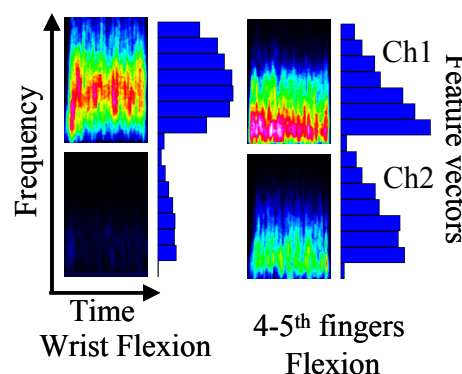


Fig. 3 Feature Vectors (Spectrum) from EMG Signals