研究テーマ　FES による麻痺肢の制御における生体電子工学的アプローチ

研究者	Tomaz　Karcnik	財団法人みやぎ産業振興機構	派遣研究員
	星宮　望	東北大学大学院工学研究科	共同研究員
	二見亮弘	東北大学大学院工学研究科	共同研究員
	渡邉高志	東北大学大学院工学研究科	共同研究員

１　フェーズⅠ

(1)　研究の概要

My research work since January 15th has been oriented exclusively towards designing a wearable and portable system for stability analysis. Stability related information can be used as basis for a bio feedback signal in order to improve the FES assisted gait. The system design has been determined so far and we are in process of preparing in integrating the suitable hardware and software.

(2)　研究の目標

The ultimate objective of our research work is to design, build and verify the wearable system capable of real-time on-line gait stability assessment.　It has been shown in our previous research work that stability is a crucial element for synthesis of faster FES assisted gait. The adopted stability control dictates the mode of walking and thus the average gait velocity and efficacy.　One possible way to achieve the improved stability control is to utilize stability based feedback signal fed back to the paralyzed subject thus providing limited sensory information.　Namely, in spinal cord injured subjects there is no sensory data transmitted from the paralyzed extremities. The subjects have to compensate the lack of sensory data by obtaining the same information through utilizing the vision. That results in bad posture and also in slow and inefficient gait. The proposed wearable stability assessment system is the first step in resolving the problem of missing sensory information from the paralyzed extremities.

(3)　実施内容

The approach used so far for stability analysis was based on motion analysis systems (Vicon, Optotrak), which provided the necessary kinematics data.　However, in that case the stability analysis is not available on-line and in real-time. Even worse, special, expensive and static hardware has to be used. A wearable system is the only possibility to make the approach viable for daily applications. The proposed design of the wearable system consists of the goniometers attached to the leg joints and foot switches under the feet and crutch tips to indicate the

ground contact. Thus we can, by applying a few approximations, determine the relationship between the supporting area and the center of gravity (COG) position/velocity. Those parameters are the key elements for the assessment of the dynamic stability. Additional advantage of the proposed solution is that the sensory information could eventually be obtained from natural sensors in paralyzed extremities, as has already been demonstrated possible by some other research groups. It is well known that the natural angle and contact sensors in the paralyzed extremities usually remain intact.

(4) 結果

From Jan. 15th to Mar. 31st we prepared the concept of the wearable system. We selected and obtained most of the hardware and software. The Vicon motion analysis system is to be used as a reference in all the verifications of our wearable system so the complete suite of Matlab based gait stability analysis software package has been adapted for use with Vicon. First tests of able-bodied gait have been made to demonstrate the agreement with our previous data.

2 フェーズⅡ以降

Future work: The first step is inclusion of goniometer and foot switch data into the measurement suite. After all hardware and software is in place the next step is testing of the entire system on able-bodied subjects. Finally the measurements on subjects with various injuries and gait disabilities will be performed. Directly clinically applicable results are expected from these measurements as well as potential publications in international scientific conferences and journals. The final step, which is outside the scope of my six-month visit to the Tohoku University, is to repeat the similar experiments on disabled subjects using biofeedback loop.