The Chinese University of Hong Kong
Department of Biomedical Engineering

Graduate Seminar – PhD Oral Defence

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Time : 9:30am
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Meeting ID : 961 1467 0474
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Title: Human Locomotion Synergy for Robotic Assistive Devices

Human locomotion is a complex combination of several synergies (inter-joint coordination and cooperation), including intra- and inter-limb synergy. Many people are with several mobility impairment problems such as neurologic disorders and cardiovascular diseases. Robotic assistive devices including lowered limb exoskeletons, partial limb exoskeletons/orthoses and powered prostheses have been developed for those with mobility impairment problems.This thesis first introduce synergy and synergy analysis. Then synergy analysis on healthy subjects, stroke patients and amputees are performed based on the gait data obtained from designed gait experiments. Gait kinematics in the gait experiments and synergy results are analyzed for stroke patients and amputees to find out the gait kinematics that most affect their synergies. Then, this thesis investigates and model human inter-limb synergy with Long Short-Term Memory (LSTM) neural network for adaptive trajectory generation of rehabilitative lower limb exoskeletons. Compared with Principle Component Analysis (PCA) adopted by previous researchers, LSTM can obtain a lower error rate in the estimation and have a better modeling of inter-limb synergy according to the simulations on data of healthy subjects. Then, LSTM is also adopted to model intra-limb synergy. The modeled Intra-limb synergy is used to help estimate the motion of the human knee joint during locomotion using the kinematics of thigh measured by a single Inertial Measurement Unit (IMU). Experimental results indicate that with the dynamic information of the thigh and the trained LSTM model of intra-limb synergy, the knee trajectories can be precisely estimated even the subjects changed the walking speed or stride length. The proposed method is promising to generate a desired and harmonious knee trajectory in line with thigh motion for robotic assistive devices.

***** ALL ARE WELCOME *****

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