Using Humanoid Technologies to Assist Humans

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Abstract— **Many countries are now facing problems associate to an aging population. Therefore, using robotics technologies to support daily life of elderly people and patients is becoming an important research topic. In my talk, I will introduce our newly developed exoskeleton robot, and show that humanoid control methods can be used to control the exoskeleton robot for assisting human movements.**

I. INTRODUCTION

Since many countries are facing the problems associated with an aging population, the development of an exoskeleton robot to assist user movements is becoming important research topic. In particular, exoskeleton robots can be used as prosthetic devices for patients such as stroke patients and spinal cord injury patients in rehabilitation programs. In recent years, it has been found that using brain activity to control a robotic assistive system can promote recovery of the arm and hand functions. Therefore, it may be possible to enhance recovery of lower limb motor functions by controlling an exoskeleton robot for assisting the lower limbs through brain activity. We develop an EEG-Exoskeleton robot system, where the exoskeleton robot is connected to the EEG measurement system so that the users can control the exoskeleton robot by using their brain activity (See Fig. 1) [1][2].

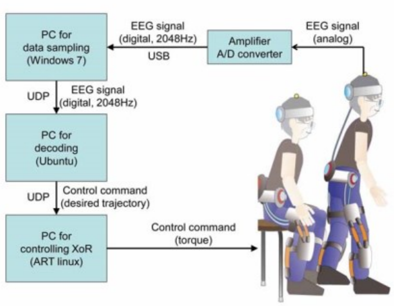

Figure 1. EEG-exoskeleton system

In order to maintain balance of the exoskeleton robot and to generate compliant movement, we use a control method originally developed for our whole-body humanoid CBi (http://www.cns.atr.jp/icorp/index.html, Fig. 2) [3] based on the force/torque control method [4].

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Figure 2. Humaniod robot CB-i.

II. EEG-BASED EXOSKELETON ROBOT CONTROL

We use a classification method which considers covariance matrices of measured EEG signals as inputs to decode brain activities. The decoded brain activity is used to control exoskeleton movements. In particular, we consider the task of assisting the stand-up movement, i.e. one of the most frequently used movements and a standard rehabilitation task. To assist the stand-up movement, we develop a force control model which takes dynamics of tendon string into account for the pneumatic-electric hybrid actuation (PEHA) system used in our exoskeleton robot (See Fig. 3) [1]. We show that the exoskeleton robot successfully assisted the stand-up movements, where the assist system was controlled by the decoded brain activities.

Figure 3. Exoskeletal robot XoR

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