Control of an Robotic Exoskeleton

Kurzbeschreibung / short description

The Institute for Human and Machine Cognition (IHMC) has built an exoskeleton for paraplegics that was successfully tested on patients (www.ihmc.us/mina). IHMC is currently developing a new version exoskeleton with NASA. This new version will have application for paraplegic mobility, medical rehabilitation, performance enhancement, and exercise. IHMC is also working with Ekso Bionics (makers of the eLegs) to develop algorithms for fall detection and balance assistance.

The research focus for this opportunity will involve controls, dynamics, and programming as applied to lower extremity exoskeletons. There will be significant hand-on work directly with the hardware as well as work in simulation. We do all of our programming in Java, so having experience in object oriented programming is essential.

This project will be conducted at IHMC in Pensacola, Florida in an integrated exchange program that is part of a collaboration between the Autonomous Systems Lab and the biologically inspired robotics group (http://www.ihmc.us/Research/biologically.php) at IHMC. We will only consider excellent students for this project that will be carefully selected.

Typ / type Master
Partner Institute for Human and Machine Cognition
Zeitdauer / period 6 Months (minimum)
Student(en) /student(s)
Betreuung intern / internal supervisor Dr. C. David Remy, cremy@ethz.ch
Betreuung extern /external supervisor Dr. Peter Neuhaus, pneuhaus@ihmc.us

Stichworte / key words
Legged Locomotion, Running, Dynamics, Simulation, Control, Optimization, Exoskeleton

Umfeld / context

In addition to providing mobility to robots through legs, researchers at IHMC are also working toward providing mobility assistance to humans through robotic exoskeletons. The current state of legged robotic mobility assistance requires the user to provide balance through the use of crutches, and the terrain is limited to relatively smooth surfaces. IHMC researchers are looking to advance this technology by adding additional actuators and control such that the exoskeleton can provide active balance assistance for mobility over rough terrain.

The other major application for lower extremity exoskeletons is in rehabilitation. The main robotic device for gait rehabilitation is the Lokomat, with is a treadmill based device. The IHMC exoskeleton will be able to provide overground robotic gait rehabilitation, which can potentially provide for more effective rehabilitation.

Arbeitspakete / work packages

- Develop fall prediction measure based on sensor data
- Create observer to estimate human/robot configuration given sensor data and structural model
- Develop fall prevention algorithms based on fall prediction and actuated joints
- Create impedance controller for leg joint trajectory

Erforderlichen Fähigkeiten / required skills

- Dynamics and linear controls
- Experience in programming in Java or other object oriented language
- Experience with mechatronics (encoders, IMU, motors, wiring, amplifiers, etc.)