Enforcing safety properties on EMG-Controlled Ankle Foot Orthosis using Runtime Requirement Enforcement

Wearable robotic systems such as the EMG-Controlled Ankle Foot Orthosis can be used to assist people with walking disabilities. The EMG-controller uses acquired EMG signals from electrodes to control the foot position. It does so by adapting the voltage of a motor which converts it to torque (and therefore to angular velocity) that ultimately changes the foot position. Such a control should satisfy a set of functional requirements that are defined over the system properties such as the position, velocity, or torque. For example, the leg position should always stay between a lower and an upper limit. To formally verify such a functional correctness, Runtime requirements enforcement (RRE) techniques can enforce such functional requirements at runtime, allowing properties to be defined and formally verified on corresponding control strategies specified by automata.

In this thesis, an RRE should be developed for enforcing a given set of functional requirements, and then formally verified using a model checker like PRISM. Existing C-based physic libraries (e.g. MuJoCo or Unity) can be used for modeling and simulating the motion patterns during walking.

Prerequisites:	Programming in Python or C++, Basic Knowledge in Control
Type of work:	Theory (25%), conception (30%), implementation (45%)
Contact:	Khalil Esper (khalil.esper@fau.de), Christian Heidorn (christian.heidorn@fau.de), Jan Spieck (jan.spieck@fau.de)

design

Lehrstuhl für Informatik 12
Hardware-Software-Co-Design
Cauerstraße 11
91058 Erlangen

FAU
Friedrich-Alexander-Universität
Technische Fakultät