

## Masterarbeit

### Soft Robotic Anti-Ankle Buckling Orthosis

The Institut für Medizingerätetechnik is investigating a project for a soft robotic anti-ankle buckling orthosis. Recurrent ankle sprains, in which the tendons around the joint are stretched beyond their physiological length and irreversible deformity ensues, are highly likely to cause Chronic Ankle Instability (CAI): a long-term condition. Ankle sprains can develop when a rapid inversion or eversion occurs as a consequence of unexpected lateral ankle buckling, causing undue stress to the tendons. The most common lateral ankle joint injury is a lateral ankle sprain, which is caused by inversion stress to the joint. Most ankle-foot orthoses (AFOs) are composed of stiff, lightweight polymers that passively impart stiffness to the ankle joint to aid balance and avoid lateral ankle buckling. Additionally, soft AFOs are used to prevent bilateral ankle buckling. Consequently, an ankle buckling prevention robotic system would compensate for all the above-mentioned. This project is focused on presenting a soft robotic ankle orthosis that acts like an airbag for the ankle and is actuated once ankle buckling is detected. The average duration of the stance phase (62 %) is approximately 0.59 to 0.67 s. The remaining 38 % of the gait cycle is the swing phase, during which the foot is non-weight bearing as it moves from one step to another, lasting, on average, 0.38 to 0.42 s. Accordingly, an immensely fast actuation unit is required to prevent ankle buckling.

Below there are some previous AFOs:



Figure 1 A. Slijper; et al. (2012): Ambulatory Function and Perception of Confidence in Persons with Stroke

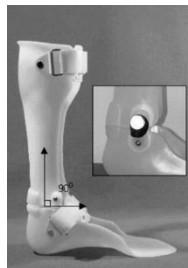


Figure 2 S. Fatone; et al (2009): polypropylene, articulated AFO.

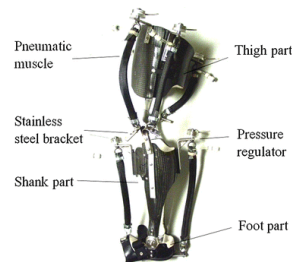


Figure 3 G. Sawicki; et al. (2009): A pneumatically powered knee-ankle-foot orthosis.

Below you will find the aim of your thesis:

- to model and characterize a chemical-reaction-based or high-pressurized cartridge-based actuation unit.
- to design and conceptualize the mechanics and electronics integration.
- to evaluate and test the soft robotic ankle orthosis.

The following requirements would be ideal for the prospective student:

- basic knowledge of programming microcontrollers
- basic knowledge of CAD (Creo Parametric preferably)
- basic knowledge of manufacturing processes
- basic knowledge of mechatronics

Supervision will be provided in English. Hence, the thesis should be written in English.

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