

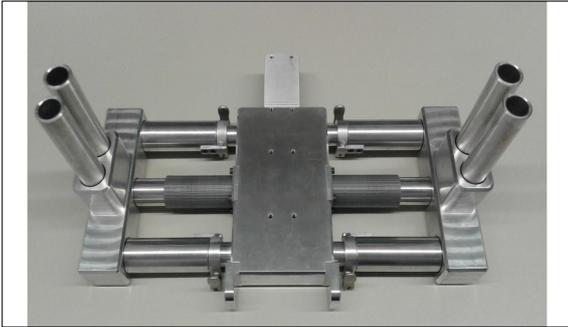


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Improvement of Exoskeleton Adjustment System

New adjustment mechanisms for the exoskeleton of the Cybathlon Team VariLeg of ETH Zurich



Newly developed hip for exoskeleton



Adjustment mechanism for the length of thigh



Mechanism for adjusting the length of the lower leg and the angle of the foot plate

Introduction: The VariLeg Team of the ETH Zurich have developed an exoskeleton for the competition Cybathlon 2016. They are still improving the exoskeleton for research purposes. Weak points of the existing exoskeleton are the mechanisms to adjust it to the body dimensions of the users. The actual adjustment mechanisms tend to slide when they are loaded because they are made as frictional connections which need to be tightened with screws. Furthermore, the adjustment is exhausting and imprecise. The aim of this project is to improve the adjustment mechanisms. The improved mechanisms shall not tend to slide anymore. The mechanisms should make it possible to do the adjustment simple, safe, fast and with a good repeat accuracy. At the existing exoskeleton, as little changes as possible should have to be made.

Procedure / Result: After the clarification of the requirements, some solution principles were worked out. These principles have been rated and discussed with the involved from ETH and HSR to get a decision on which principle to elaborate. After elaboration, the parts were produced at external workshops. In the final step, the parts were assembled and tested at HSR and ETH.

Solution: Three mechanisms allowing for four adjustments have been developed. One allows to adjust the width of the hip and thereby the distance between the legs. With the second mechanism, the length of the thigh can be adjusted. The adjustment of the length of the lower leg and the angle of the footplate is made with the third mechanism.

- The new hip is made with a center part and two side parts. The center part carries the control unit of the exoskeleton and the attachment points for belts and other extensions. Both side parts can be moved in and out by rotating a continuous spindle with a left-handed and a right-handed thread. This spindle is rotatably mounted in the center part.
- The thigh adjustment mechanism is deeply integrated in the existing thigh. The part which carries the hip motor is slidably mounted between rails. To lock the adjustment, pins are put through different drill holes in the rails. The special hole pattern allows an increment of only five millimeters by a shortest hole spacing of ten millimeters.
- Mostly three different tubes made the new lower leg. There are many drill holes in these tubes, also with a special hole pattern, which allows a separate linear and angular adjustment. The tubes are stuck into each other, and connected with ball lock pins.

(Diese BA wurde im FS 2017 abgeschlossen)