FEASIBILITY OF AN EXOSKELETON POWERED BY ECCENTRIC JOINT WORK FOR REDUCING WALKING METABOLIC COST.

INTRODUCTION
Walking is a self-resistive movement that requires substantial metabolic energy. Different groups are developing walking exoskeletons in attempt to increase the metabolic economy. The main practical problem is limited power source autonomy. The proposed ideal solution would be to power the exoskeleton by recycling eccentric joint work that naturally occurs during walking (1).

In previous experiments our group developed a pneumatically powered ankle foot exoskeleton that could reduce metabolic cost (2).

Current goal: Measure inverse dynamics with the exoskeleton in order to find out if sufficient eccentric joint power is available to power the exoskeleton with, instead of powering the exoskeleton with compressed air.

RESULTS AND DISCUSSION
Results of one subject show clear eccentric power phases in the knee and hip joint (figure 2). The summation of te eccentric power phases indicates that sufficient eccentric joint power is available to reproduce the concentric power of the pneumatic exoskeleton.

One concern is that the eccentric joint power will have to be transferred over different joints and/or stored and released at a later time which will cause some energy loss. Another concern is that a recycling exoskeleton will probably affect the gait pattern and consequently eccentric joint power. On the other hand humans could adapt their gait to optimally exploit a recycling exoskeleton just like they adapted to use anatomical features such as bi-articular muscles.

METHODS
9 subjects (height: 1m68 +/- 0.055, mass= 59.88kg +/- 3.87) walked over an instrumented walkway wearing a plantarflexion assisting exoskeleton that was tethered to an air compressor and a steering unit on a trolley (figure 1).

Measurements:
- Ground reaction forces (Kistler& AMTI, 1000hz)
- Full body kinematics (Qualisys, 200hz)
- Joint kinetics (Visual3D)

REFERENCES

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