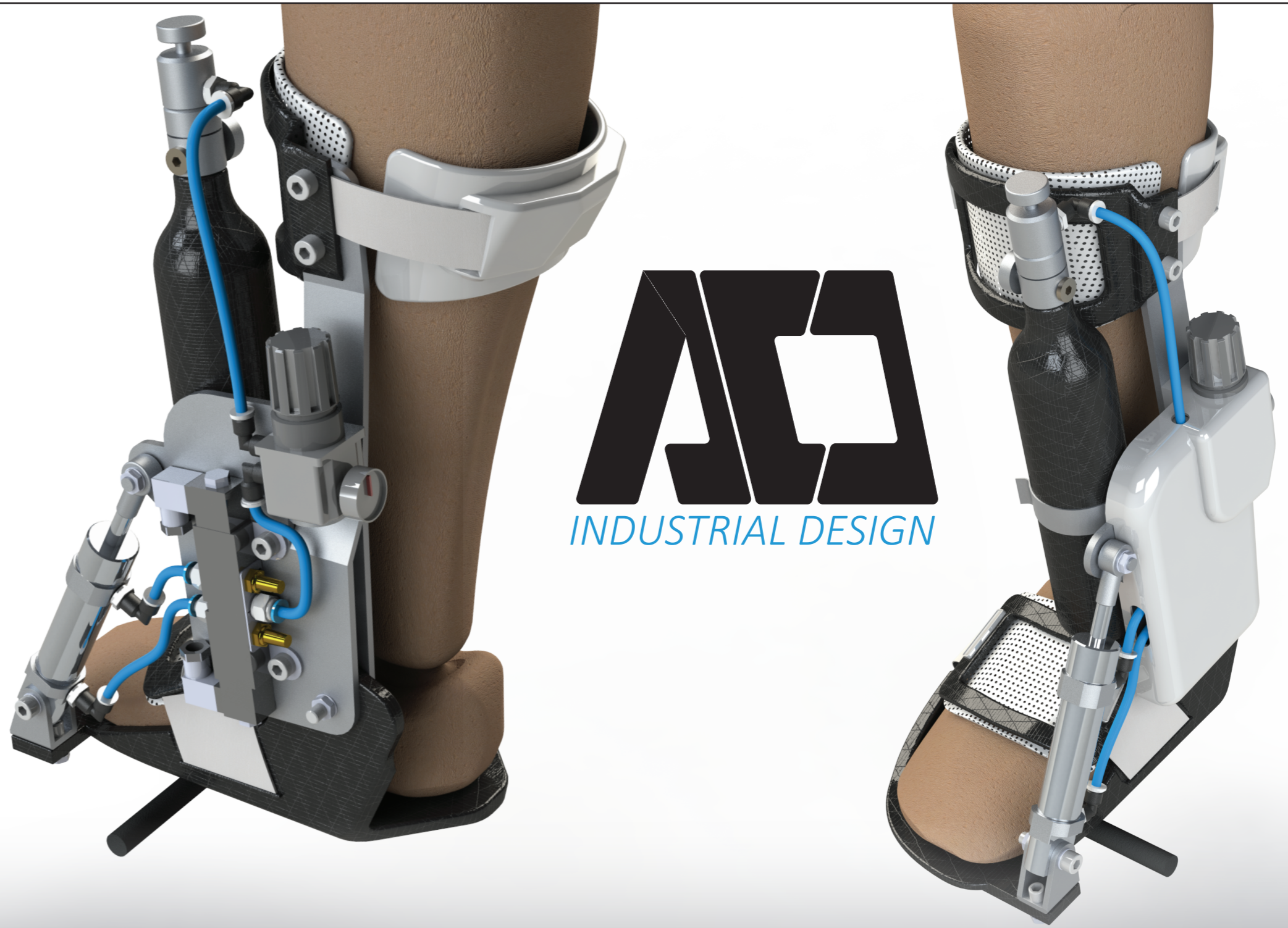


DESIGN OF AN ASSISTIVE CYCLING ANKLE-FOOT ORTHOSIS FOR CHARCOT-MARIE-TOOTH PATIENTS

ANKLE-FOOT ORTHOSIS

Ankle-foot orthoses (AFO's) are commonly prescribed by clinicians to overcome foot drop, foot slap, toe-off and other conditions to conserve walking. Assistive or active Ankle-Foot Orthoses (AAFO's) are computer controlled exoskeleton devices that are able to vary compliance or damping of the ankle joint. This graduation project is aiming to develop the first AAFO design for usage on a bike with sensors and other electronic components that are able to gather patient specific data about their physical performance and can control the application of torque for pedal assistance.



The ACO is intended for rehabilitative usage on a bike ergometer. The compressed air tank of 0,5 L is providing sufficient air supply for the 'artificial muscle' to assist the patient during cycling exercises for up to 30 min.

A double-acting pneumatic cylinder is the 'artificial muscle' that assists the patient's muscle function and can create up to 50% of assistance during plantar- and dorsiflexion motion. The spring characteristics of the pneumatic cylinder are providing an elastic response to the movements of the human muscle.

CMT PATIENTS

Charcot-Marie-Tooth (CMT) disease is a 'hereditary motor and sensory neuropathy', also referred to as HMSN. The progression of the CMT usually has a slow onset that is affecting the intrinsic muscles of the feet first progressing to more proximal muscles of the lower limb. As the symptoms progress the peroneal muscles and the foot dorsiflexors become weaker, resulting in inefficient dorsi- and plantar-flexor muscles of the ankle joint.

MARKET

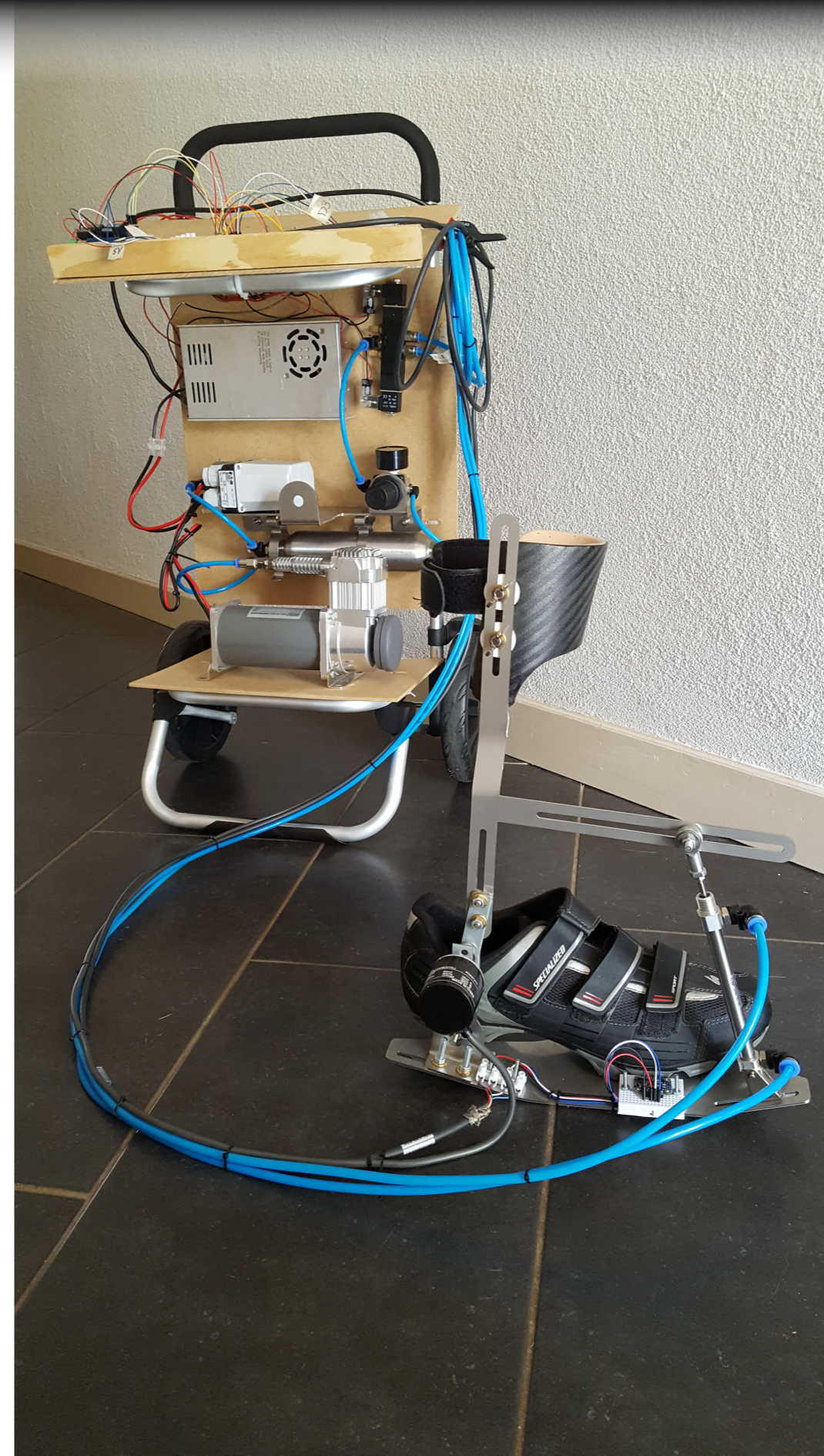
CMT is one of the most common genetic diseases with an estimated prevalence of 1 in 2.500 people. With the ACO, clinicians are able to closely monitor the progression of neuro-muscular diseases and are able to create personal rehabilitation programs to provide valid expectations for patients and obtain valuable information for health insurers.

SOCIETY

By stimulating rehabilitative exercise in a rehabilitation centre knowledge about the disease will be gathered which contributes to this relatively unknown disease among society.

FUNCTIONAL PROTOTYPE

After evaluating the industrial design on its manufacturability with the available resources and the compatibility of the design for a proof-of-principle prototype testing. The importance of a design modification step was acknowledged. With the reviewed criteria a simplified design was developed with integrated mechanical components, electronic components, and pneumatic components. During a proof-of-concept testing exercise with a CMT patient it was justified that the functionality of the envisioned ACO is proven. The prototype showed the potential to yield the proposed working principle of the ACO by providing assistance torque while performing a full pedal cycle. This statement is corroborated by examination of the measurements as well as the verbal feedback of the CMT patient while he was executing the cycling exercises.



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