1. Development of an ankle exoskeleton

Participants: 5
Skills: CAD, Actuation, Implementation
Supervisor: AM

Fig. 1. **M-BLUE ankle exoskeleton module and components.**

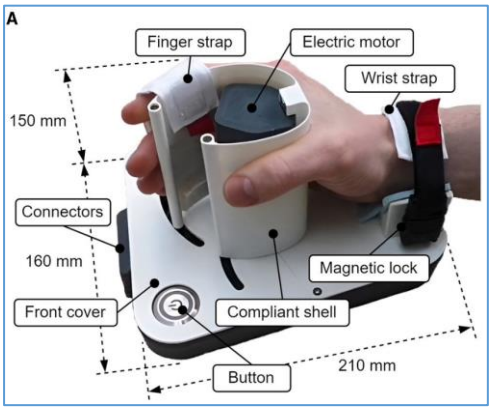
This project builds on the open design provided by Robert Gregg (University of Michigan).
Link:https://ieee-dataport.org/documents/bill-materials-and-component-cad-modular-exoskeleton-0

Objectives:

- Non exhaustive literature review,
- Design the ankle exoskeleton, adapting the exoskeleton of RG to a Swiss brand of mountain shoes (other daily living shoes, to be discussed)
- Construct it

2. Hand rehabilitation device

Participants: 5
Skills: CAD, Actuation, Implementation
Supervisor:



This project builds on the implementation of the team of Laura Marechal Crespo. We aim to extend this design, which only considers the actuation of the grasp, by actuating the flexion-extension of the wrist.

Link:

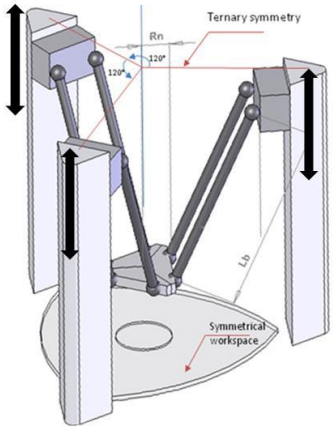
Objectives:

- Non exhaustive literature review,
- Review the design of MM Crespo, and extend it with the actuation of the flexion/ extension of the wrist.
- Size the actuation of the wrist and propose a mechanical design.
- Finalize the manufacturing dossier.

3. Linear Direct Driven vertical Delta

Participants: 6
Skills: CAD, Actuation, Kinematic and dynamic simulation
Supervisor:

In this project, we target the development and realization of a vertical linear Delta. Two versions will be simulated and evaluated.
The linear actuator from the Faulhaber series LM will be used to develop a linear direct-driven vertical Delta.



We will take advantage of the current implementation of the angular Delta developed for the robotics practicals, in the implementation of the spherical joints and the robotic arms.

4. Development of a mobile wheeled platform

Participants: 6
Skills: CAD, Actuation, Mobility, Simulation
Supervisor:

This project aims to evaluate different configurations of actuated omnidirectional wheels, simulate mobility, and suggest a construction for the wheeled mobile platform.

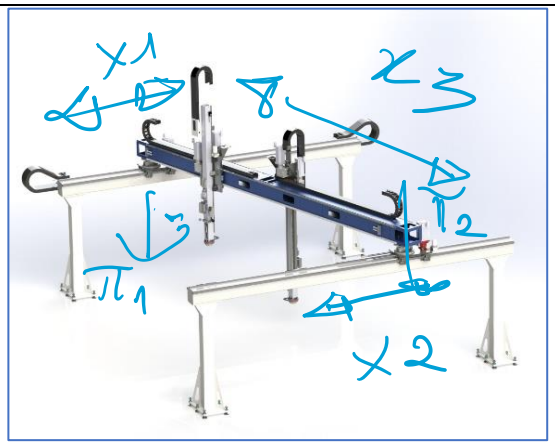
The platform payload consists of the manipulation robots and their controllers (to be decided), an adjustable-height chair.

5. Dual linear parallel platform (ref. Isochronic)

Participants: 6
Skills: CAD, Actuation, Mechanisms, Kinematic simulation
Supervisor:

This kinematics is used by company Isochronic, to implement a robotic assembly solution with 3 degrees of freedom (Plan XY, and the rotation around the vertical axis Z). These 3 DOFs are realized using 2 parallel actuated linear axis X1 and X2, and an additional linear axis X3. The linear axis X3 pivots around the two pivots $\pi 1$ and $\pi 2$.

Ref. link

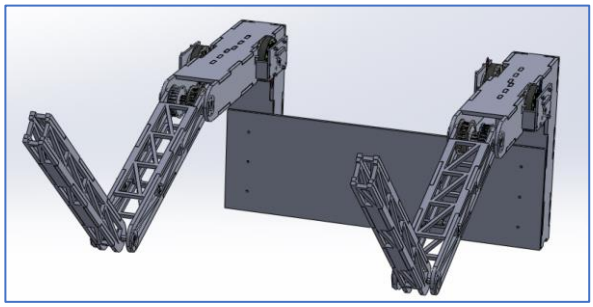


Objectives

- Simulate the kinematics
- Develop a demonstrator of the structure, inspired by the construction of the LINIX mechanism.
- The realization is open, as a bonus

6. Re-design of Wearable Supernumerary Robotic Limbs (SRL)

Participants: 6
Skills: CAD, Actuation, Transmission, Manufacturing
Supervisor:

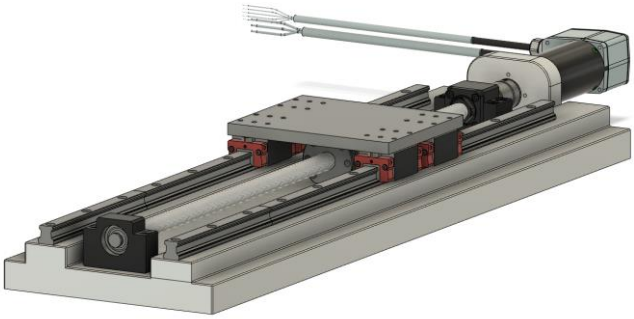


The objective of this project is to :

- Redesign the supernumerary robotic limbs, using sandwich-like carbon fiber plates,
- Add the actuation of the abduction-adduction shoulder joint,
- Ré-évaluate the actuation capability, and size the transmission accordingly
- Réalize the SRL
- Bonus: évaluate the SRL,

7. Design of a ball screw-driven linear axis

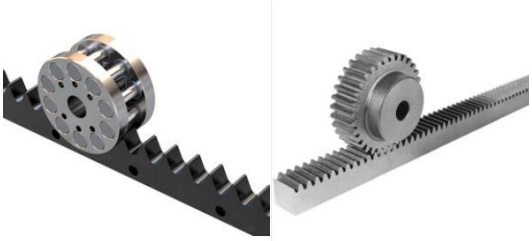
Participants: 4
Skills: CAD, Actuation, Transmission, Manufacturing
Supervisor:



This project aims to design a ballscrew-driven actuated linear axis, from specifications to the realization of the linear axis

8. Design of a rack-pinion linear axis

Participants: 3
Skills: CAD, Actuation, Transmission, Manufacturing
Supervisor:



This project aims to design a high-precision rack-pinion driven actuated linear axis (below 1 micron), from specifications to the realization of the linear axis

9. Design of a belt-driven linear axis

Participants: 3
Skills: CAD, Actuation, Transmission, Manufacturing
Supervisor:

This project aims to design a high-precision belt-driven actuated linear axis (below 1 micron), from specifications to the realization of the linear axis

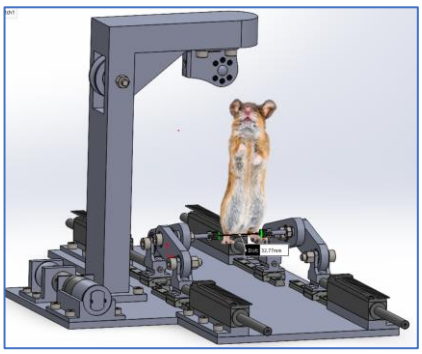
10. Comparative study, to evaluate the performance & requirements of actuation for lower limb exoskeletons.

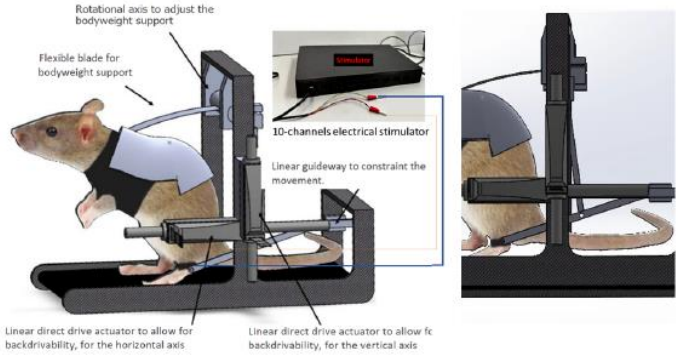
Participants: 3
Skills: CAD, Actuation, Transmission, Simulation
Supervisor:

In this project, we would like to evaluate different industrial actuators for the design of a lower limb exoskeleton. Gait trajectories and weight compensation considerations will be used to assess the performance of each of the actuators.

11. Revisit the lambda robot, to develop a "Mice Gait Trainer"

Participants: 7
Skills: CAD, Actuation, Mechanisms, Simulation
Supervisor:





(Left)Robotic exoskeleton with FES, (Right)Lambda structure implementing the sagittal movement of the back legs.

This project aims to revisit the former design of the lambda-based gait trainer for mice. Different configurations will be evaluated according to the needed space and the available workspace.

12. Explore the potential to develop “Endoskeletons”

Participants: 7
Skills: Innovation, Mechanisms
Supervisor: Christoph Fiedler

Endo-skeletons are invasive (implanted) in-body structures to assist the movement of human joints. The objectives of this project are to explore the scientific and industrial literature, and to assess the readiness of - the technology, - the regulation, and – the ethics to make such kind of implementation possible tomorrow.
Ideally, the students may suggest an implementation framework according to the different aspects of:

- Implanted structures (bodies in general)
- Sensing,
- Actuation,
- Source of energy (batteries)

….

This project will be constructed by discussing all together and is supervised by Christoph Fiedler, an expert in implanted prostheses.