EPFL

Flying Cellulo for rehabilitation

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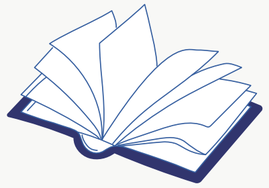
Goal of the Project



Study the feasibility of a haptic device to assist in arm movement for healthy aging and rehabilitation

Start the design of a first proof of concept

Market analysis

Hocoma is one of the leaders in movement rehabilitation.

Armeo®Power [1]

For early arm rehabilitation. Completely assists the patient's arm.

Armeo®Spring [2]

Provides arm weight support.

Armeo®Senso [3]

Only sensor-based. For moderate to mild impairments

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Solution: Flying drone

- solution that can be brought home
- can support the weight of a hand
- affordable

Requirements

- hand must be safe from propellers
- maximal load of 1.5kg
- no battery needed
- compatible with Playstation/Wii/Xbox communication protocol

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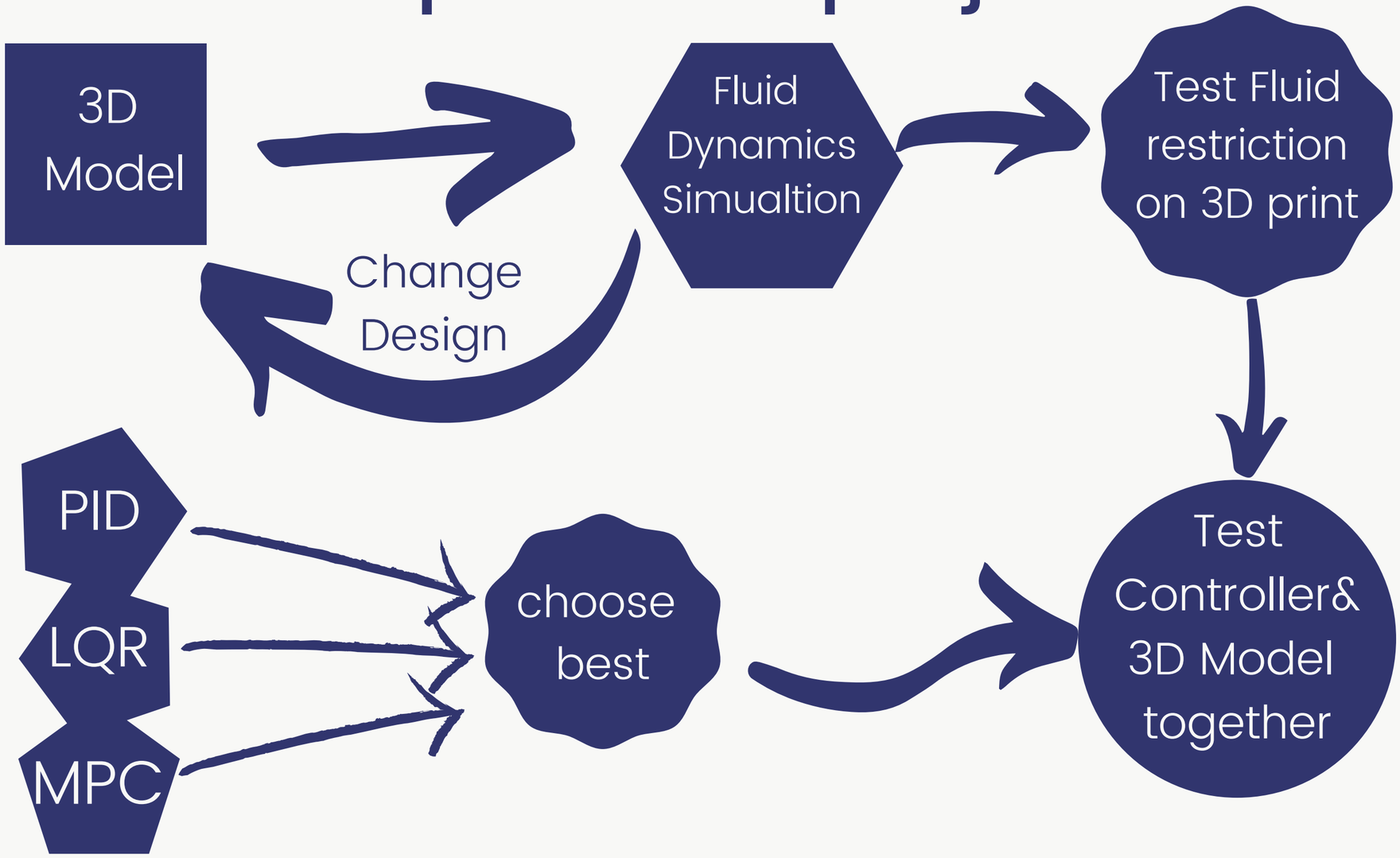
Steps of the project



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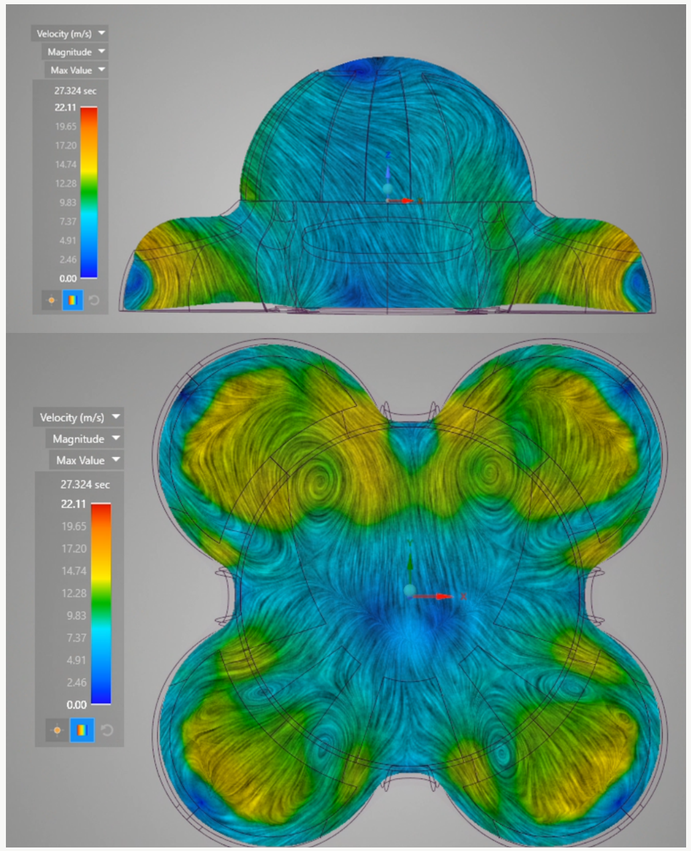
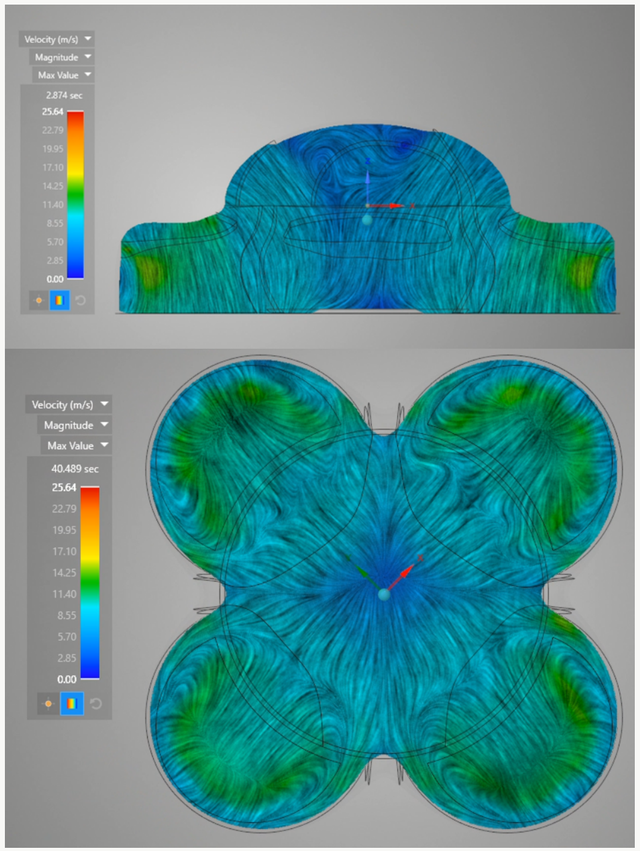
Fluid Simulations

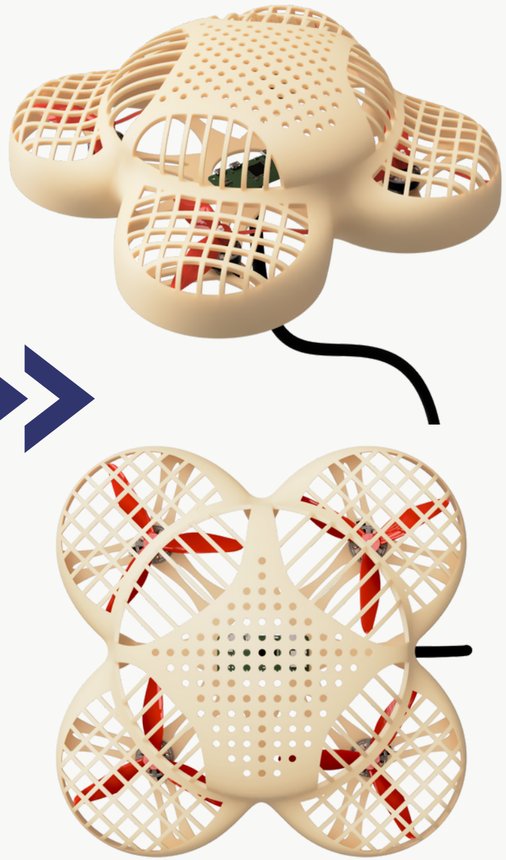
1st iteration



4th iteration



final design



Control Algorithms

PID

- Easiest to design
- Difficult to tune
- Poor performance

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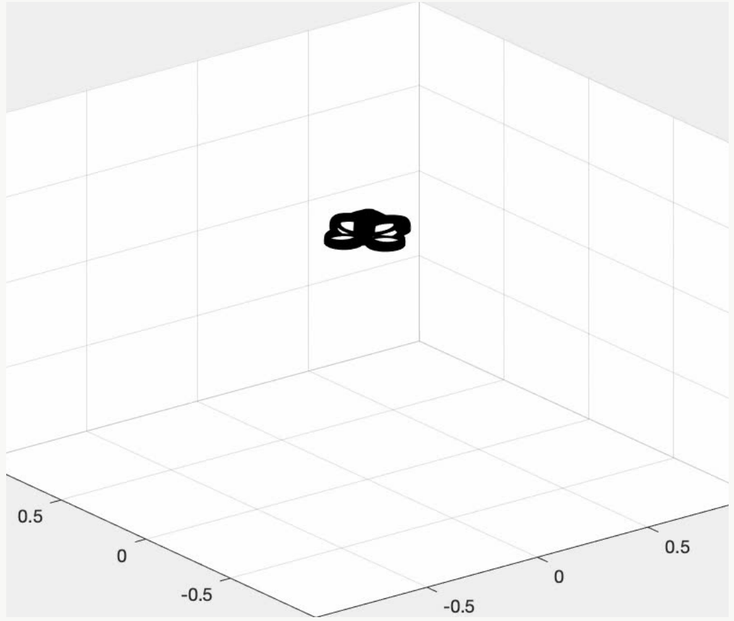
no satisfactory result

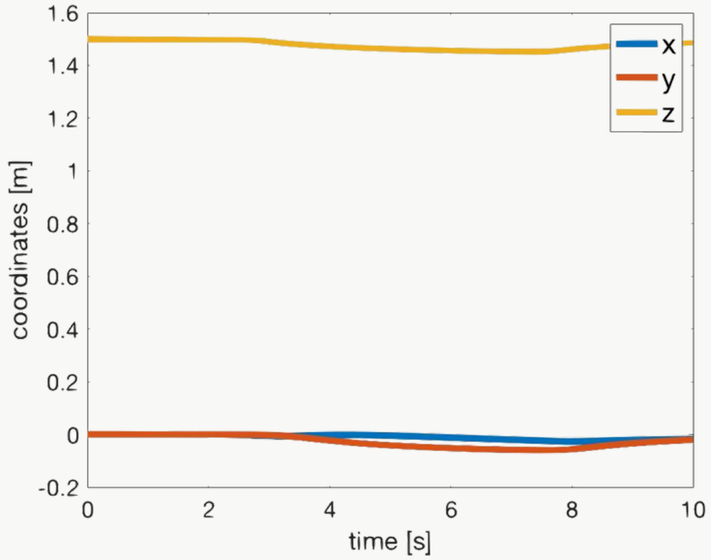
LQR

- Easiest to design
- Easy to tune
- Poor performance



MPC

- Difficult to design
- Easy to tune
- Best performance
- Very ressource intensive



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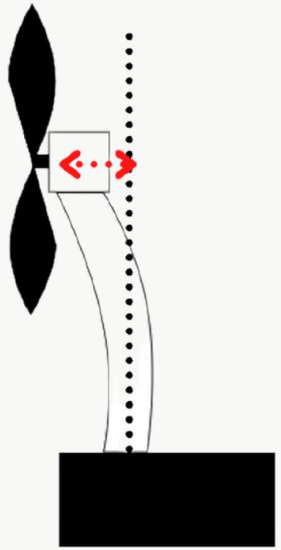
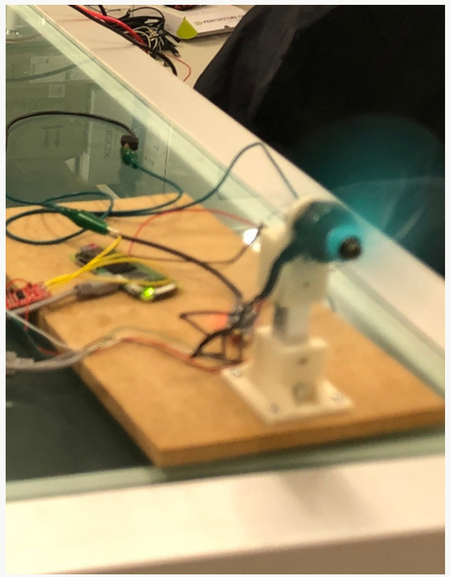
Test of the motors

Goal

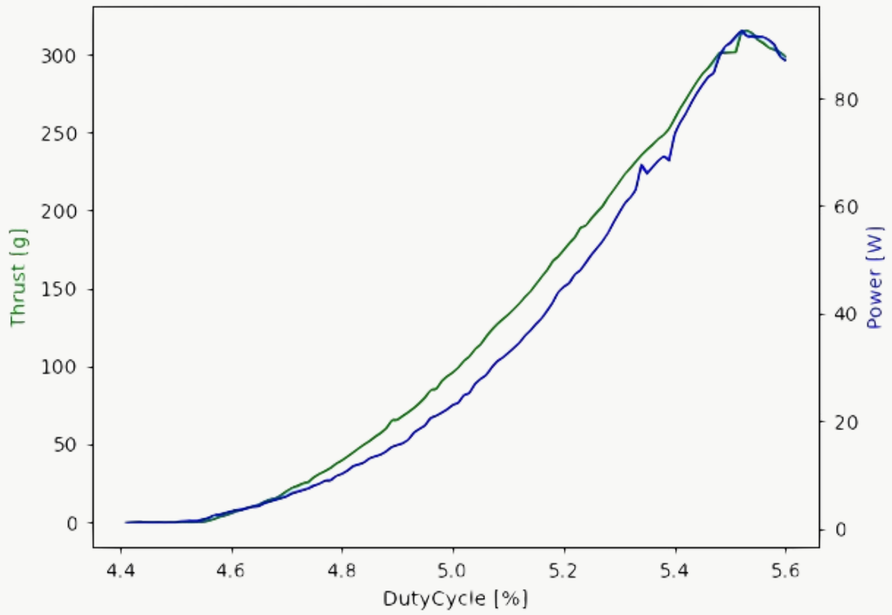
- Check if motor fullfills requirements
- Find the relationship between the command and the thrust
- Find the maximal thrust for a given power

Architecture





Results



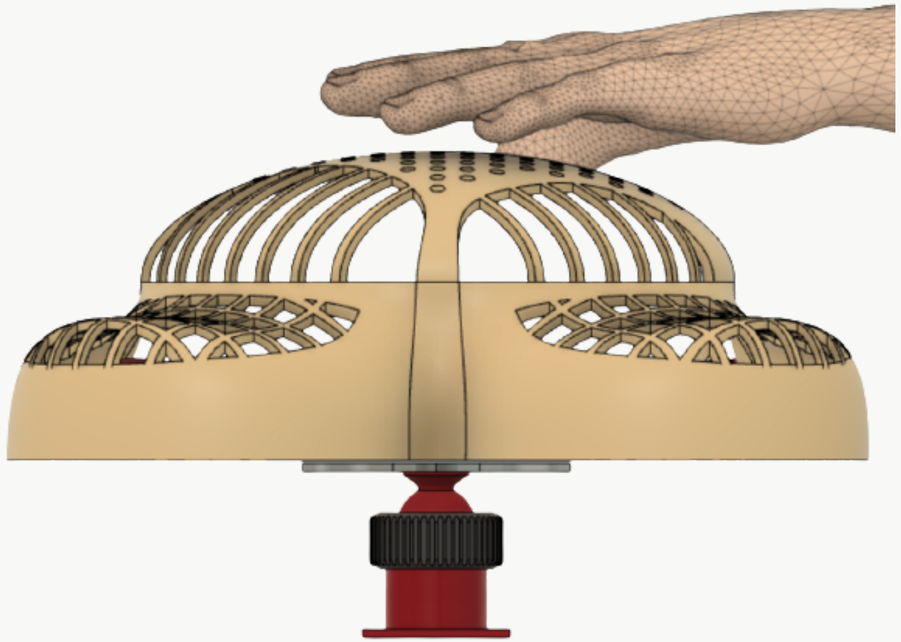
Test of the controller

Limitations:

- hazards of untested flying drone
- power supply not sufficient to have a flying drone

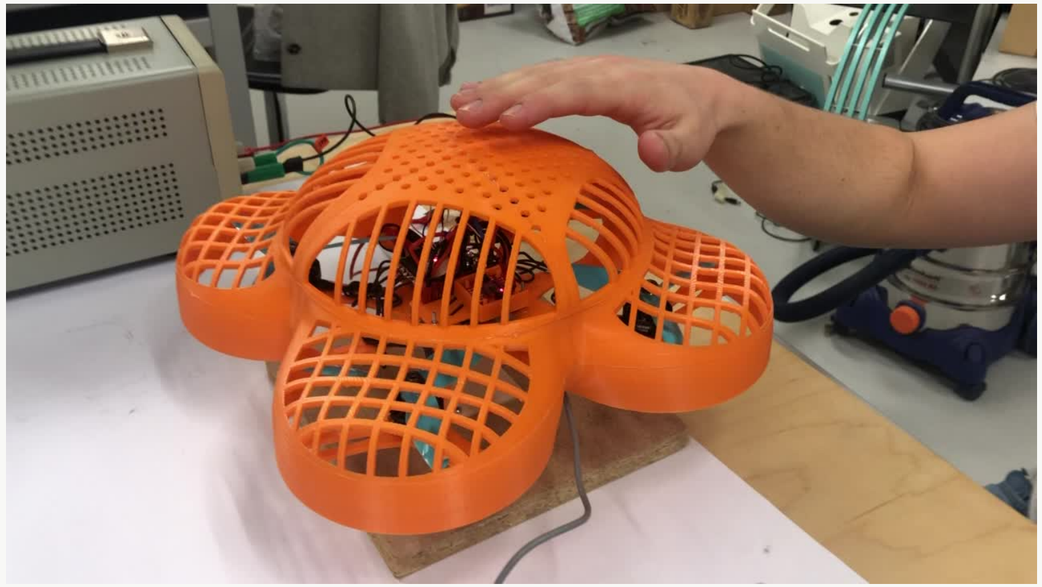
Solution:

- only study inclination ⟶ use of a balljoint



Test of the controller

Controller off



Controller on

Thanks

[1] “Armeo® power.” https://www.hocoma.com/solutions/armeo-power/.
[2] “Armeo® spring.” https://www.hocoma.com/solutions/armeo-spring/.
[3] “Armeo® senso.” https://www.hocoma.com/solutions/armeo-senso/.