Sébastien Guerif

MECHANICAL DESIGN ENGINEER PORTFOLIO

OMNIDIRECTIONAL TREADMILL - BLUEGOJI

Sept. 2024 – May 2025

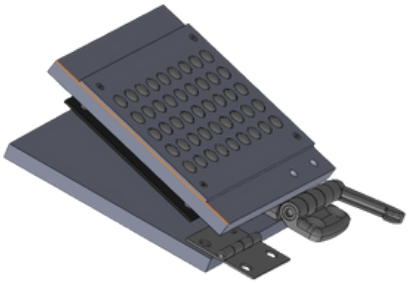
Context:
Design an **omnidirectional surface** integrating advanced signal processing and **user-centered prototyping** to revolutionize mobility in Virtual Reality, rehabilitation, and interactive gaming.

Objectives:

- Integrate **advanced signal processing** for precise motion tracking and safety.
- Prototype and validate through **testing**, **simulation**, and **user feedback**.

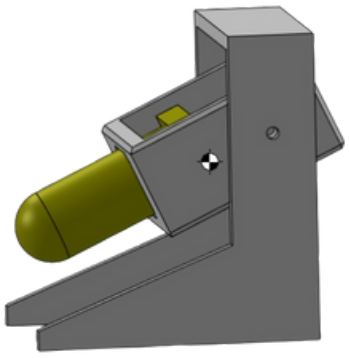
Process:

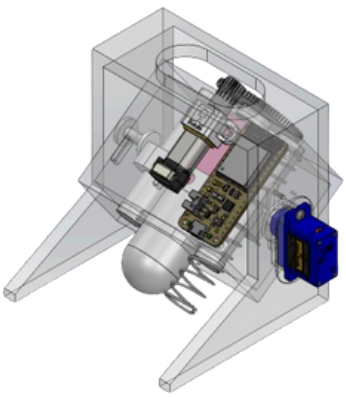
- Researched resistive mechanisms and braking systems to **optimize force control**.
- Used product design tools to select the most **effective prototype**.
- CAD designs and **SolidWorks** simulations validated **structural integrity.**
- Built prototypes, tested performance, and refined based on BlueGoji feedback.

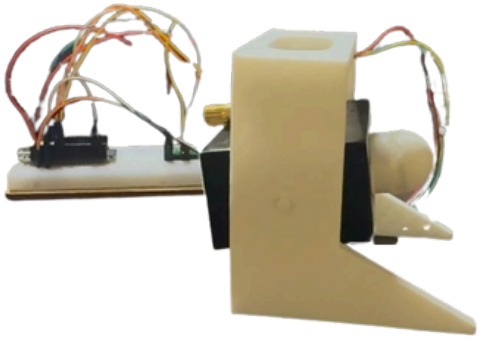


TRAJECTORY JUMPER

Sept. 2024 – Dec. 2024







Objective:
Design a **spring-powered jumping system** capable of executing precise **leaps through hoops**.

Process:

- Identified physically impossible jump angles through mathematical analysis.
- Designed the prototype in **SOLIDWORKS**.
- Used **MATLAB/Simulink** to test jump parameters and refine system behavior.
- **3D-printed** components and assembled a functional jumper mechanism.

Results:

- Achieved precise jump trajectory simulations with an **error margin of ±0.2m.**
- Motor torque and spring stiffness prevented lift-off despite **accurate trajectory computations.**

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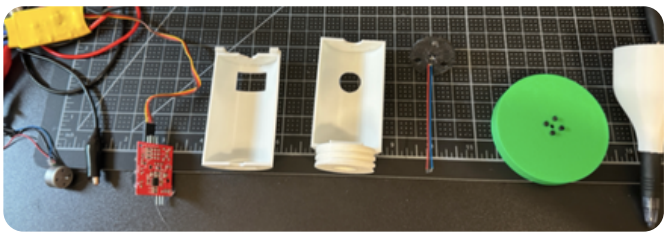
ASSISTIVE WRITING DEVICE FOR HAND TREMORS

Sept. 2024 – Dec. 2024



Objective:
Design an **assistive pen** using **Human-Centered Design** principles to stabilize hand tremors, optimizing ergonomics, weight distribution, and user experience.

Process:

- Chose **gyroscopic stabilization** based on **user feedback** and **expert** input.
- Analyzed mechanical constraints and **discarded ineffective designs**.
- Developed six prototypes, refining motor power, weight, and materials (e.g., PETG-carbon fiber).
- Tested **usability**, adjusted **power**, and improved **grip stability**.

MECHANICAL WATCH

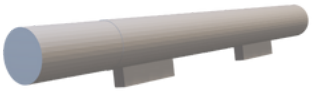
Jan. 2024 – May 2024

Objective:
Design a **mechanical watch mechanism** from scratch and develop a functional prototype.

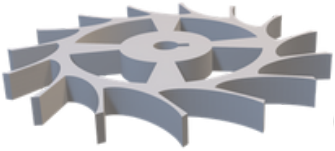
Process:

- Designed a compact, durable watch system with **bibliography** research.
- Applied **DFM/DFA**, performed calculations, 3D CAD modeling in **CATIA V5**, and **COMSOL** simulations.
- 3D-printed parts (PLA, PETG) and developed a **5-turn barrel system**.
- Assembled components, identified precision issues, and iterated using an **agile approach**.

Results:



- **Independent operation** of individual components.
- Frequency simulation results highly accurate and **close to real-world performance.**
- Minor **play affecting precision**, but still within acceptable range.
- Successful and smooth final **assembly** of all parts.



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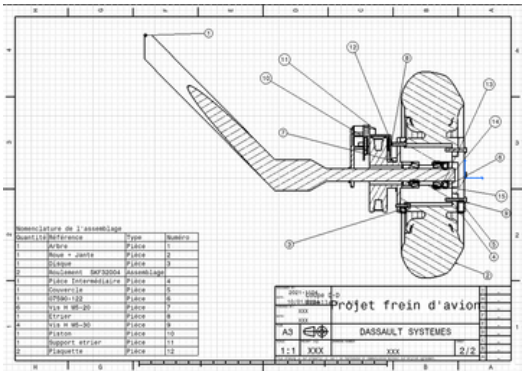
MECHANICAL DESIGN ENGINEER PORTFOLIO

LIGHT AIRCRAFT BRAKING SYSTEM

Sep. 2022 – Jan. 2023

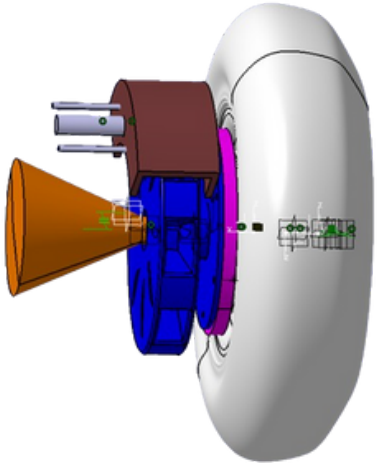


Objectives:

- Design **aircraft brakes** with **mobile calipers**.
- Generate the **technical drawings** with **GD&T** of the parts and assembly.

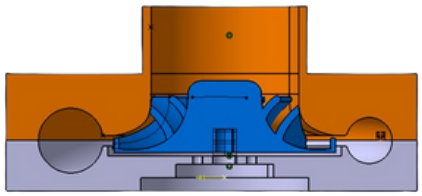
Process:

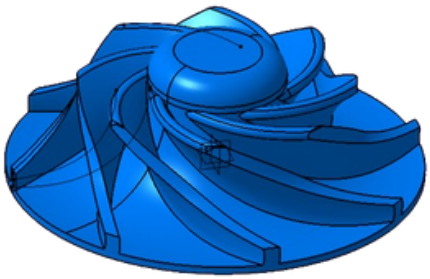
- Sizing using **energy balances** and **thermodynamics** analyses.
- CAD on **CATIA V5**.
- Generated **ISO-compliant** drawings.

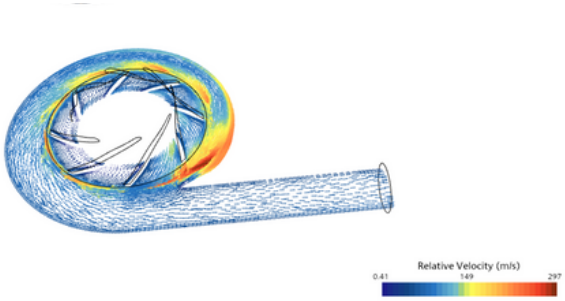


TURBOCHARGER FOR TOYOTA MIRAI FUEL CELLS

Sep. 2023 – Dec. 2023







Objectives:

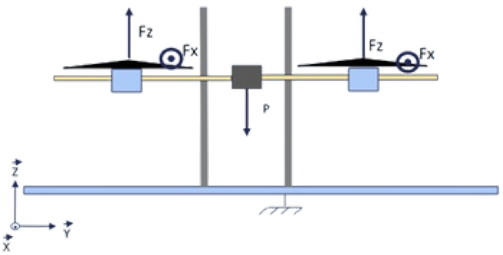
- Design a **centrifugal compressor** tailored for the **fuel cells** of the **TOYOTA Mirai**.
- Assess **performance** via CFD and **wind tunnel experimentation**.

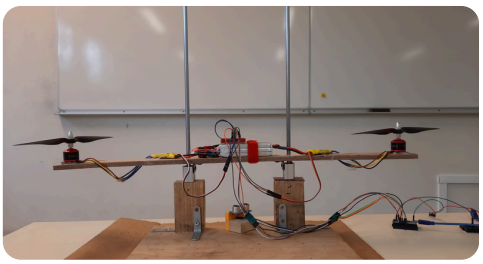
Process:

- **Enhanced** the impeller **efficiency** using a Genetic Algorithm optimization program on Python.
- CAD in **CATIA V5** using **Generative Shape Design**.
- CFD in **COMSOL Multiphysics.**
- **3D printed** a prototype in PLA/ABS (**efficiency = 0,65**).

DRONE BY THRUST AXIS

Jan. 2022 – June 2022





Objective:
Design and implement a **precise vertical positioning** control system for a **drone.**

Process:

- Designed a **closed-loop** control using **Scilab/Xcos.**
- Integrated a **phase lead controller**, ran simulations, and conducted experiments.
- Achieved stable altitude control, meeting **accuracy** (<5% error) and **response time goals** (<10s) , with potential for overshoot reduction.