A – lab LMTS

Defying Newton's Third Law: Designing a Vibrotactile Stimulator Without Recoil

Soft Transducers Lab (IGM-LMTS)
Contact: Dr Thomas Daunizeau
https://www.epfl.ch/labs/lmts/

3 - 4 students

We are looking for a group of motivated students to design and prototype a handheld, wireless vibrotactile stimulator that can deliver precise vibrations (10-2000 Hz, 10 nm-10 µm) for self-testing of touch sensitivity anywhere on the human body.

Working closely with **EPFL faculty**, neuroscientists from the **University of Geneva Faculty of Medicine**, and clinicians at the **Geneva University Hospitals**, you will explore **small high-speed actuators**, **closed-loop sensory integration**, and **advanced damping strategies** to overcome these challenges. The main development will take place at EPFL, with regular visits and co-supervision by research laboratories in Geneva.

The device has immediate applications in pain medicine, neurology, post-surgical follow-up, and women's health, including sensitivity self-testing for survivors of female genital mutilation (FGM) to support rehabilitation and clinical care. FGM still affects 1 in 17 women and girls worldwide. This project is part of a broader FGM-related initiative that has been awarded the Leenaards Foundation 2025 Science Prize (to UniGE)

https://vimeo.com/1071152083?fl=pl&fe=sh

How do you make the tip vibrate without the handle vibrating too? By Newton's third law, every vibration at the device tip produces an equal and opposite force in the handle. Because our fingertips can detect vibrations in the range of tens of nanometers, even the slightest off-target vibrations in the handle are perceptible and can interfere with an objective self-assessment of another body part. In addition, acoustic emissions must be minimized to avoid influencing perceptual testing. Designing this seemingly simple device thus requires highly innovative and interdisciplinary engineering approaches.

EPFL-LASA (A. Billard) EPFL-LMTS (H. Shea) HUG-UNIGE (D. Huber)

B – lab LRESE

Concentrated light spectral separation

Projet d'ingénierie simultanée

2025-26

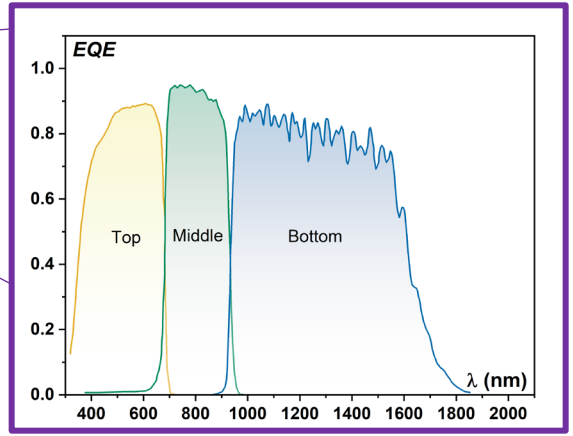
Prof. Sophia Haussener

sophia.haussener@epfl.ch

STI / IGM / LRESE Laboratory

Photo-electrochemistry with high concentrated light

Clemens Suter

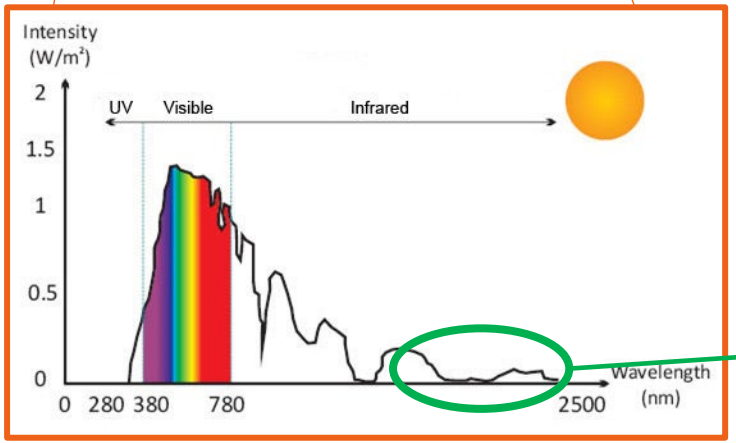


PV

Needs high energy photons

Must remain at low temperature

Photons above 1600 nm are **useless** and even **harmfull**



Solar Spectrum

Large spectral spread (up to 2500 nm)

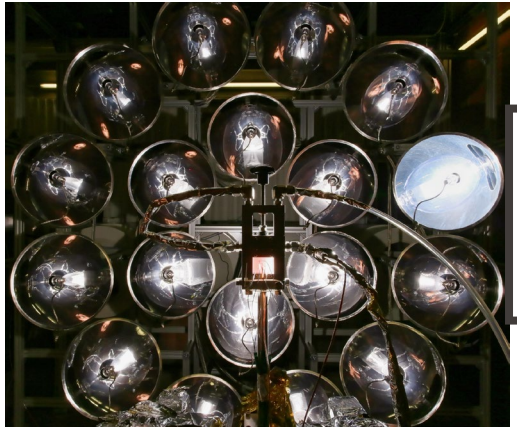
Only 7% irratiation power is between 1600 and 2500 nm

But at **1000 suns**, it is **70 suns** equivalent of heat in useless IR

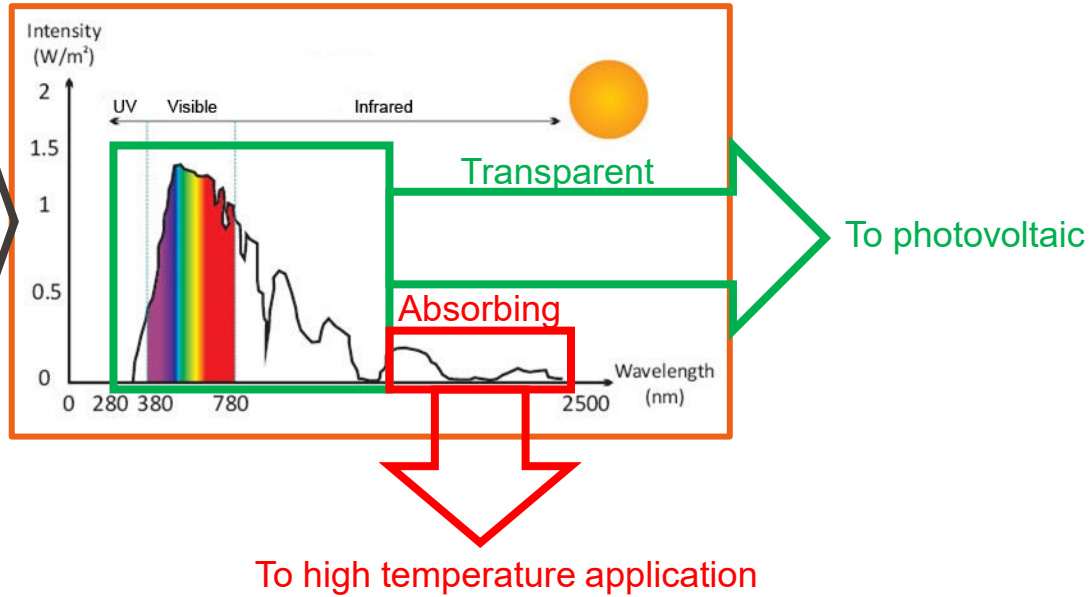
Projet d'ingénierie simultanée

Clemens Suter

HFSS @ LRESE



Design of an IR TRAP



During the project, each group will design and fabricate an **IR Trap** optimizing for transparence and absorption in the appropriated spectral ranges.
Eventually **a contest** will be organized at our in-house high flux solar simulator (HFSS) around **500 suns** to elect the IR trap having the **best combination** of **PV performance** and **T output**.

C – lab HEAD

Sound of turbomachine – Project 1

Credit: IPESE

Goals:

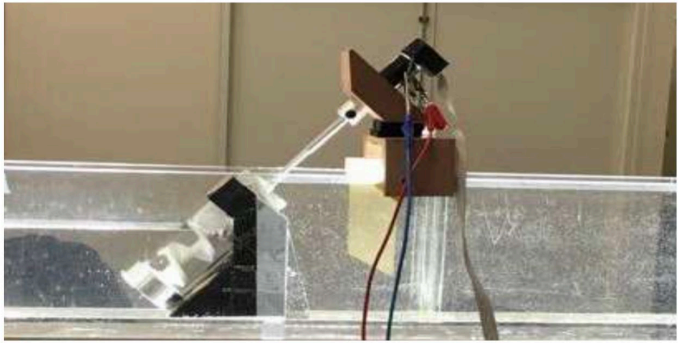
- Study how the acoustic works
- Measure the frequency, tones of each part (turbine & compressor, link to the geometry of blades (length, curvature, thickness variation)
- FFT analysis, wavelet,..
- Experimental modal analysis
- Compose and play

- HEAD-Lab. Prof. E. Yim

A sister project with Prof. Gallaire on numerical modal analysis on blade acoustics

Archimedes' screw–Project 2

A technology developed recently consists in turbines specifically designed for Very Low Head (VLH) sites around 1.5-3.5m.
The goal of this project is to explore this technology dedicated to micro hydraulic and to study how the system behaves during a flood.



Archimed screw model

- Goals:
  - Model a river in a lab setting and characterize dynamic regimes : transition river /torrential
  - Assess and control the impact of a traditional dam on a river or a narrow (upstream and downstream)
  - Quantify the yield of the Archimed screw model
  - Study the behavior of the setup during a flood

- HEAD-Lab. Prof. E. Yim

D – UDE

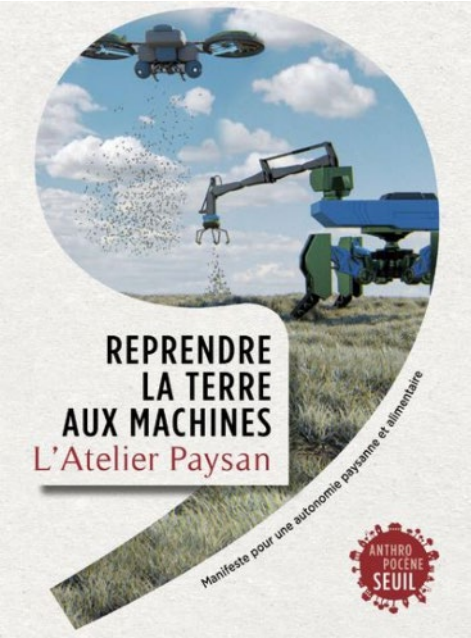
Projets d'outils agricoles Low Tech

Cours
Projet d'ingénierie simultanée

Siroune Der Sarkissian
04.12.2025

Vous cherchez…

- Un projet qui soit relié à un besoin venant du **terrain** ?
- Avec une réflexion low-tech ?
- En lien avec un besoin **commun de mieux se nourrir** ?
- A **développer** des **compétences** techniques (soudure,…) et à **mettre en pratique** vos connaissances théoriques?
- Avec un aboutissement **concret** ?



2 projets

1- Outil de ramassage de doryphores

2- Outil de générateur de mouvement avec gestion de couples différents

Ramasseur doryphores

Objectif : Améliorer l'outil de ramassage de doryphores sur les plants de pommes de terre

Outil développé par des étudiant·es sur la ferme de Bassenges, plusieurs paramètres à améliorer

Outil de générateur de mouvement avec gestion de couples différents

Objectif : Développer un vélo ou autre outil amélioré comme générateur de mouvement pour adapter à differents besoins

Laveuse de légumes

Enrouleur/dérouleur de filet

E – Lab MICROBS

EPFL

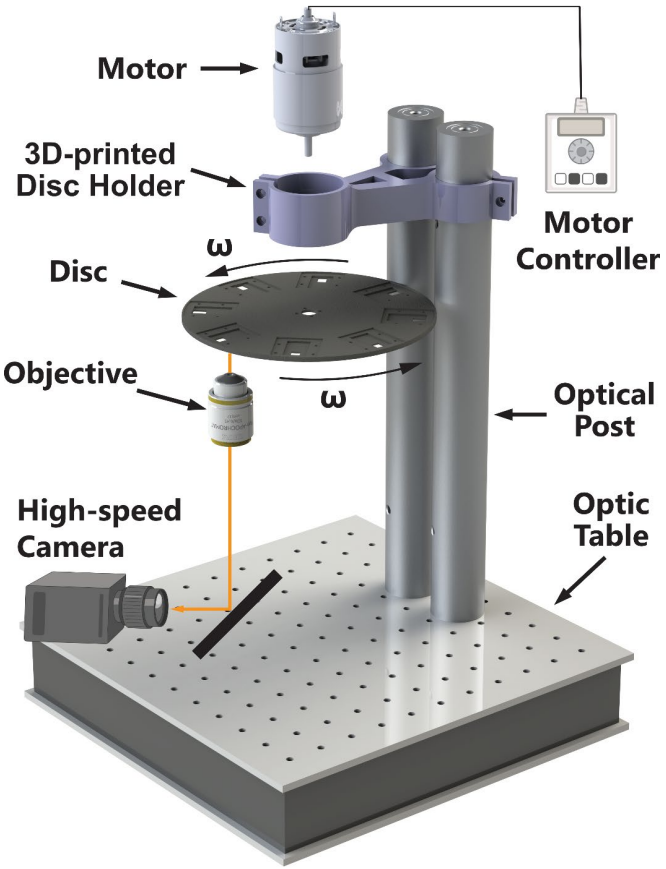
Micro BioRobotic Systems Laboratory

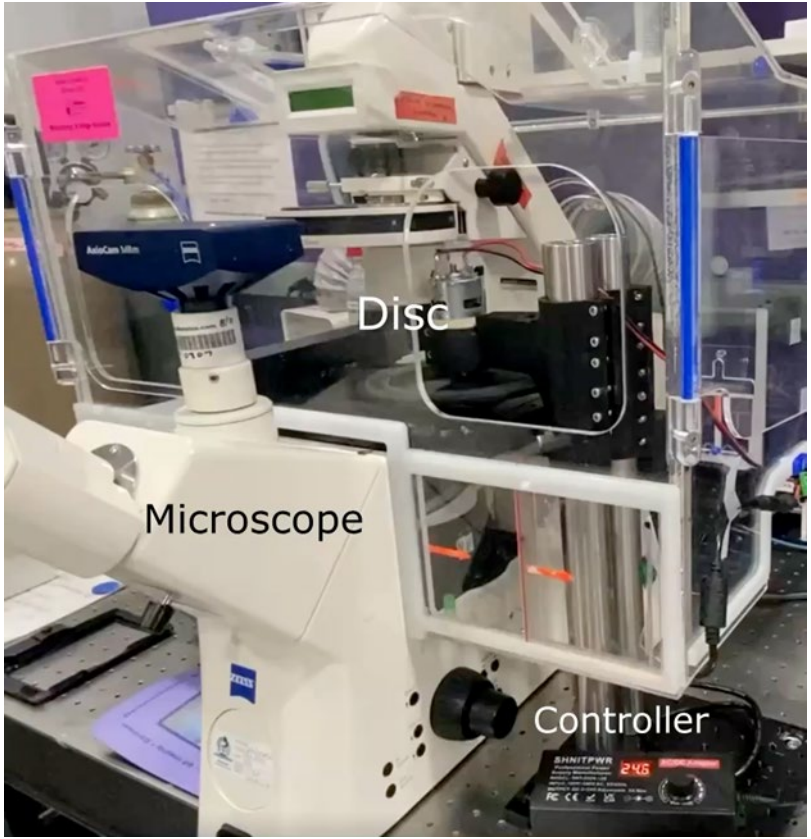
Project at the MICROBS Laboratory

Mahmut Selman Sakar
Institute of Mechanical Engineering

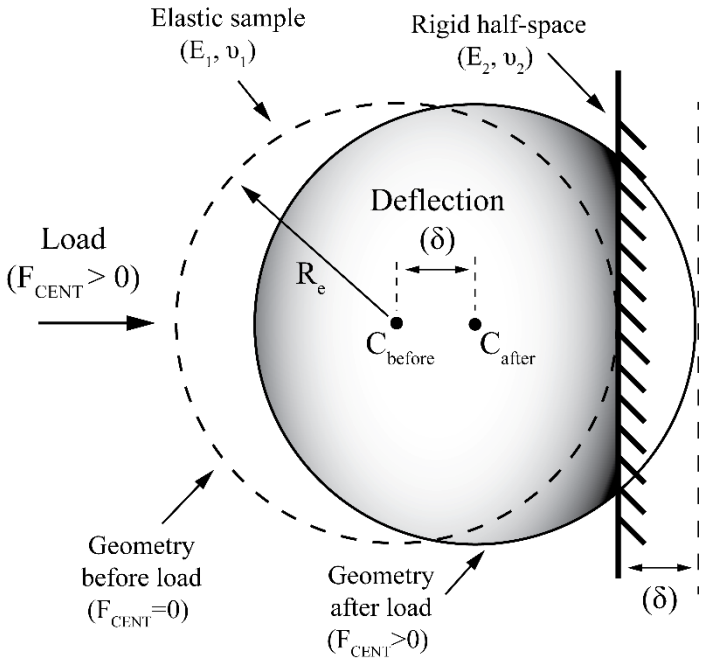
December 4th, 2025

Project: Centrifugal Biomechanical Testing

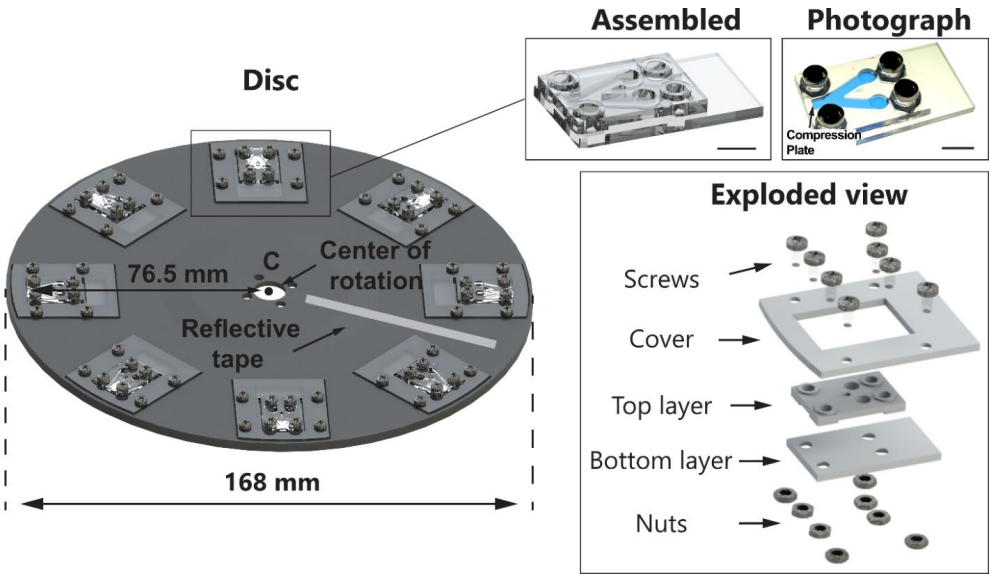




Project: Centrifugal Biomechanical Testing



Project: Centrifugal Biomechanical Testing



- **Task:** Build and program an upgraded version of this platform
- **Application:** Measuring the stiffness of organoids
- **Tool:** CAD design, prototyping, motor control, image processing

F – lab LFMI

LFMI1: Sound of turbomachine FEM prediction

Credit: IPESE

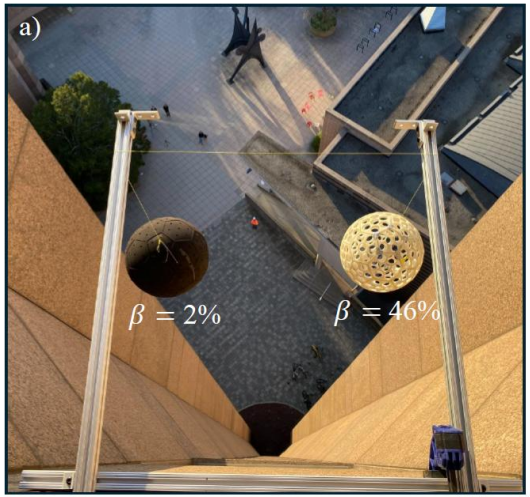
Goals:

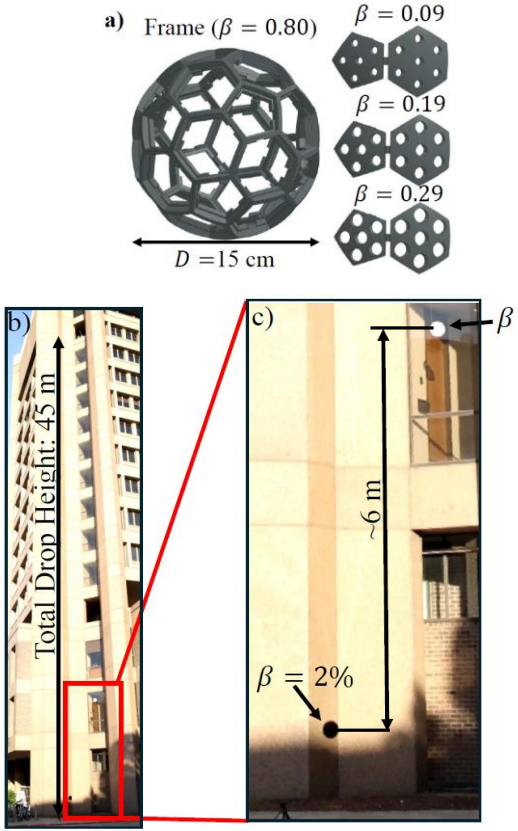
- Learn to conduct FEM modal analysis
- Predict the frequencies and tones of each blade
- Vary blade geometry- flat/curved/torsion

- LFMI Pr. Gallaire

A sister project with Prof. Yim on experimental sound and vibration analysis

LFMI2: canon a balles poreuses





Buts:

- Developper le lanceur
- Impression 3D des balles
- Détermination de la force de trainee à partir de l’analyse de trajectoire

- LFMI Pr. Gallaire

Conlin et al JFM 2025

G – Lab Unfold

EPFL

UNSTEADY FLOW DIAGNOSTICS LAB
UNFOLD

How do inflatable air dancers move?

Tasks

- Build your own air dancer
- Track the motion of the air dancer
- Analyse the movement

- Choose your path:
  - Model the dynamics of the air dancer

    OR
  - Modify the design to alter its motion

    OR
  - Try to predict the dancing dynamics

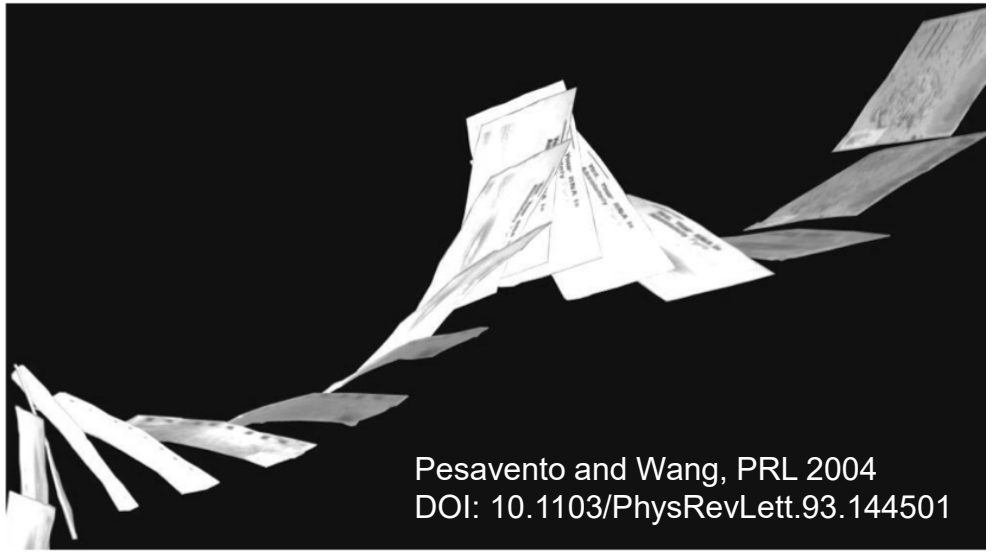
    OR
  - Make them dance to the song of your choice

EPFL

UNSTEADY FLOW DIAGNOSTICS LAB
UNFOLD

Sinking of objects with non-uniform mass distributions

When leaves or seeds fall from the tree, they can descend steadily, flutter, or tumble depending on various non-dimensional numbers such as the thickness-to-width ratio, the non-dimensional moment of inertia, and the Reynolds number. In this project we want to look at the sinking behaviour of three-dimensional bluff bodies with non-uniform distributions to identify different sinking regimes and characterise the relevant non-dimensional numbers that characterise their behaviour.



Pesavento and Wang, PRL 2004
DOI: 10.1103/PhysRevLett.93.144501

Tasks

- Create objects with different offsets of their centre of mass
- Design a release mechanism to drop them in a fluid tank
- Measure the sinking trajectory of the object
- Analyse the trajectories
- Characterise the sinking behaviour
- Optimise the object to sink straight or disperse most

OR

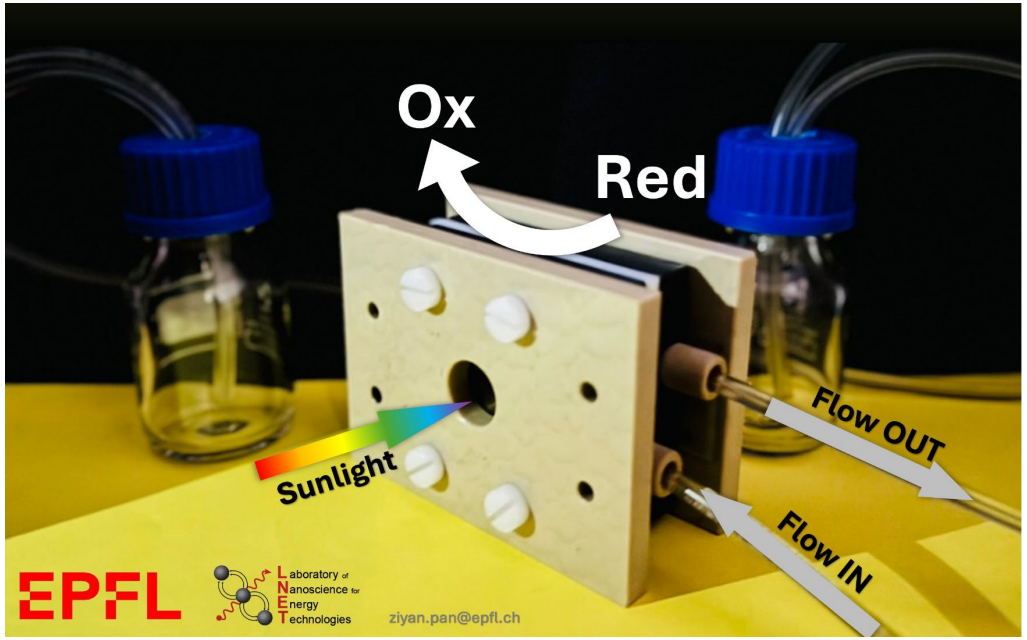
- Try to model or predict the behaviour with the method of your choice

H – lab LNET

Creating Continuous Sunlight: Structural Design of a Solar Redox Flow Battery

Background

Solar energy is clean and renewable but limited by intermittency. The **Solar Redox Flow Battery (SRFB)** integrates solar **harvesting** and electrochemical **storage** in one device, enabling direct light-to-energy conversion and controlled **release**. Compared with conventional storage, SRFBs provide scalability, safety, long lifetime, and reliable utilization of solar power.



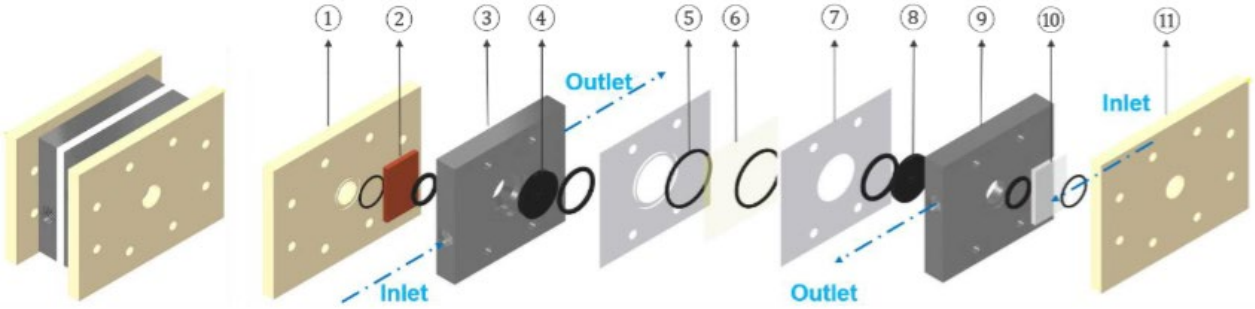


Figure S2. Solar redox flow cell system: ① PEEK front frame; ② Photoelectrode (PE); ③ Bipolar graphite chamber 1; ④ Carbon felt 1(CE1); ⑤ EPDM O-rings; ⑥ Nafion 115; ⑦ PTFE gasket; ⑧ Carbon felt 2 (CE2); ⑨ Bipolar graphite chamber 2; ⑩ Glass; ⑪ PEEK back frame.

Aim

In SRFBs, light-driven efficiency depends on the electrode structure, the reaction interface, and the electrolyte flow. This project aims to design a solar redox flow battery with efficient photoelectrochemical reactions and good mass transport.

You are not just designing a battery, you are creating a way to make sunlight never stop shining.

Methods

Students will build upon an existing SRFB platform to create an improved design. The main tasks include:

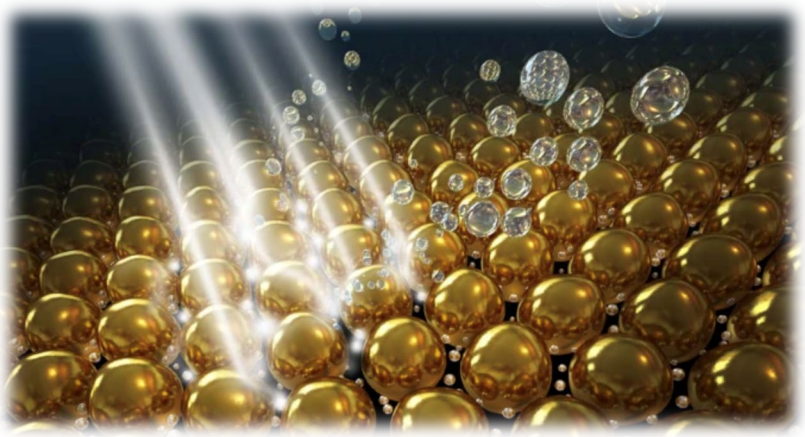
- Designing electrode and photoelectrode arrangement for uniform light exposure.
- Optimizing flow channels to enhance reactant transport and product removal.
- Adding sealing, modular replacement, and electrode integration for testing.

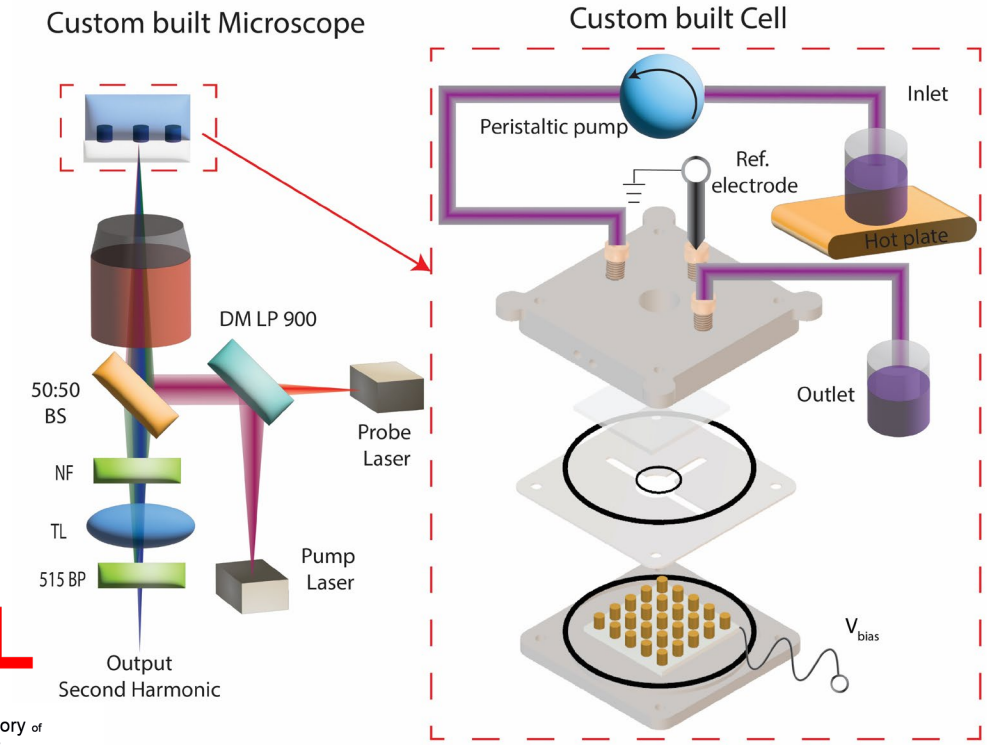
The final design will be evaluated through modeling and prototype experiments.

Contact: Ziyan Pan (ziyan.pan@epfl.ch), Giulia Tagliabue (giulia.tagliabue@epfl.ch) - Laboratory of Nanoscience for Energy Technologies

Design of Miniaturized Reaction Cell for In-Situ Microscopy toward Sustainable Energy Conversion

- Interfacial photo-electrochemistry focuses on chemical transformations at the boundary between the solid and liquid phases.
- Unlike reactions happening in bulk reactors, which often require high temperatures and pressures, this process can be powered sustainably using solar energy.
- At LNET, we are developing novel strategies to generate solar fuels, such as hydrogen, and to promote sustainable chemical production through CO_2 reduction.





An in-situ approach has been developed to study chemical reactions using a non-invasive optical technique.

There is an opportunity to contribute in the following areas:-

1. Design and optimize the reaction cell to be placed on the microscope platform.
2. Identify effective strategies for *temperature control* and monitoring within the cell.
3. Optimize *fluid dynamics* conditions inside the cell for active electrolyte pumping.

EPFL
Laboratory of Nanoscience for Energy Technologies
tarique.anwar@epfl.ch

T. Anwar, et al—arXiv:2510.08809. Revealing Light-Driven Dynamics at Nanostructured Solid-Liquid Interfaces with In-Situ SHG

Thermal Microscope Holder for Thermo-Optic Metasurface Experiments

Lab: LNET | Start: Spring 2026 | Duration: 1 semester | ECTS: 5

Aim:

Design and fabricate a compact **thermal sample holder** for microscope stages using a **low-thermal-conductivity material** (e.g., high-T polymer, PTFE).

Integrate a Thorlabs **ceramic heater** with safe cable routing, sample retention, and optical access.

Characterize **temperature reach** (300–400 °C), **stability**, **uniformity**, and **stage compatibility**.

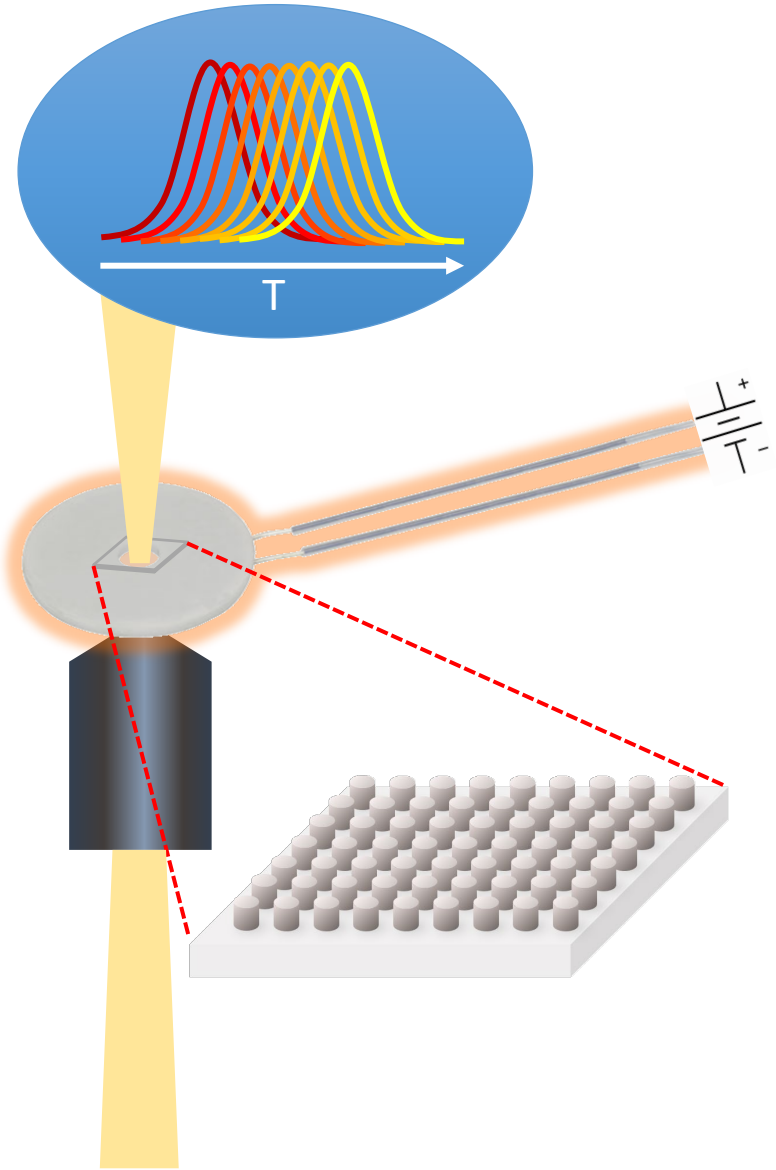
Deliverables:

CAD files, assembled prototype, calibration report, user guide.

Required skills:

CAD, hands-on fabrication

(thermal modeling/electronics/microscopy helpful)



Laboratory of Nanoscience for Energy Technologies

Contact: diana.dallaglio@epfl.ch, giulia.tagliabue@epfl.ch

I – Lab LA

Ingénierie simultanée 2026

Laboratoire d’automatique

christophe.salzmann@epfl.ch

Mecanum wheels car challenge

Multi-years challenge

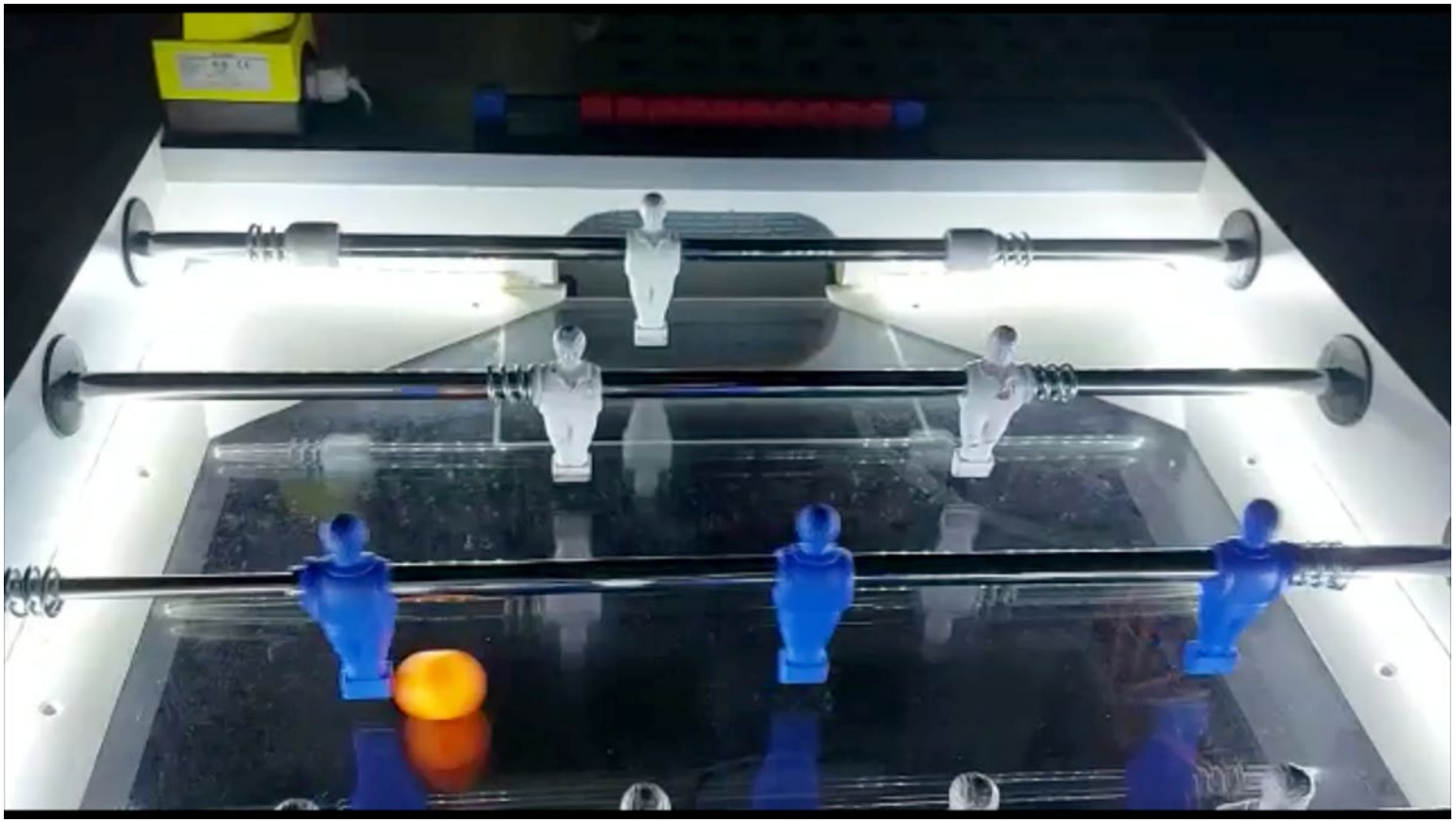
Year 1 : initial mechanical setup + control

Year 2 : path following/tracking + communication

Year 3+ : crowd control via camera tracking

Nbr etudiants: 16, 4 x 4 groupes
Responsables: Christophe Salzmann
Assitants: Vishnu, Mert

Babyfoot global strategy



Link strategies wisely + visualization

Programmed in **LabVIEW** !

Nbr etudiants: **3**

Responsables: Christophe Salzmann

Bumper cars

Implement cooperative/swarm behavior
Matlab, Python, C/C++

Nbr etudiants: 3-4
Responsables: Simone Baratto

Follow me

Select localization technology: UWB, BT, Vision, …
Implement chosen solution on vehicle/robot platform
Test without obstacle
Test with moving obstacles

Nbr etudiants: 3
Responsables: Christophe Salzmann
Assitants: -

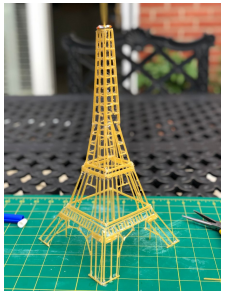
J – SGM-GE

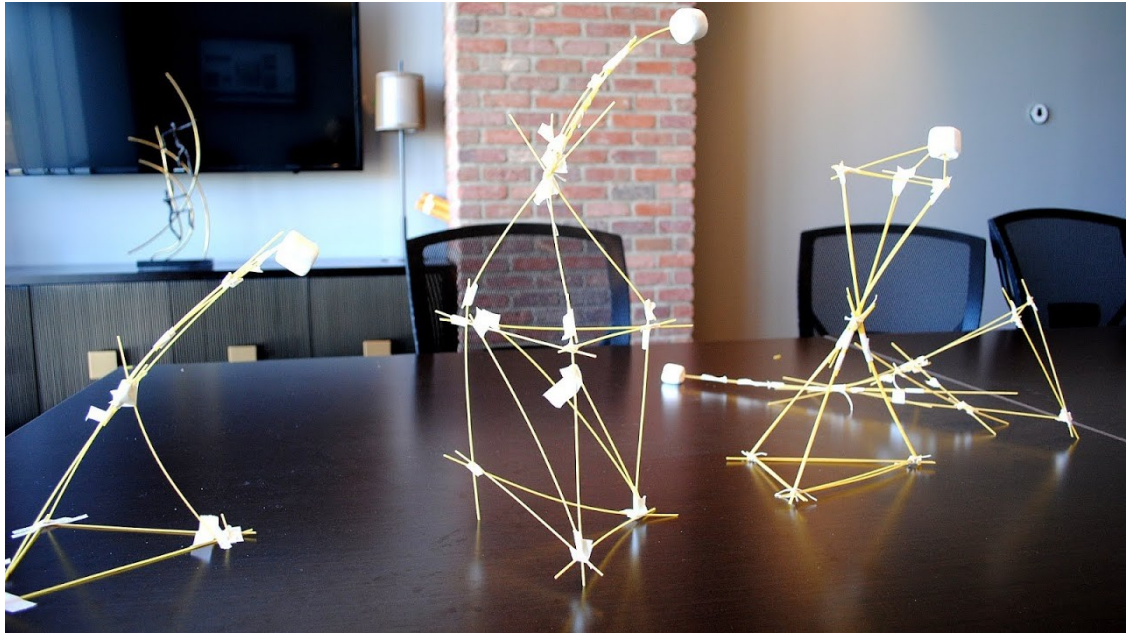
Spaghetti marshmallow challenge

- **Objectif :** concevoir une tour en spaghetti atteignant la hauteur maximale possible.
- **Approche :** utiliser un logiciel de simulation par éléments finis pour modéliser le comportement de la structure et analyser les déformations

SIMULIA ABAQUS

Ansys

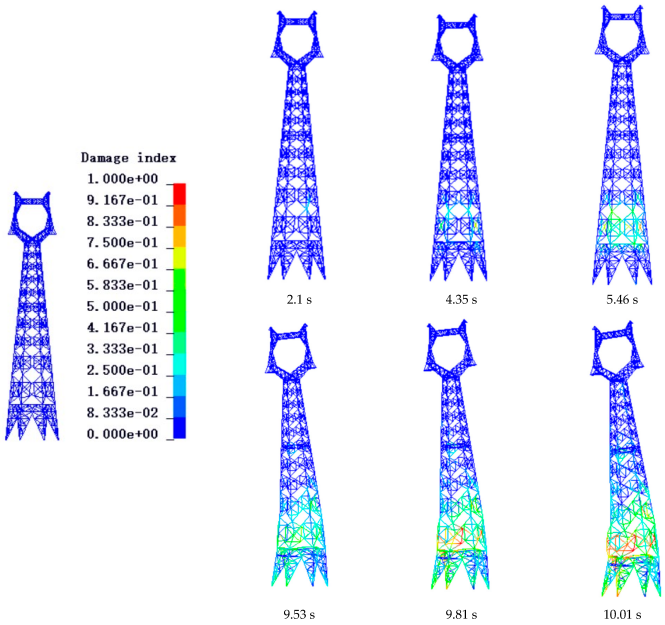


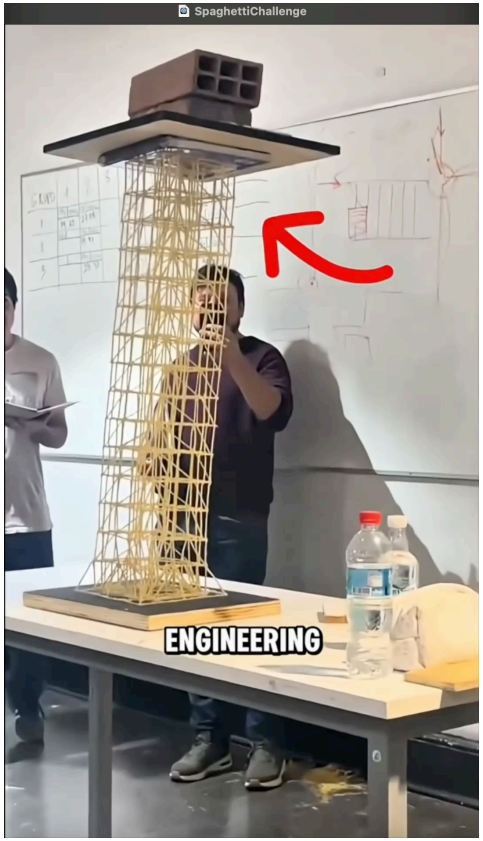


Nbr étudiant.e.s: 16 (4 x 4 groupes)
Responsable:

Stefano Burzio
Scientific collaborator

Spaghetti marshmallow challenge



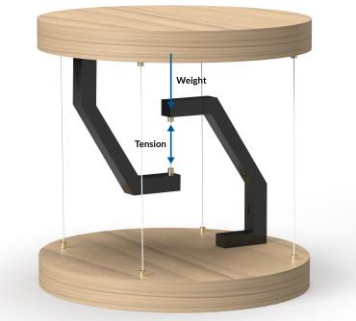


(Source: MDPI)

K – lab MESOBIO

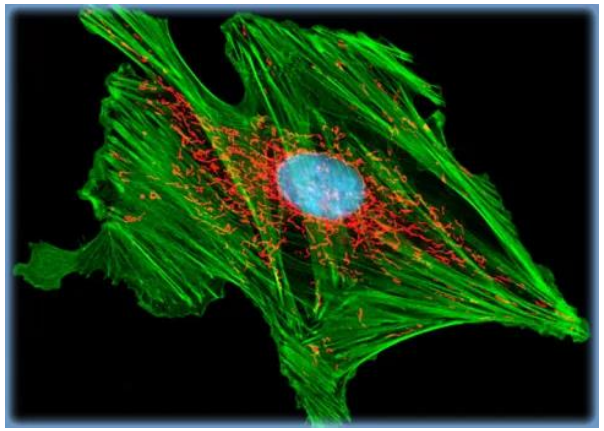
Tensegrity Challenge

Wikimedia Commons



https://www.comsol.com/blogs/modeling-tensegrity-with-a-floating-table

https://www.creativemachineslab.com/tensegrity.html



https://paul-thorpe.com/2015/02/06/bio-tensegrity/

Isolated compressed elements

+

Continuous network under tension

Challenge: How can we apply the concept of tensegrity to design new structure?

- Tunable mechanical properties
- Artistic structures/Shape morphing structures
- Achieving specific functions

Tensional integrity or **Floating compression**

L – lab FlexLab

Da Vinci-inspired Design Challenge

SGM - Projet d'ingénierie simultanée 2025-2026

Goal: Taking the codices or other art pieces of Leonardo da Vinci as a starting point, you will be ideating, developing, prototyping, analyzing, and studying an innovative technique, process, structure, application, or research/science question.

Up to 3 teams of 5 students. Open-ended project. Lab work will take place at DLL.

Flexible Structures Laboratory – IGM.

Contact: pedro.reis@epfl.ch

kanthasamy.ubamanyu@epfl.ch
jisung.park@epfl.ch

https://actu.epfl.ch/news/bringing-leonardo-da-vinci-s-designs-to-life-3/

Bringing Leonardo da Vinci's designs to life

STUDENT PROJECTS - Fourteen mechanical engineering students spent a semester getting inside the head of Leonardo da Vinci. Using his drawings from the 15th and 16th centuries, the teams built ingenious machines – altering the design in some cases – in order to better understand how they worked.

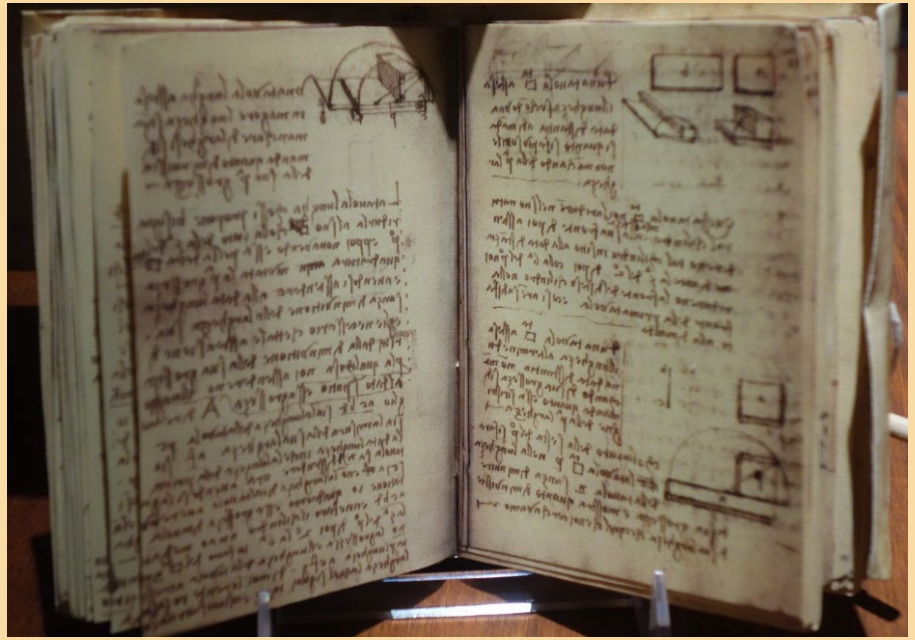
03.07.23

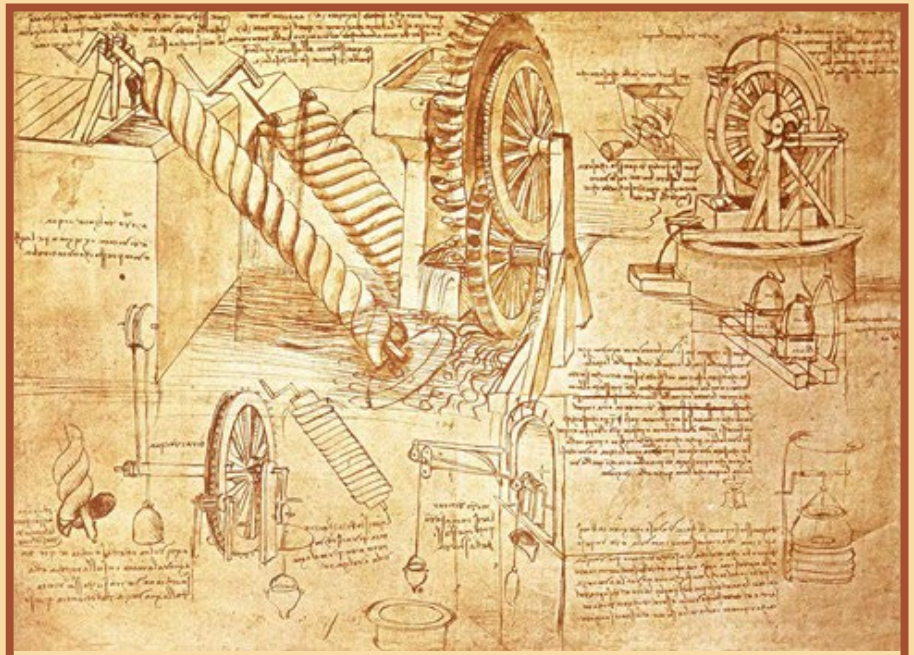
TAGS

CIS | design | electrical engineering | engineering | ERC | mechanics | rehabilitation | students | summer series

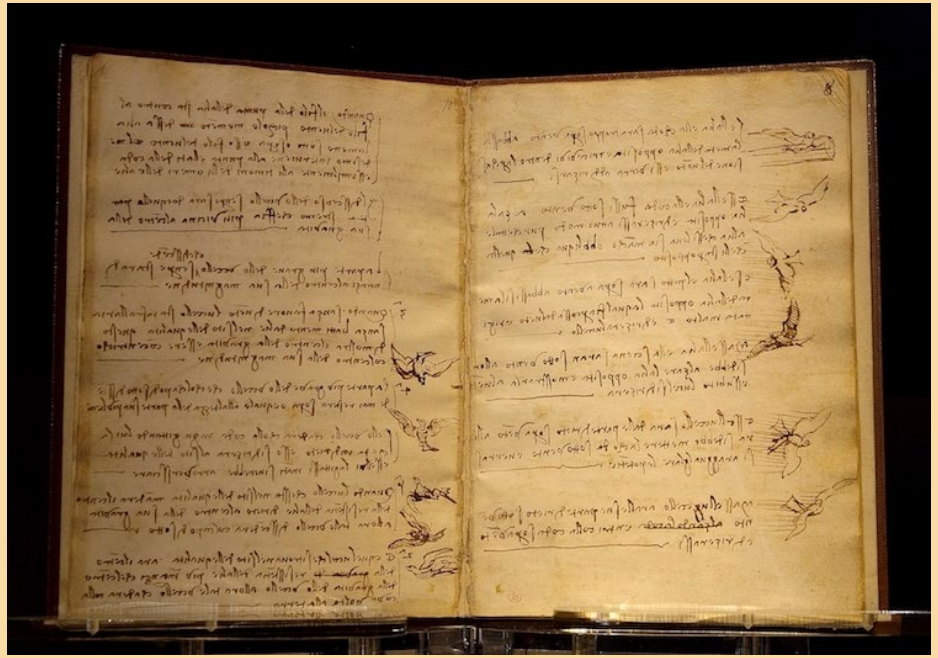
The *Codex Arundel* (CA. 1480S-1518) is a 283-page manuscript by Da Vinci that contains notes on a wide variety of subjects that interested him, including **mechanics and geometry**. The physical copy is held in The British Library.

The *Forster Codex* (1487-1505) is made up of five pocket notebooks that have been bound into three volumes. Inside, Da Vinci explores **geometry, hydraulic engineering, theory of proportions, topology**, and more. The physical copy is held in the Victoria and Albert Museum in London.





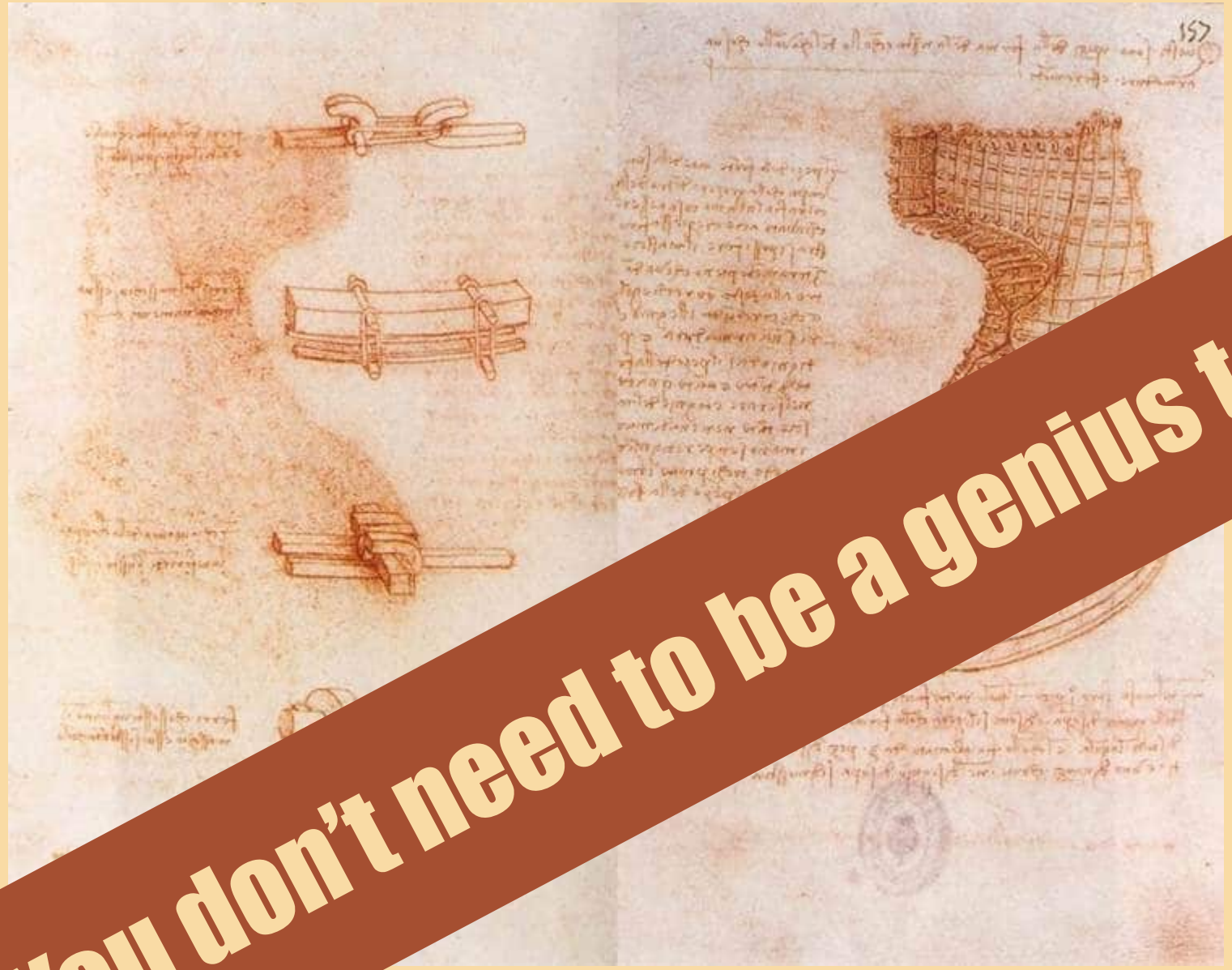
The *Codex Atlanticus* (1478-1519) is the largest single collection of drawings and writings by Da Vinci. It includes content about **weaponry, musical instruments, mathematics, botany**, and more across 1,119 leaves of paper. The entire codex spans Da Vinci's career through Florence, Milan, Rome, and Paris. The physical copy is held in the Biblioteca Ambrosiana in Milan, Italy.



The *Codex on the Flight of Birds* (1505) is one of the best-known manuscripts. Relatively short, the codex includes illustrations and notes examining the **flight patterns of birds and several inventions for flying machines**. The physical copy of the manuscript is held in the Royal Library in Turin, Italy.

https://mymodernmet.com/leonardo-da-vinci-notebooks-online/

You don't need to be a genius to join this project!



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M – lab CREATE

Minidrone Project in Simulink (Matlab)

Project Description

Design controls for a digital twin of a quadcopter built with MATLAB & Simulink.

Simulate your solutions in a 3D environment.

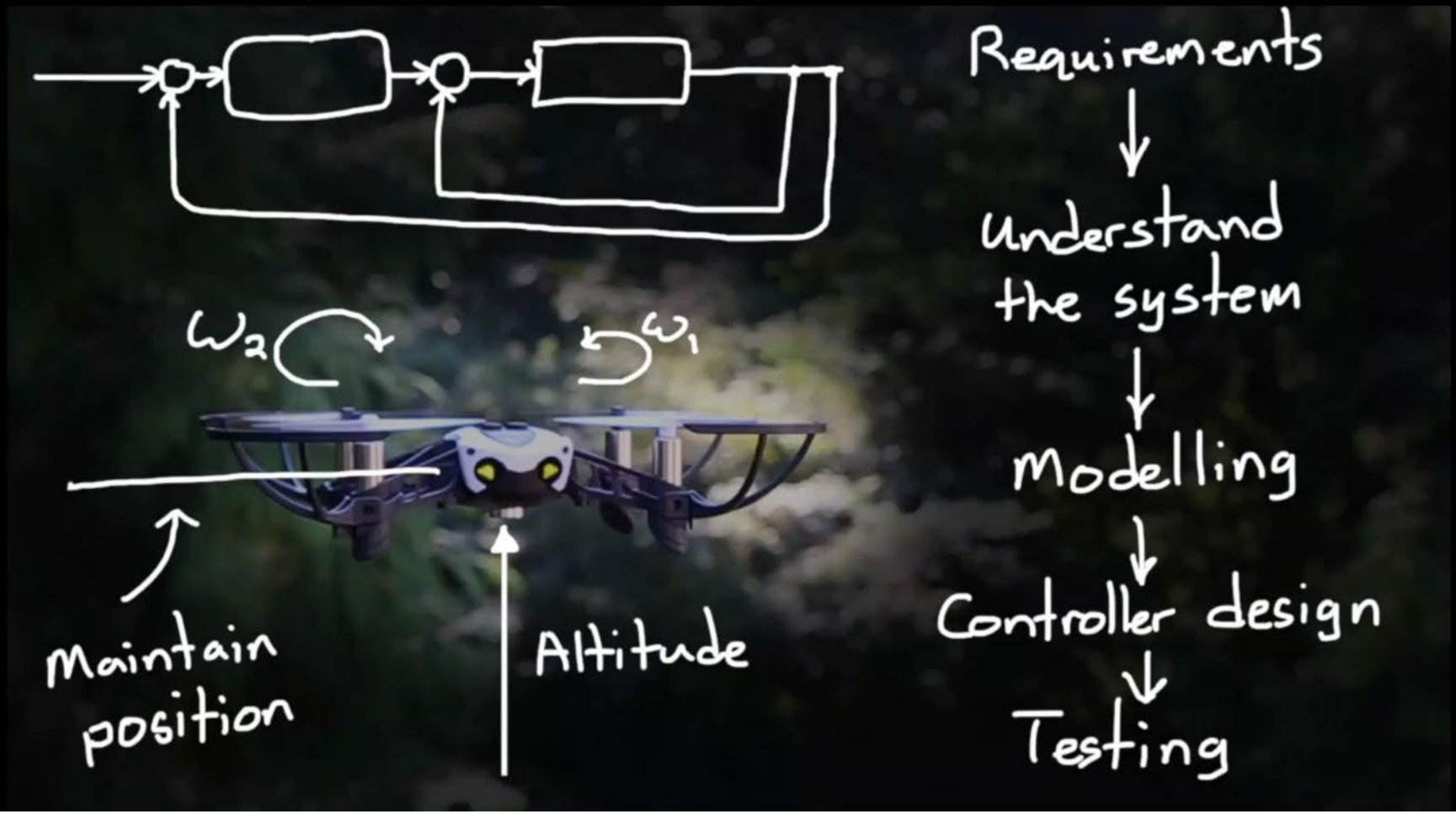
Problem Statements

Implement high-level algorithms for line-following or path-planning using drone sensors.
A specific challenge will be given, for a mini competition between groups.

Further Materials

- MATLAB Quadcopter project
- MATLAB Tech Talks: Drone Simulation and Control

Understand the basics



Requirements
↓
Understand the system
↓
Modelling
↓
Controller design
↓
Testing

Key Outcomes

- Implement a physics based model of a quadrocopter
- Develop a controller for flight control of a quadrocopter
- Participate in a mini- simulation based competition (if there are enough groups, we may run a real world deployment!)

- Groups of 2-3
- Self-learning materials, and supervision from CREATE Lab and Mathworks

N – Lab Sycamore

Reinforcement learning for real-world systems control

Projet d'ingénierie simultanée 2025-26

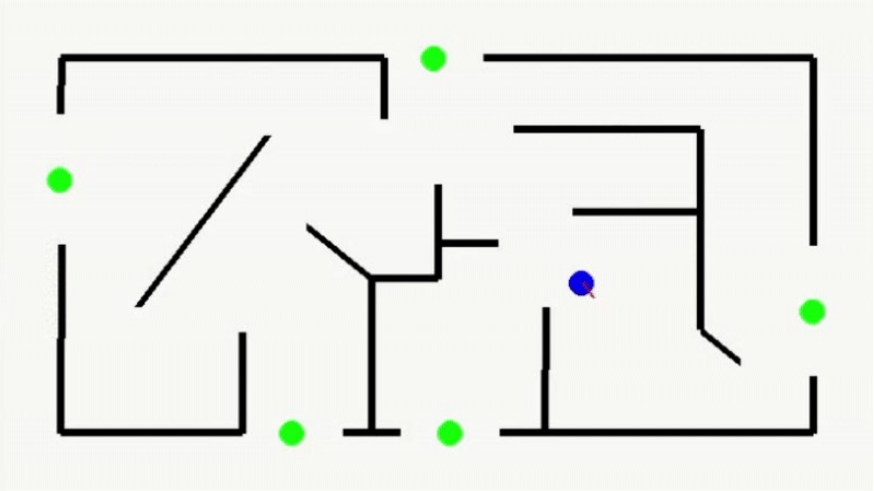
Gabriel Vallat, Kai Ren, Gregorio Valenti
December 4, 2025

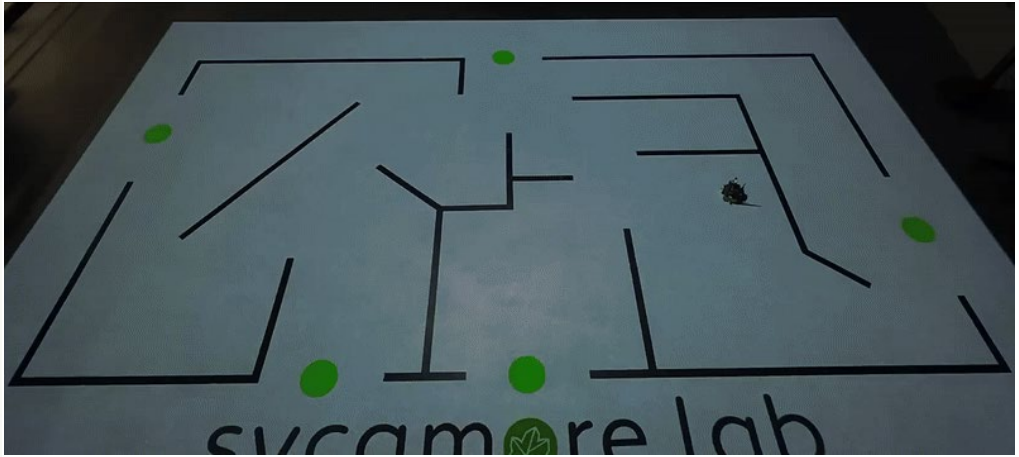
sycamore lab

SYSTEMS CONTROL AND MULTIAGENT OPTIMIZATION RESEARCH

Learning to control real-world systems

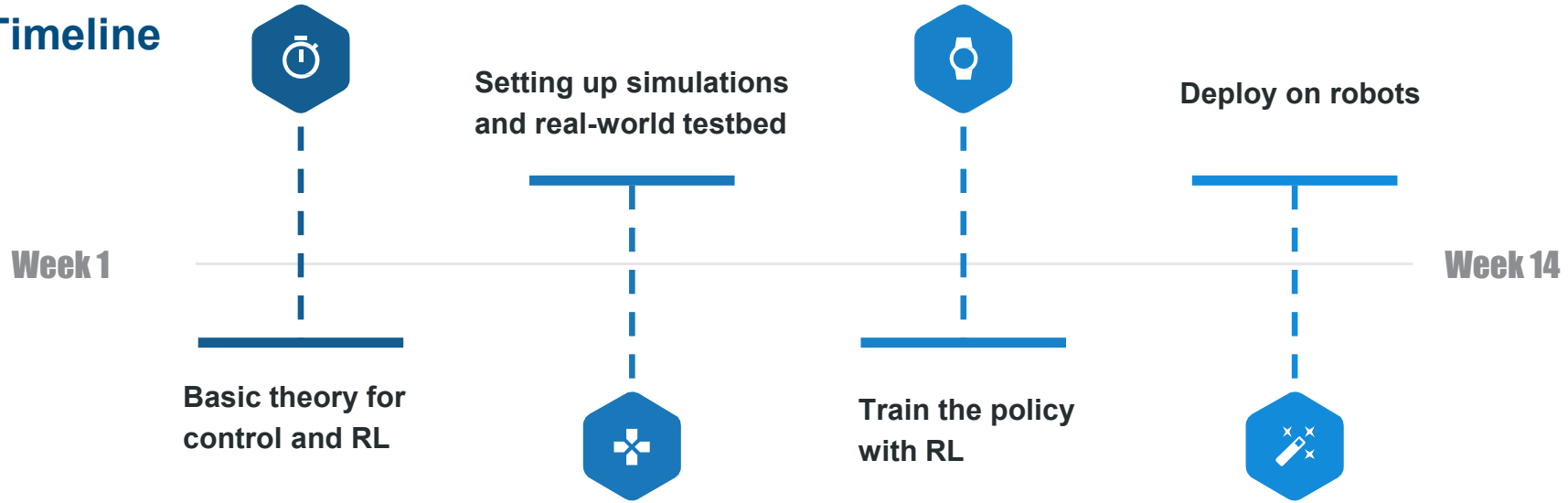
- Reinforcement learning for autonomous system control
- Deployment in real-world systems





Learning to control real-world systems

Timeline



Requirements:

- Math background (analysis and probability theory)
- Proficiency in python
- Teamwork

O – NEMS

EPFL

Advanced NEMS Lab
Lab projects

École
polytechnique
fédérale
de Lausanne

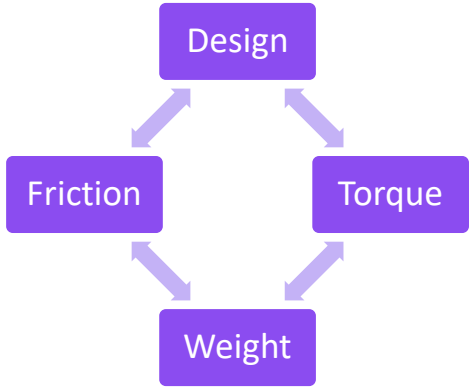
NEMS Projet 1 – Mouvement Perpétuel

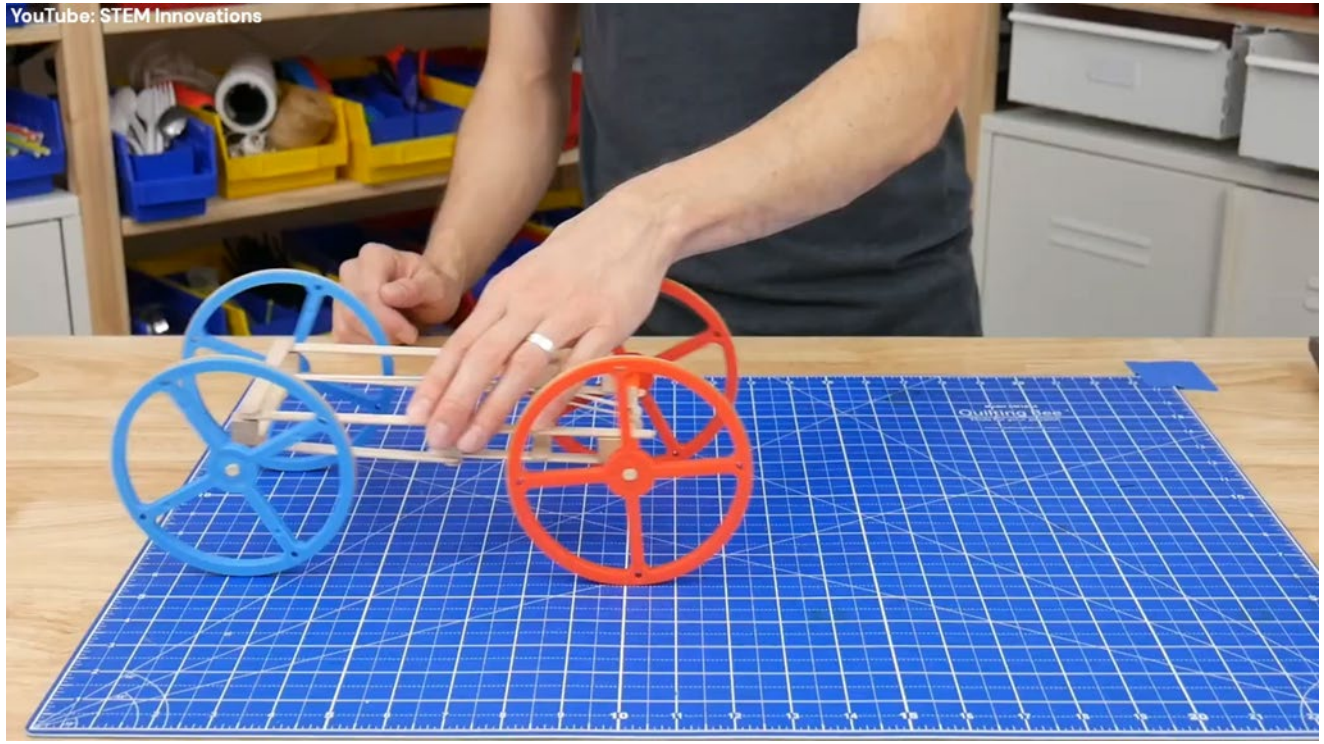
- Mécanique: Conception et construction du système
- Electronique: Construire l'électronique impliquée pour détecter la balle et activer l'électro-aimant au moment précis.
- Compétition

Max. 4 Groupes – 3-4 personnes par groupe approx.

Guillermo.Villanueva@epfl.ch

NEMS Projet 2 – Rubber car challenge





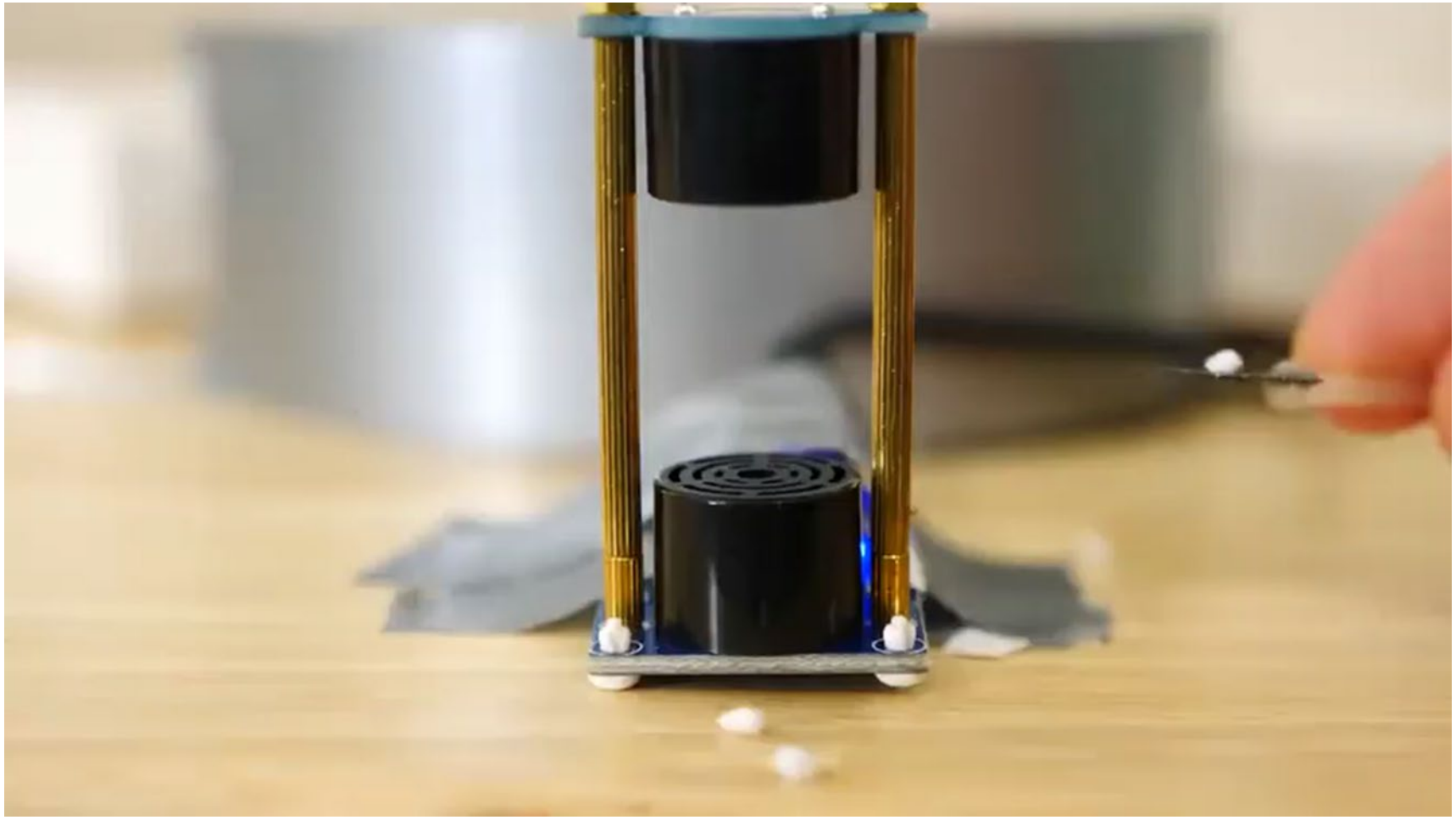
- Propulser une voiture à l'aide d'élastiques
- Objectif : parcourir la plus grande distance possible
- Compétition

P.I.S. 2024: 150m!!!!

Max. 4 Groupes – 3-4 personnes par groupe approx.

Guillermo.Villanueva@epfl.ch

NEMS Projet 3 – Acoustic levitation



- Analyse de la cavité acoustique
- Conception et construction du système

Guillermo.Villanueva@epfl.ch

Max 4 Groupes – 3-4 personnes par groupe approx.

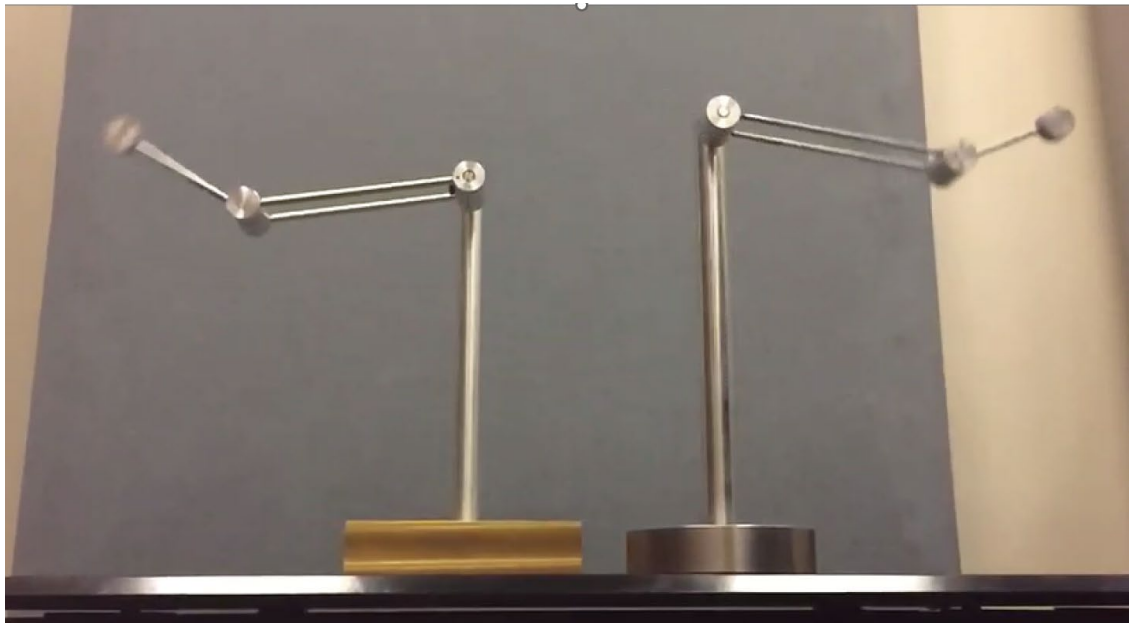
NEMS Projet 4 – Toupie

- Conception, Analyse, Calcules
- Construction
- Test
- Compétition

Max 4 Groupes – 3-4 personnes par groupe approx.

Guillermo.Villanueva@epfl.ch

NEMS Projet 5 – Double Pendulum



- Analyser le mouvement → numérique par python//matlab
- Conception du système, Construction
- Tester en régime lineaire (petits angles) ET non-lineaire//chaotique

Guillermo.Villanueva@epfl.ch

Max 4 Groupes – 3-4 personnes par groupe approx.

NEMS Projet 6 – Échecs (pas dans le cours)

- Conception du mécanisme
- Design des pièces
- Fabrication
- Tester

Max 4 Groupes – 3-4 personnes par groupe approx.

Guillermo.Villanueva@epfl.ch

NEMS Projet 7 – Logo Renforcé

- Analyse de structure
- Identification des points faibles
- Renforcement
- Supporter au moins 150 kg
- Pour votre Bagistrale 2026

Max 4 Groupes – 3-4 personnes par groupe approx.

Guillermo.Villanueva@epfl.ch

For questions…

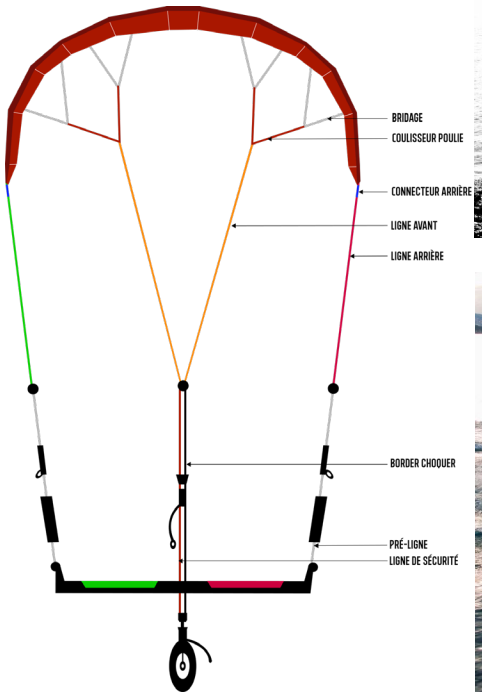


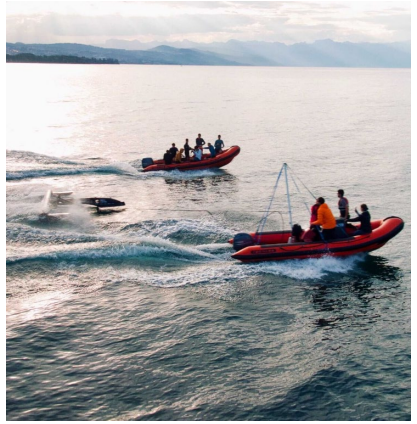
- Mercredis
  - 10.12 ou 17.12
  - CE 1 104
  - 14-16h (série d’exos de Mec Vibra)

- By email:
  - Guillermo.Villanueva@epfl.ch

P – MAKE-Aether

PROJET : Implémentation d'un Amortisseur pour le Prototype V2





Utilisation
- Amortir les sauts de force pour protéger l'aile
- Amortir les forces élevées
- A la manière d'un filtre, avoir une traction la plus continue possible

Besoin
- Réutilisable sur d'autres prototypes
- Robuste
- Résistance en milieu marin
- Montage et Démontage Facile
- Sécurité

Travailler sur l'optimisation
- Poids et Taille à optimiser

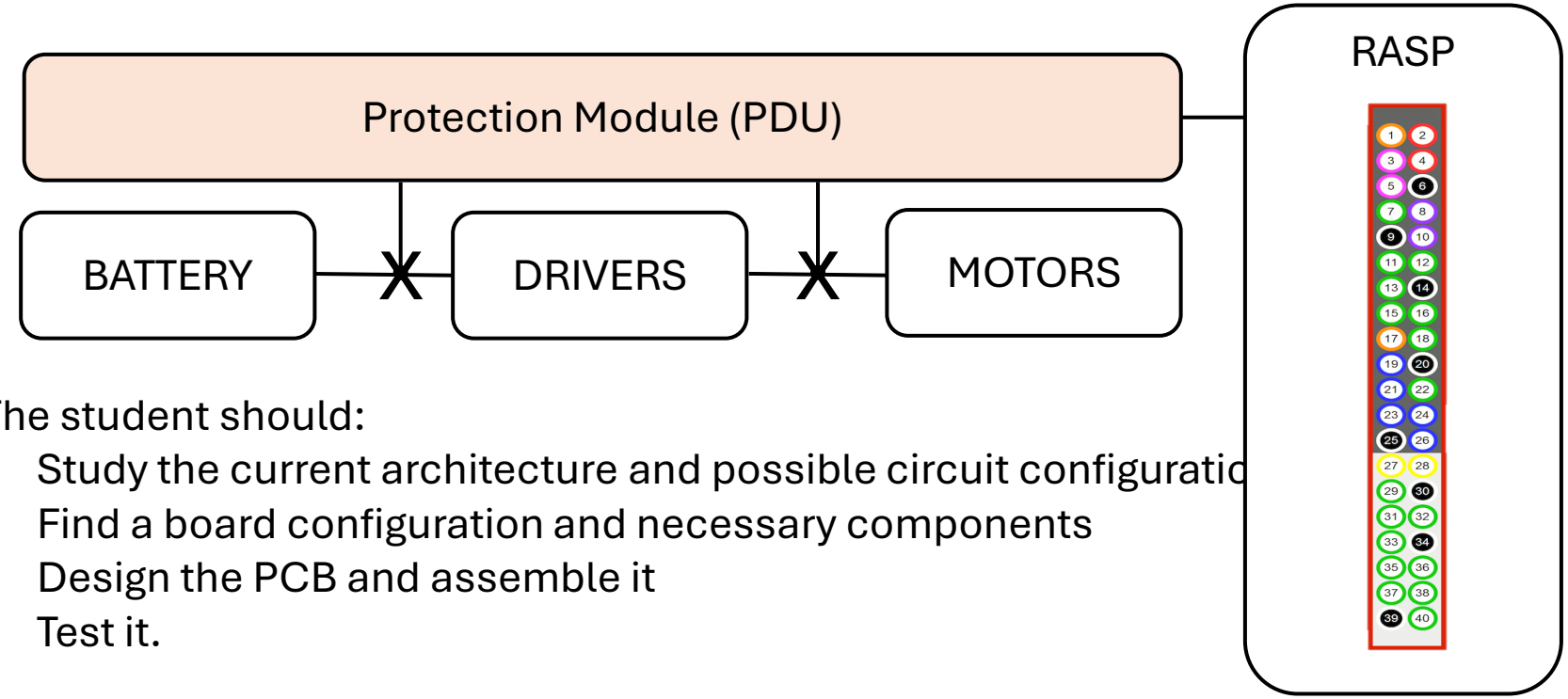
Conception
- Produire les pièces nécessaires pour l'amortisseur
- Assemblage des différents composants

Superviseur : Philippe Mullhaupt

Power Delivery Unit (PDU) board

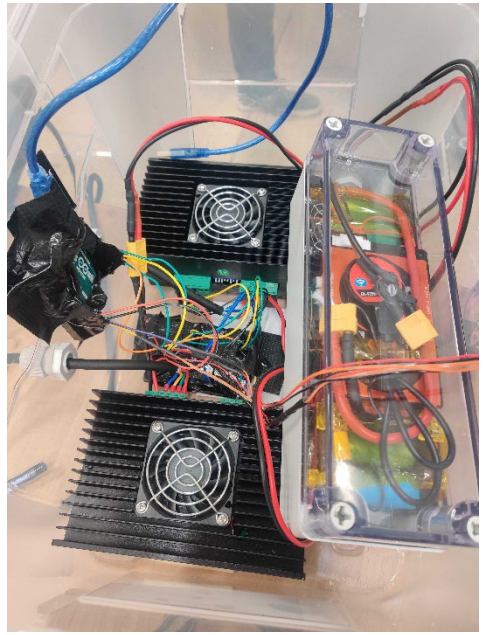
Design a protection board for the V1. This board should:

- Accept digital control input from the Raspberry
- Safely disconnect the 48VDC, 100A max battery, either digitally or with a switch
- Safely disconnect the DC motors and manage the back EMF creating +200V back voltages.
- Integrate all nexessary safety features



The student should:

- Study the current architecture and possible circuit configuratic
- Find a board configuration and necessary components
- Design the PCB and assemble it
- Test it.



This project is mostly analogic-electronics oriented and does not require to code firmware.

Power Delivery Unit (PDU) board

Potentials improvements :

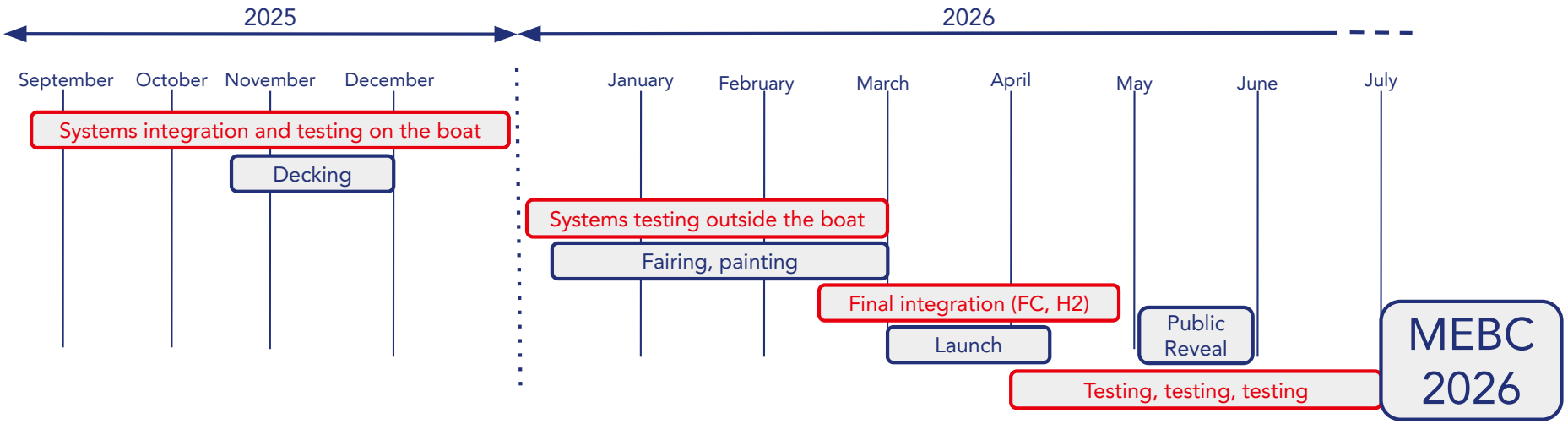
- software control
- current and voltage monitoring (arduino)
- prevent High Inrush Current

Q – MAKE-SwissSolarBoat

Swiss Solar Boat

The Renewable Energy Foiler (REF)

Timeline for this year



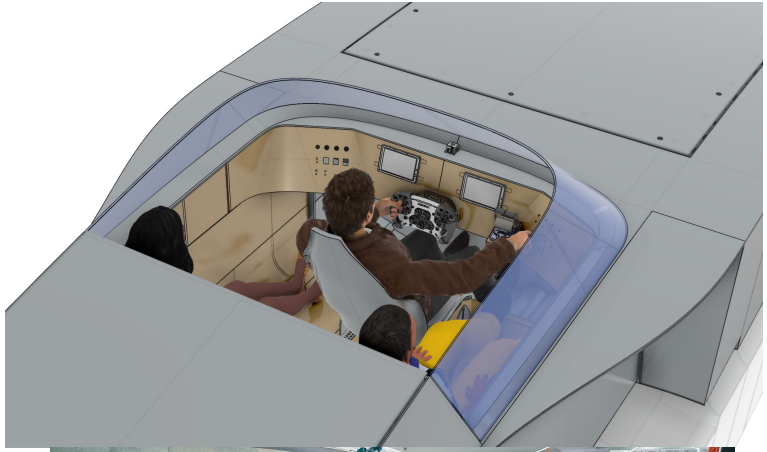
1. Cockpit

- Windshield design and production
- Dashboard production + integration
- Rear view mirror design + production
- Finishing and details

Complete project

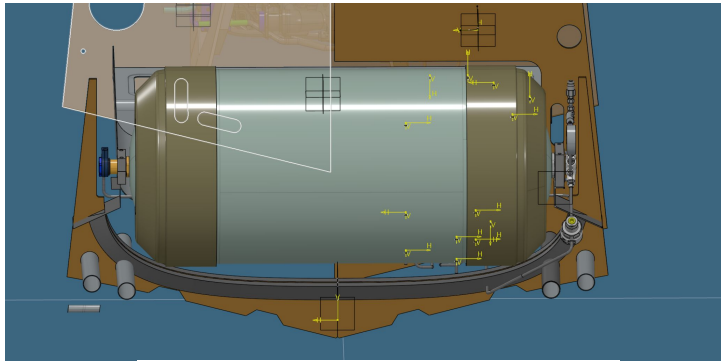
Very good autonomy and practical thinking needed

Very tight deadlines



2. Electronics and Energy Systems integration

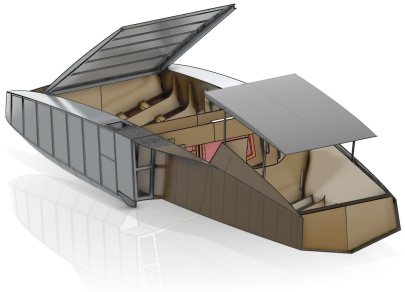
- Mast (lights/antenna) design+ production
- Battery support design (FEM) + production
- Photovoltaics panels integration
- Hoods integration



Complete project

Very good autonomy and practical thinking needed

Very tight deadlines



3. Boat testing and procedures

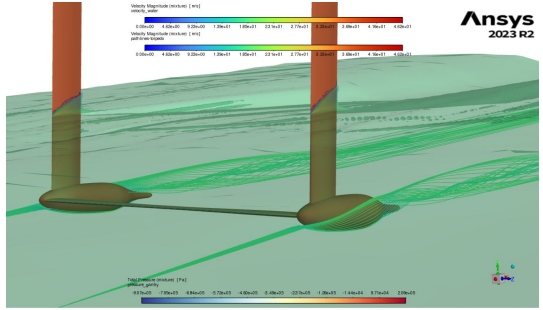
- Redaction of all the procedures for boat operation (craning, watertightness testing, road preparation)
- Design and production of all the custom parts for the boat operations and logistics (torpedo support, custom boxes…)

- Vast project

Very good autonomy and reaction needed

4. Hull CFD

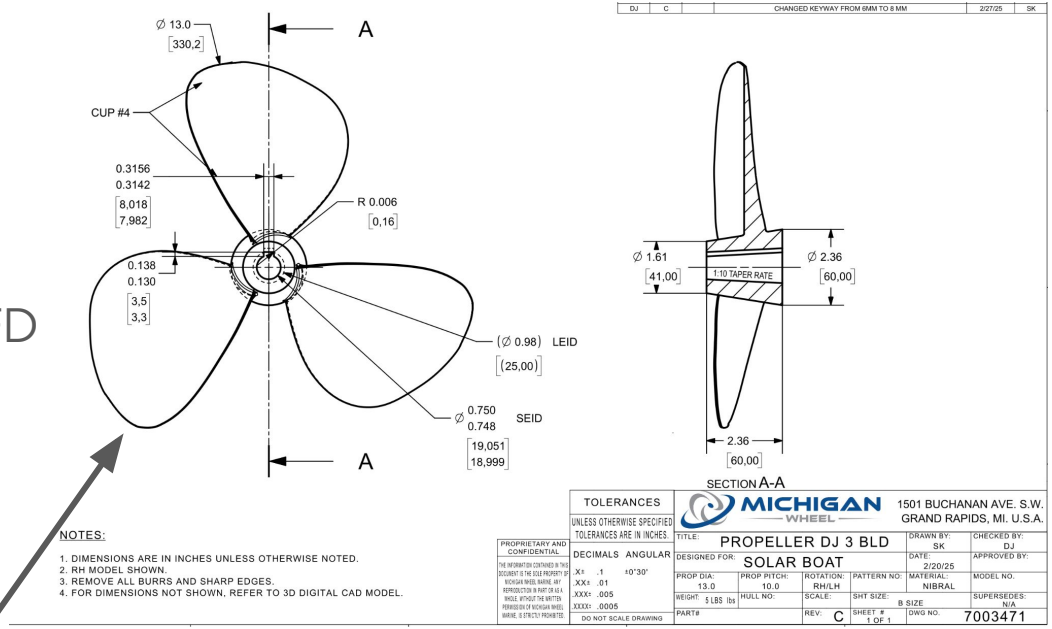
Until now the focus was on the foils :

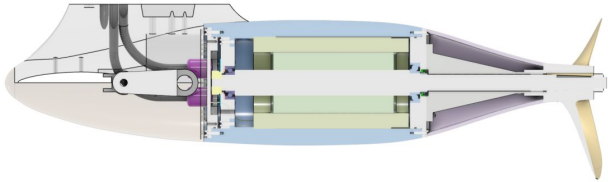


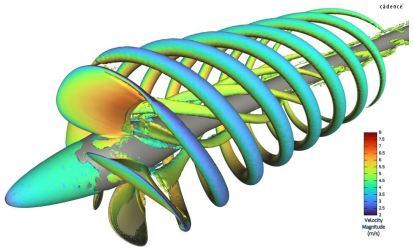
- Very complex problem
- Objective : Create a working CFD of the hull to understand archimedean and take-off characteristic (<15 kts)
- Check for suction effects and how to mitigate them.
- Verify CFD with real world data

5. Propeller CFD

- Very complex problem
- Objective : Create a working CFD model of the propeller to begin the optimization
- Verify CFD with real world data

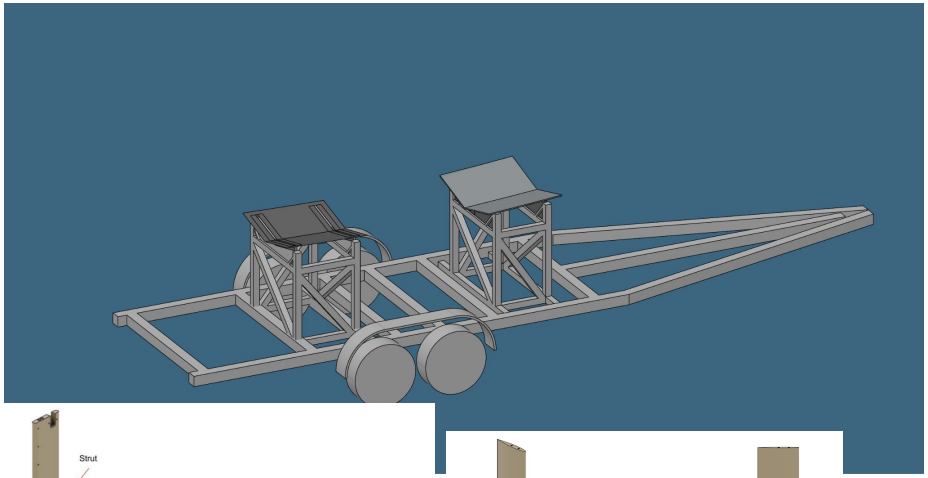


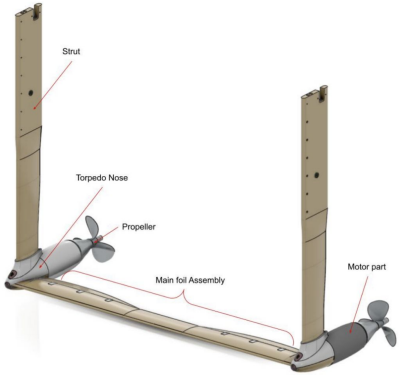


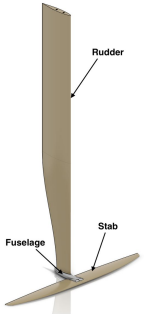


6. Trailer preparation/boat protection

- Design of storage compartments on the trailer
- Creation of boat, foil and torpedo covers for manipulation and transport





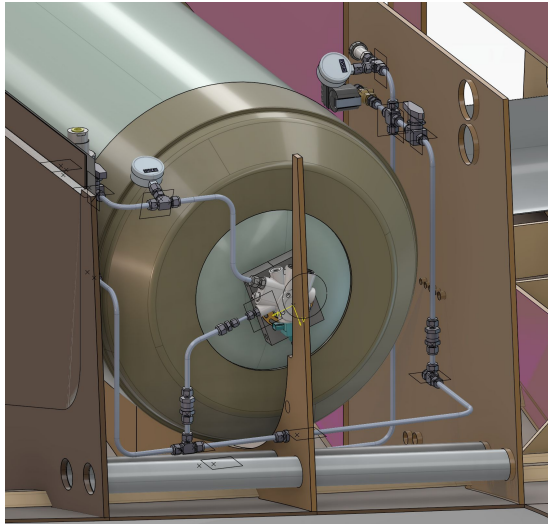


7. Electronic steering system

- Design a custom and lightweight force-feedback steering system
- Calibrate motor parameters to achieve desired feeling
- Prepare for the integration on the boat

Good electronic and mechanical background needed

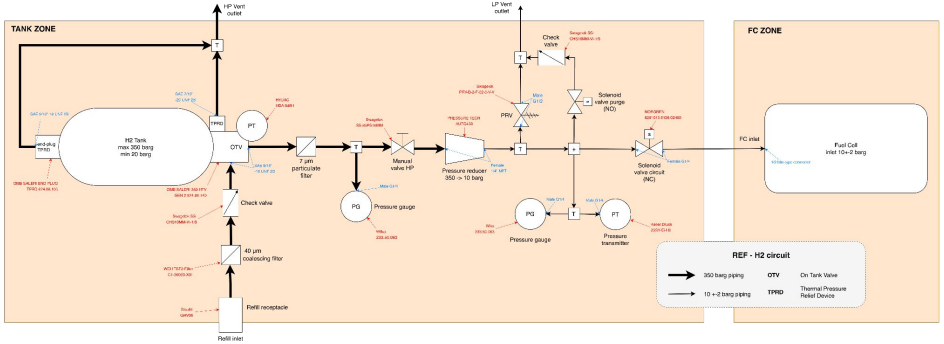
8. H2 Preparation and operation



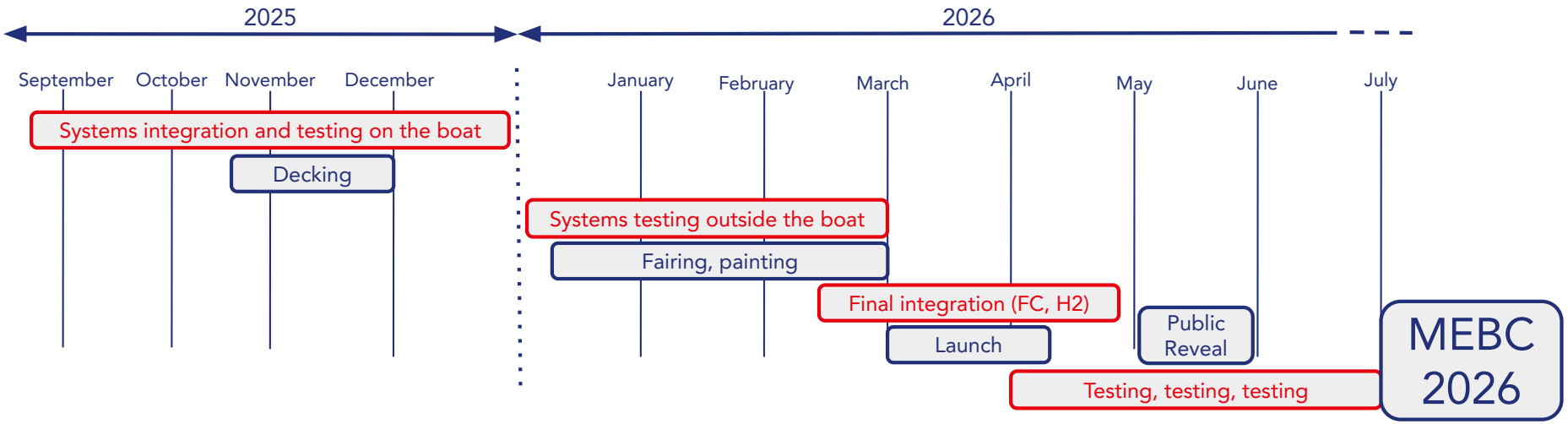
- Redaction of all safety procedures
- Piping assembly
- Overpressure testing of the H2 piping system
- System integration
- Testing and data analysis

Requires extremely rigorous students

Multiple aspect are concerned



Timeline for this year



Swiss Solar Boat

Thank you! Questions?

R – MAKE-RacingTeam

EPFL RACING TEAM

Formula Student

Worldwide engineering competition

600+ Teams
3 categories
30 countries

Innovation focused competition

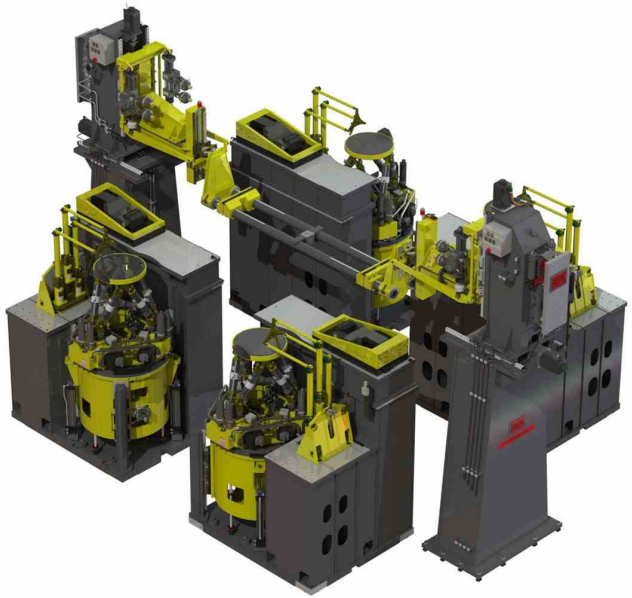
Mechanical Systems and Kinematics

Design of a Suspension Kinematics and Compliance Testing Rig

La conception d'un banc de test pour suspension pour valider les résultats théoriques kinematics & compliance

Compétences et acquis de formation:

- *Conception mécanique*
- *Dynamique du véhicule et cinématique de suspension*
- *Analyse de données Kinematics & Compliance*
- *Outils CAO et simulation*



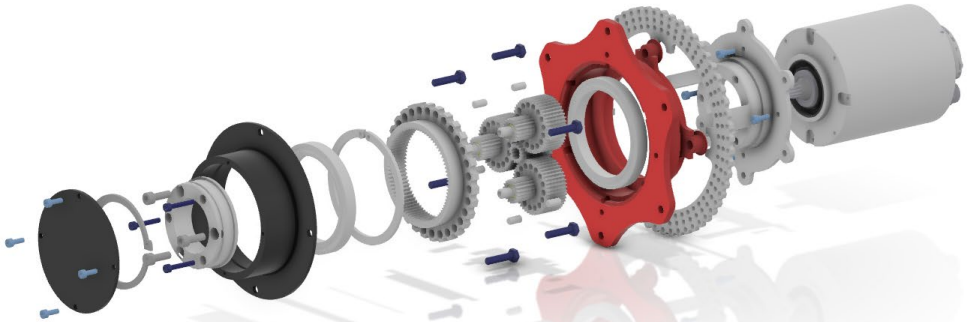
Mechanical Systems and Kinematics

Wheel-Assembly

Design d’un Wheel Assembly pour une voiture de Formula Student. Le Wheel assembly est un des sous-systèmes le plus important de la voiture, c’est à travers lui que toutes les forces générées par le moteur sont transmises au sol.

Compétences et acquis de formation:

- *Conception mécanique*
- *Dimensionnement d’engrenages*
- *Conception assistée par ordinateur*
- *Analyse par éléments finis (FEM)*



Mechanical Systems and Kinematics

Conception du système de direction

Le système de direction permet au pilote d'amener la voiture là où il le souhaite. En plus de la colonne et du rack, un système permettant de coupler un moteur électrique permet d'assurer la conduite autonome de la voiture.

Compétences et acquis de formation:

- *Travail sur les différents moyen de transmission et transformation du mouvement*
- *Réflexion sur les systèmes de découplage*
- *Conception assisté par ordinateur*
- *Simulations FEM*

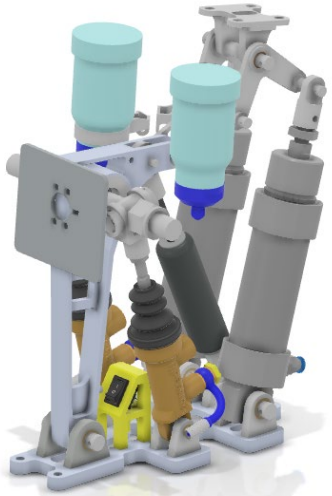
Mechanical Systems and Kinematics

Conception du système de freinage

Le système de freinage est le premier élément de sécurité de la voiture. Il regroupe la pédale et les étriers, ainsi que le système pneumatique de freinage d'urgence (spécifique au driverless).

Compétences et acquis de formation:

- *Conception de systèmes impliquant des conduits hermétiques à haute pression*
- *Réflexion autour de la structure des pistons*
- *Conception assisté par ordinateur*
- *Simulations FEM*



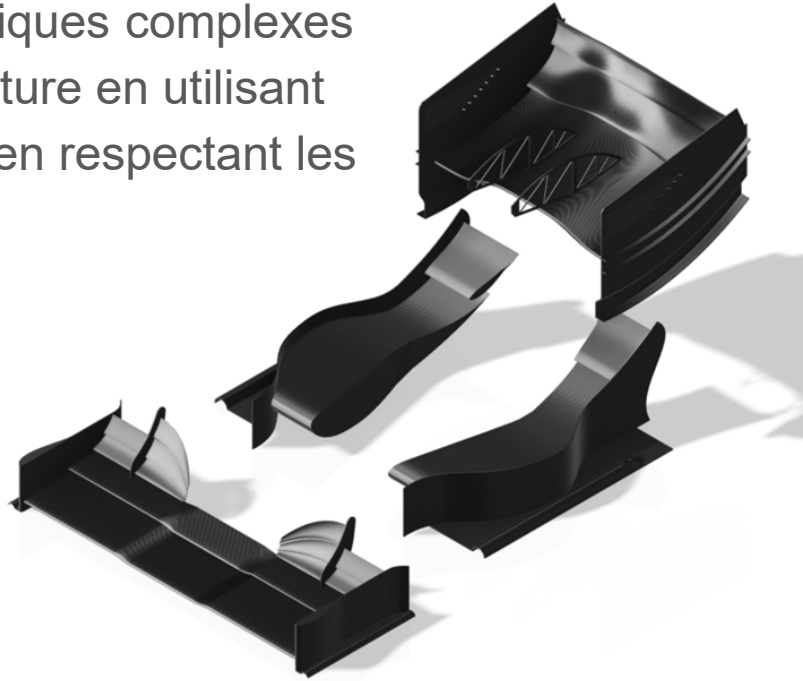
Aérodynamique

Design Front Wing & Rear Wing

Concevoir et optimiser deux pièces aérodynamiques complexes pour améliorer la performance globale de la voiture en utilisant des logiciels de CAO, des simulations CFD, et en respectant les règles Formula Student.

Compétences et acquis de formation:

- *Modélisation CAO de géométries complexes*
- *Simulations CFD fiables*
- *Interpréter les résultats et ajuster les designs*
- *Respects des règles de la Formula Student*



Châssis

Conception de jantes en carbone pour une monoplace de Formula Student

Concevoir un set de jantes en fibres de carbone et optimiser le layup composites par itération à l'aide de simulations structurelles.

Compétences et acquis de formation:

- *Conception assistée par ordinateur*
- *Conception selon un cahier des charges*
- *Simulations structurelles de composites*
- *Interprétation et validation de résultats de simulations*

Merci pour votre attention

epfl-racing-team@epfl.ch

EPFL RACING TEAM