A – lab FLEXLAB

Da Vinci-inspired Design Challenge

SGM - Projet d'ingénierie simultanée 2024-2025

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.

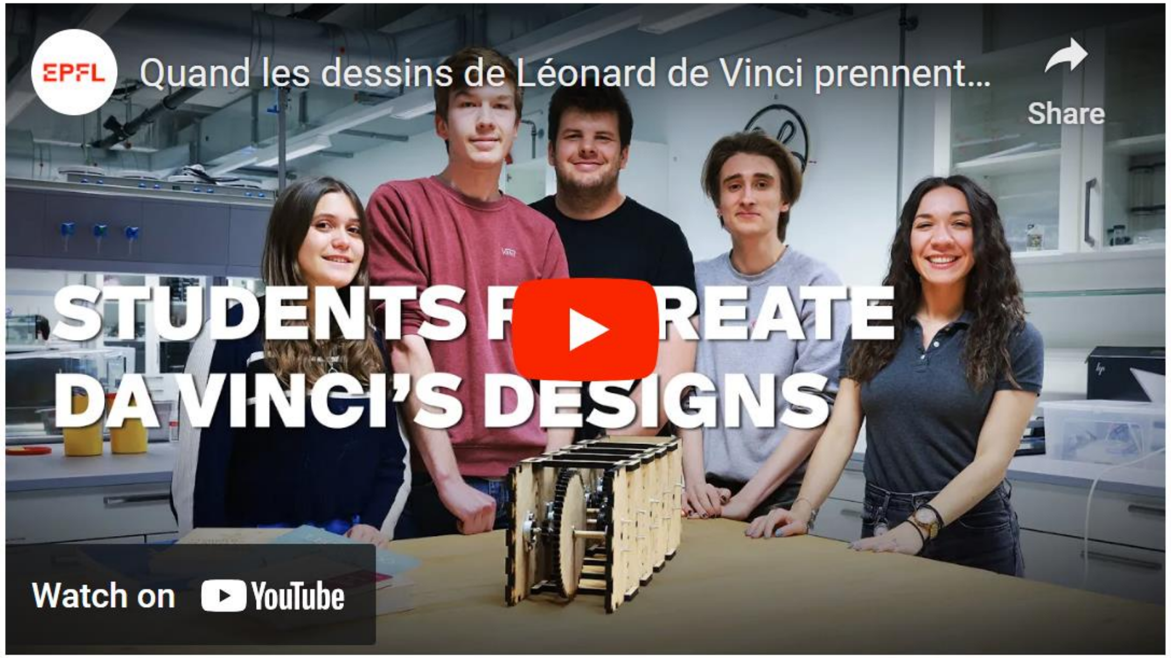
Up to 3 teams of 6 students. Open-ended project. Lab work will take place at DLL.

Flexible Structures Laboratory – IGM.

Contact: pedro.reis@epfl.ch

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

Bringing Leonardo da Vinci's designs to life



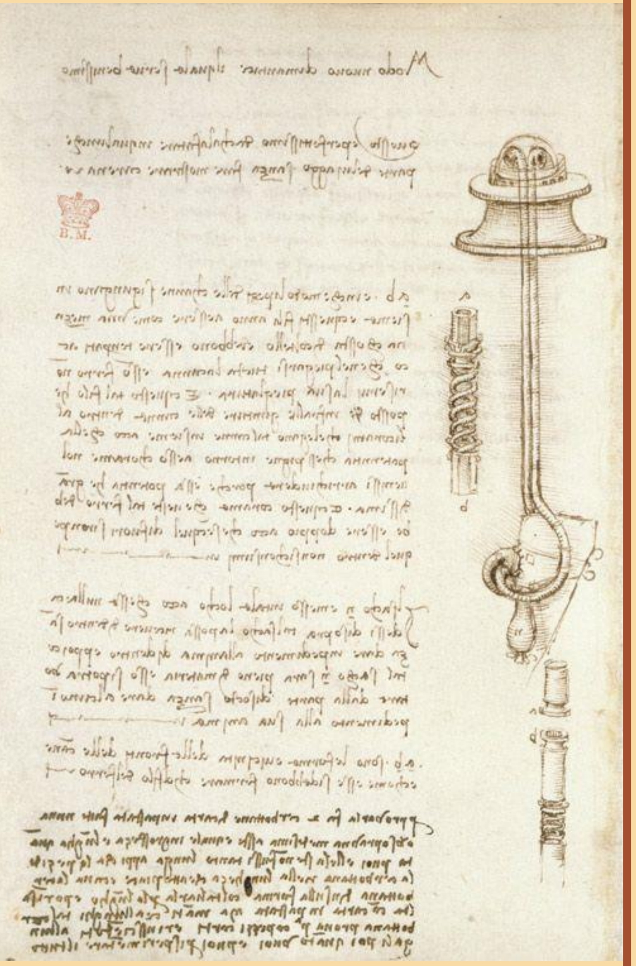
STUDENT PROJECTS - Fourteen mechanical engineering students spent a semester getting inside the head of Leonardo da Vinci. Using his drawings from the 15th and 16th centuries, the teams built ingenious machines – altering the design in some cases – in order to better understand how they worked.

03.07.23

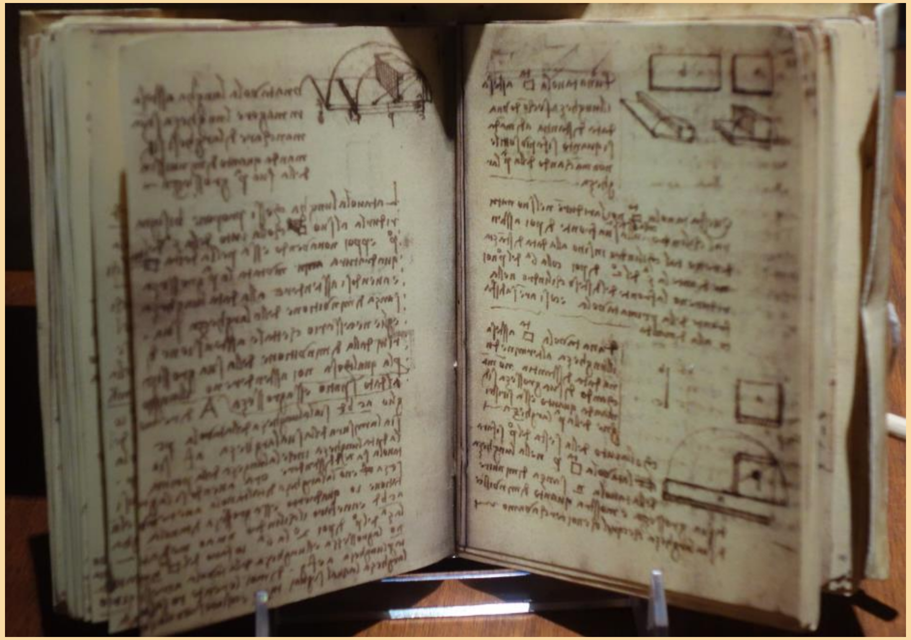
TAGS

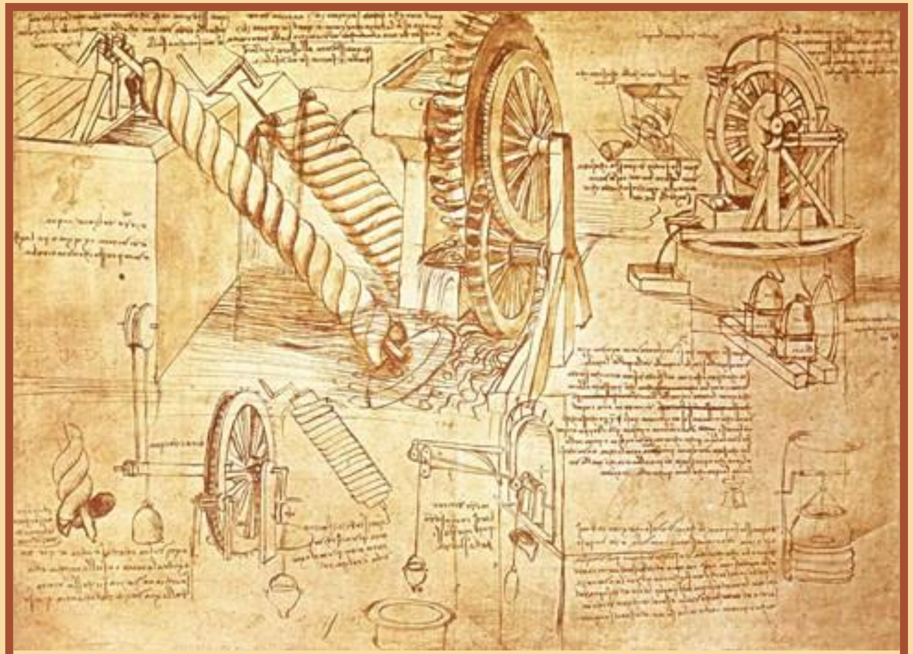
CIS | design | electrical engineering | engineering | ERC | mechanics | rehabilitation | students | summer series

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.



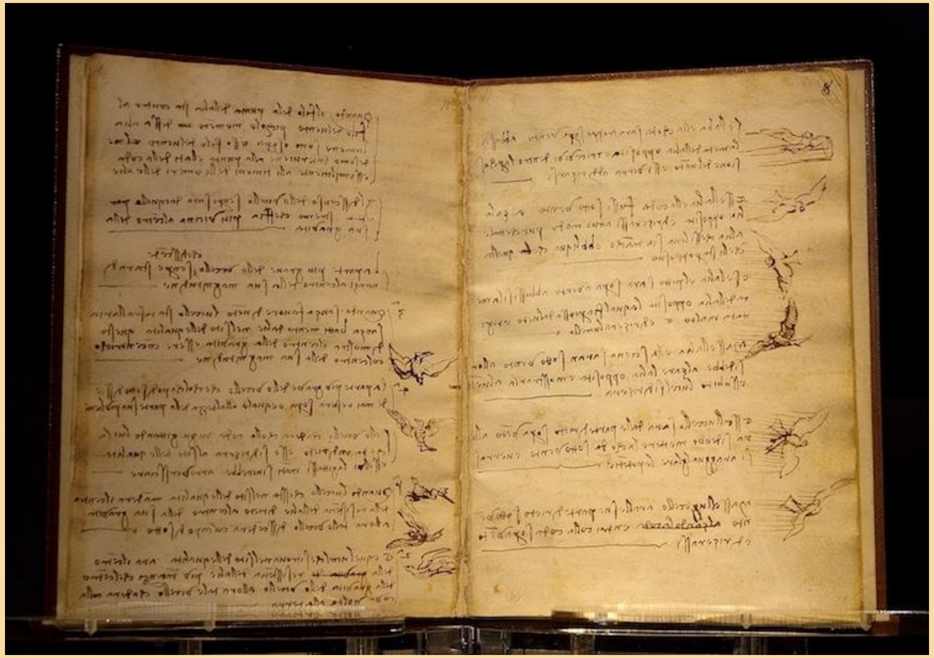
The *Forster Codex* (1487-1505) is made up of five pocket notebooks that have been bound into three volumes. Inside, Da Vinci explores **geometry, hydraulic engineering, theory of proportions, topology**, and more. The physical copy is held in the Victoria and Albert Museum in London.



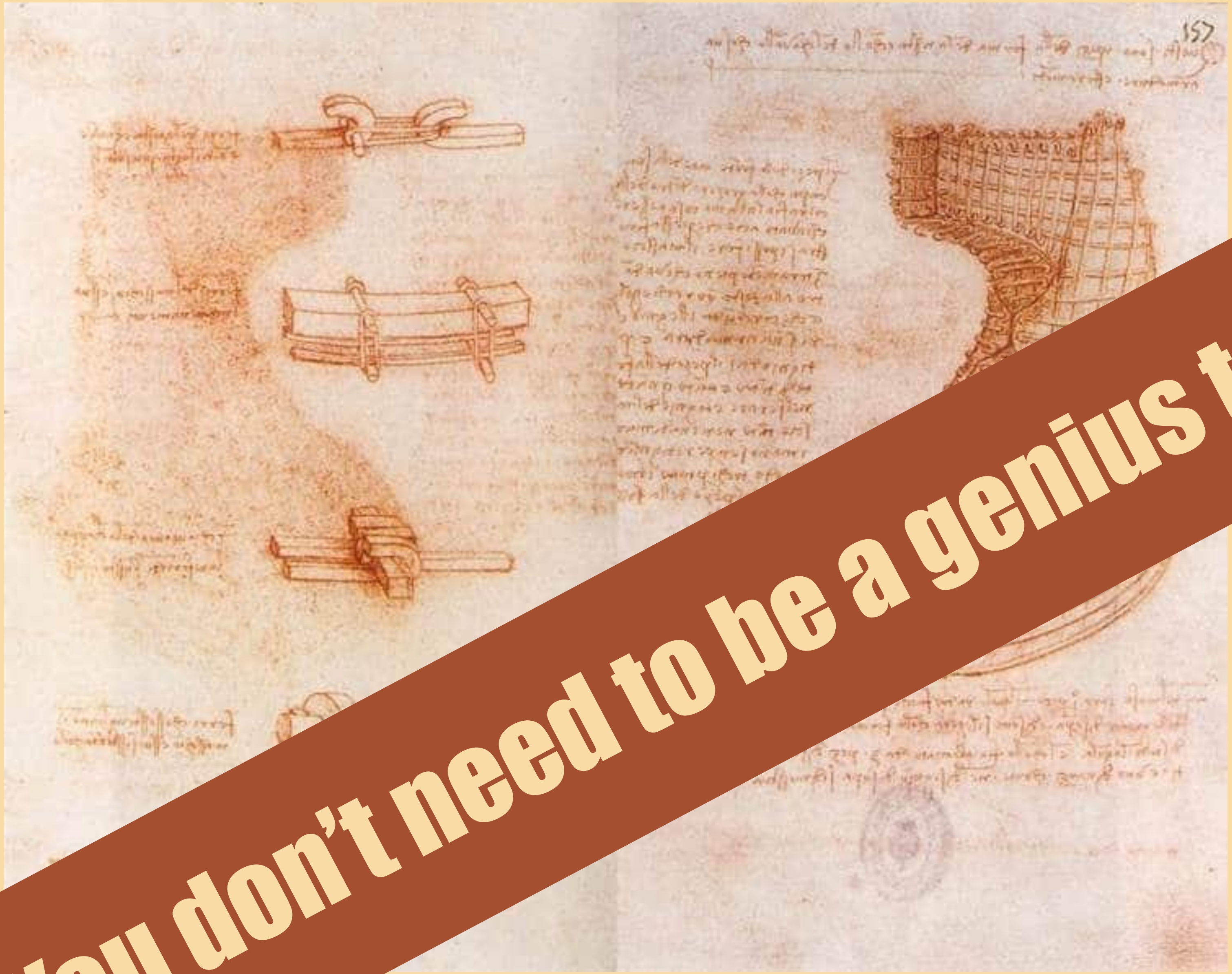


The *Codex Atlanticus* (1478-1519) is the largest single collection of drawings and writings by Da Vinci. It includes content about **weaponry, musical instruments, mathematics, botany**, and more across 1,119 leaves of paper. The entire codex spans Da Vinci's career through Florence, Milan, Rome, and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



The *Madrid Codice*…
the most im…
refined…
…science of
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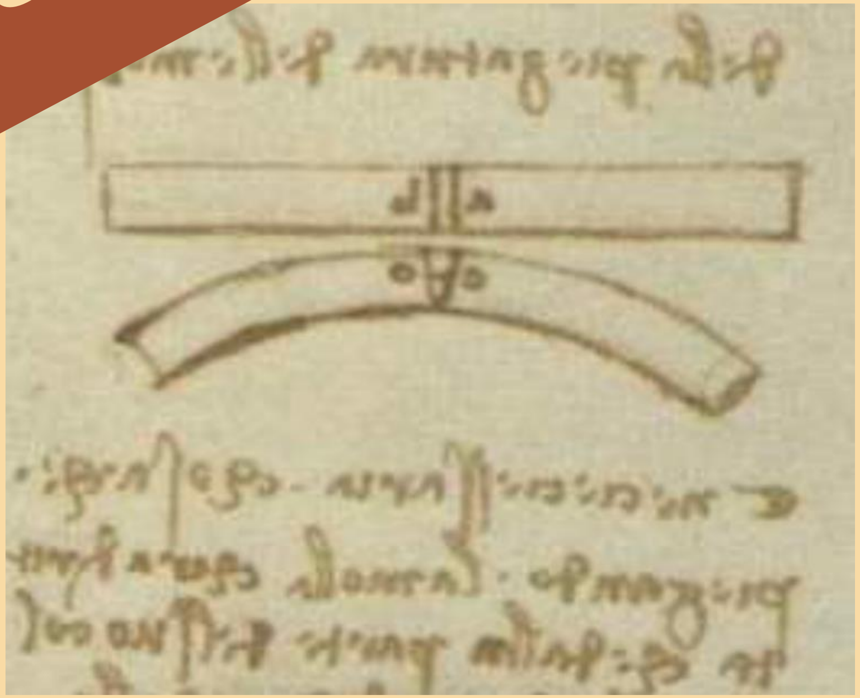
…Nacional de España.



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

…rdo-da-vinci-notebooks-online/

B – lab NEMS

Advanced NEMS Lab
Lab projects

École
polytechnique
fédérale
de Lausanne

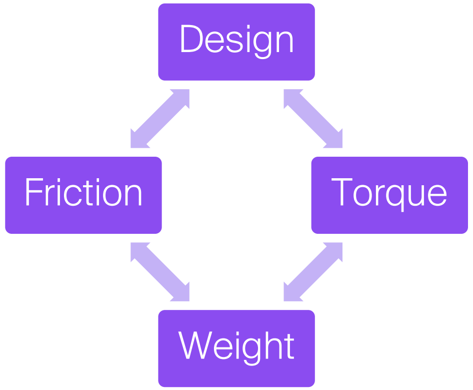
NEMS Projet 1 – Mouvement Perpétuel

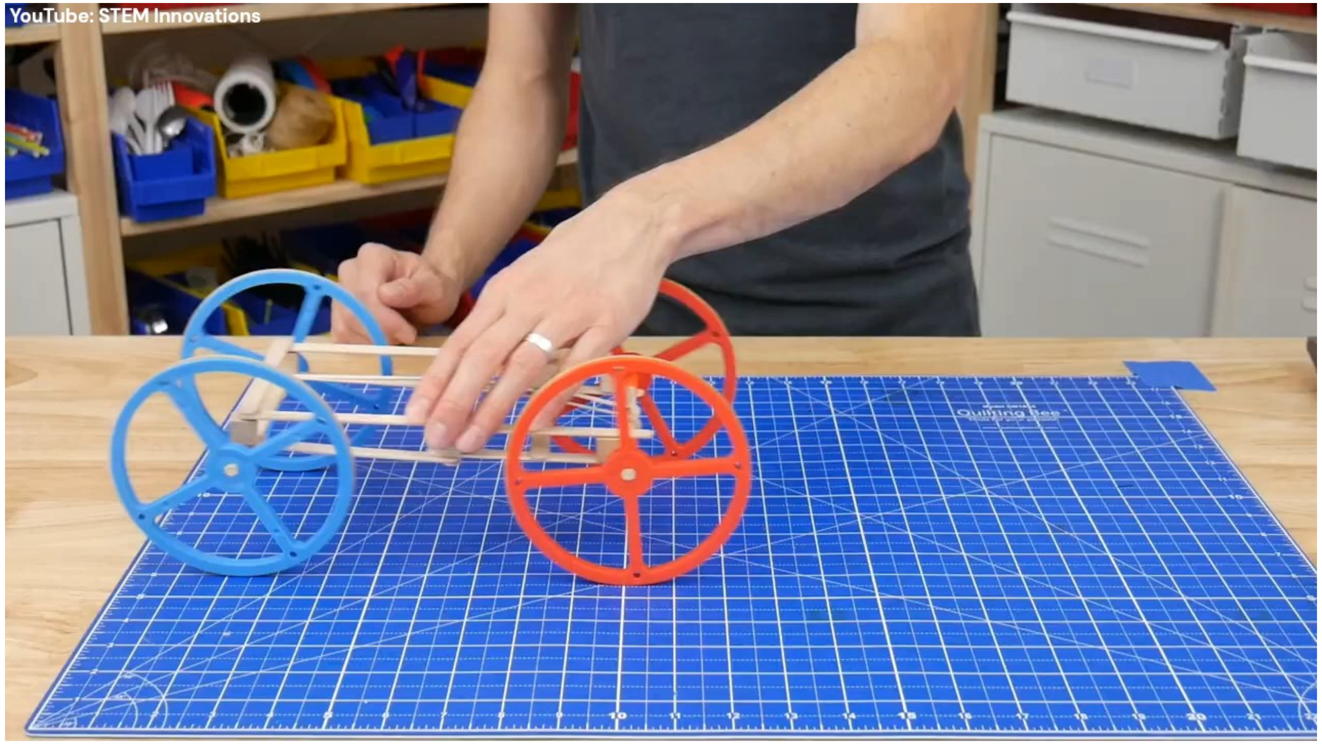
- Mécanique: Conception et construction du système
- Electronique: Construire l'électronique impliquée pour détecter la balle et activer l'électro-aimant au moment précis.

Guillermo.Villanueva@epfl.ch

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

NEMS Projet 2 – Rubber car challenge





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

Année passée: 150m!!!!

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

Guillermo.Villanueva@epfl.ch

NEMS Projet 3 – «Fusée»

- Conception et construction du système
- Analyse aérodynamique du système
- Soft landing!!!!

Guillermo.Villanueva@epfl.ch

Max 5 Groupes – 3-4 personnes par groupe approx.

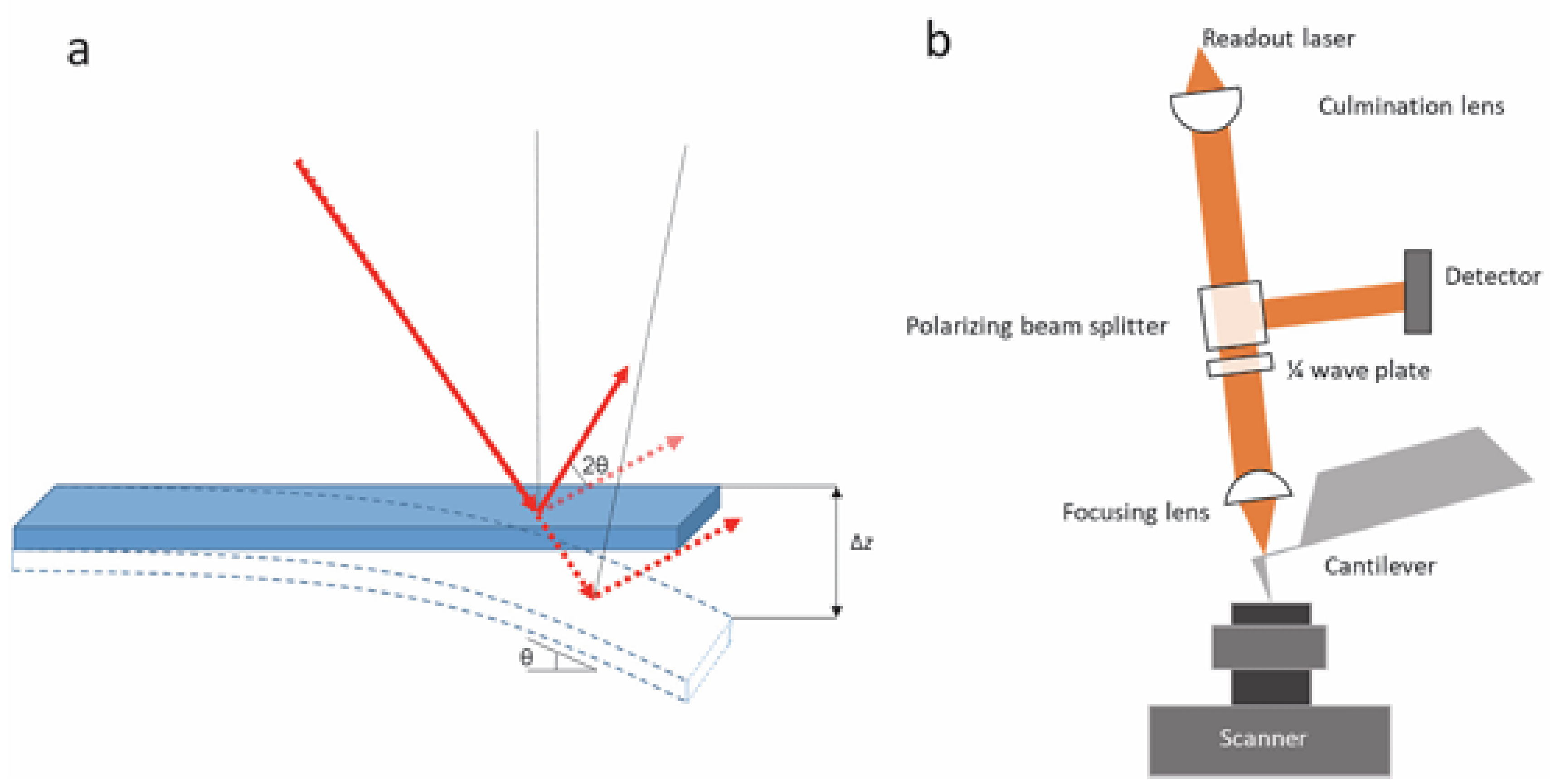
NEMS Projet 4 – Plaques vibrantes

- Design & Fabrication de plusieurs montages expérimentales
- Simulations par éléments finits
- On les utilisera l'année prochaine en «vibra»
- Plusieurs matériaux, plusieurs types d'excitation,...

Guillermo.Villanueva@epfl.ch

1-2 Groupes – 2-3 personnes par groupe

NEMS Projet 5 – Construction d'un setup exp



- Mesurer le mouvement de poutres en liquide
- Conception et construction du système
- Expériences pour validation

Guillermo.Villanueva@epfl.ch

1 Groupe – 2-3 personnes

For questions...

- Mercredis
  - 14.12 ou 21.12
  - Polydôme
  - 14-16h (série d'exos de Mec Vibra)

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

C – 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.

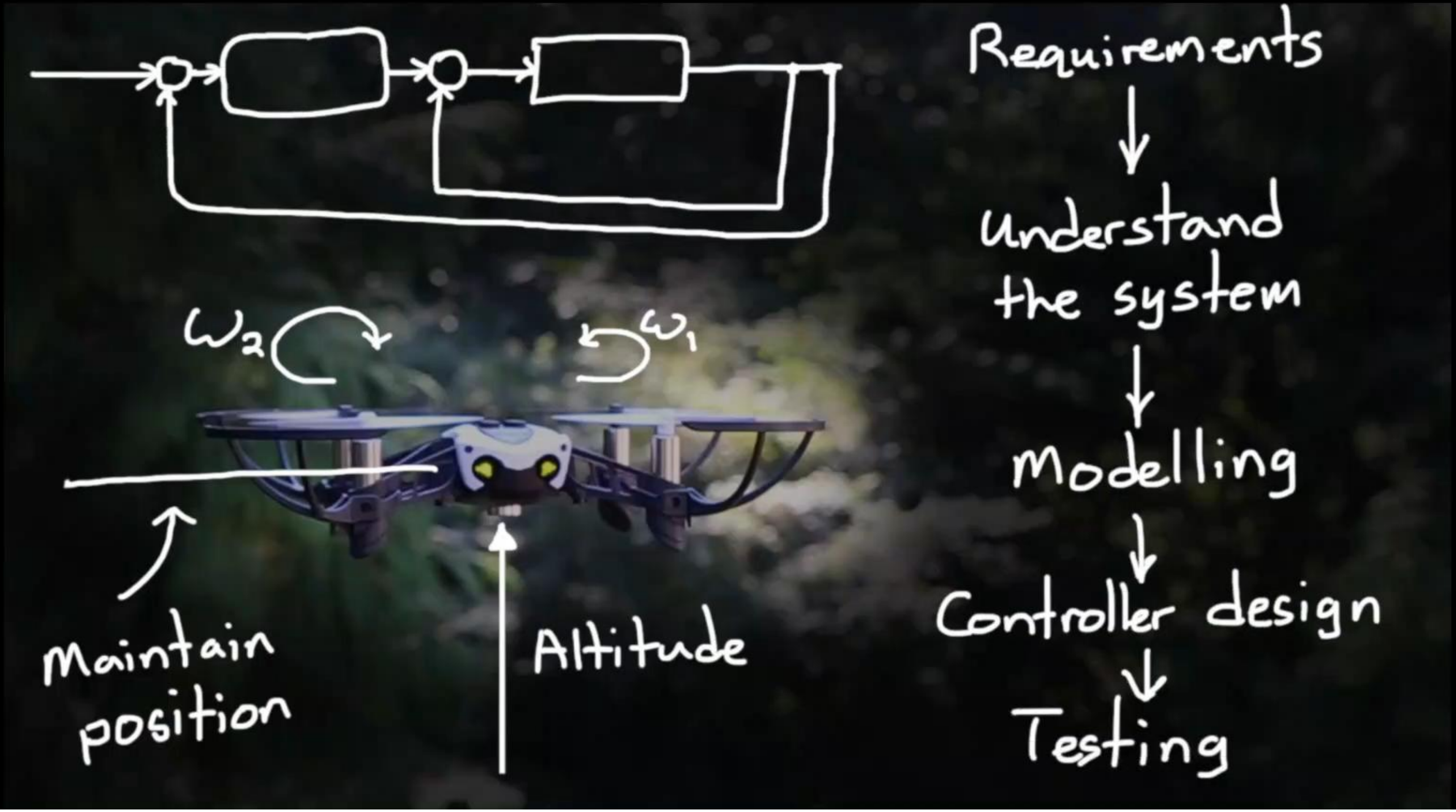
Problem Statements

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



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

D – Lab EMSI

Leaping Latches

PIS pitch - 2024

Kolinski 5.12.2024

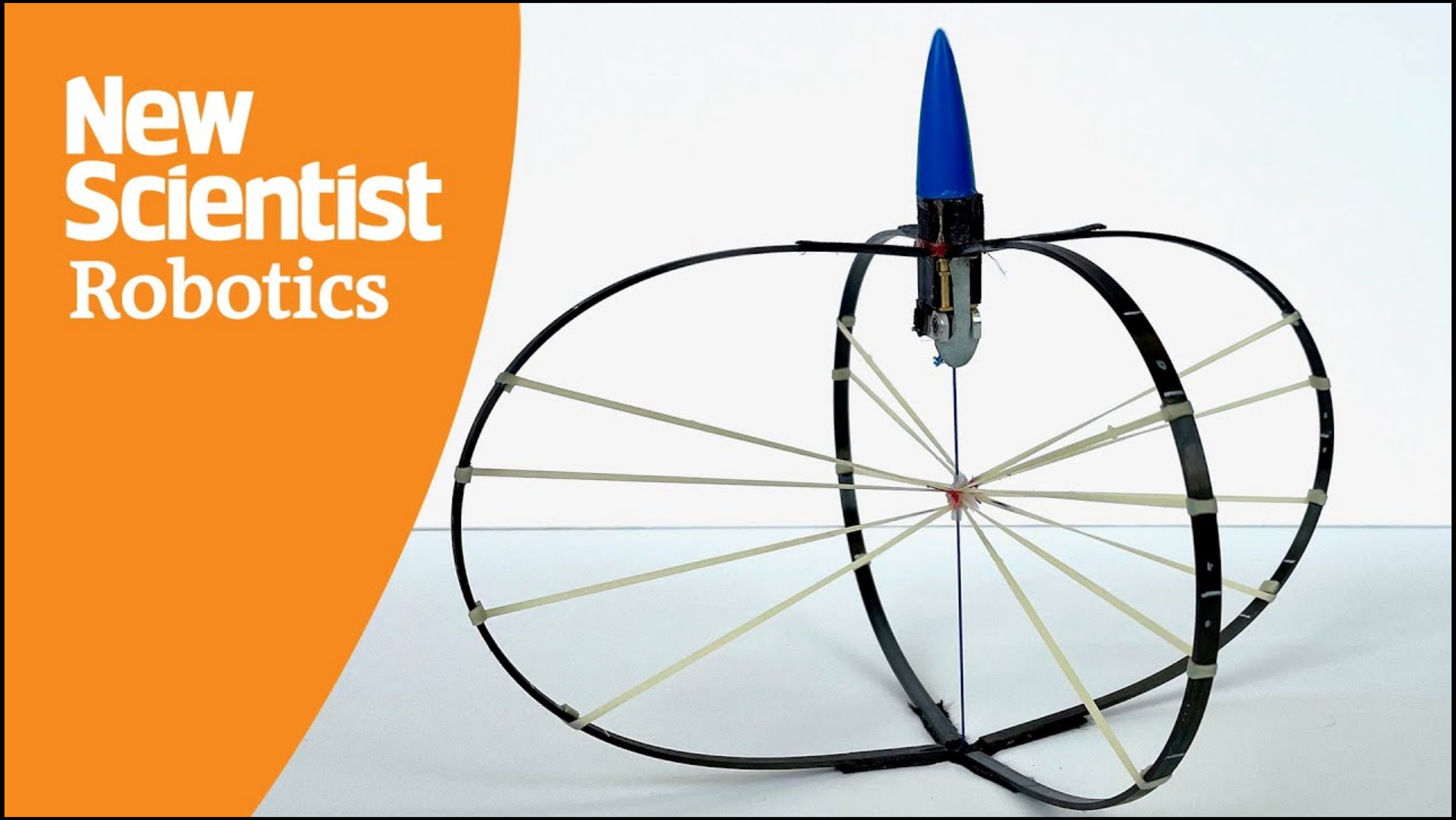
The goal

What is a `leaping latch?’

Example leaping latches

From toys to biology

Video: the Guardian



Video: New Scientist

E – Lab LA

Ingénierie simultanée 2025

Laboratoire d'automatique

christophe.salzmann@epfl.ch

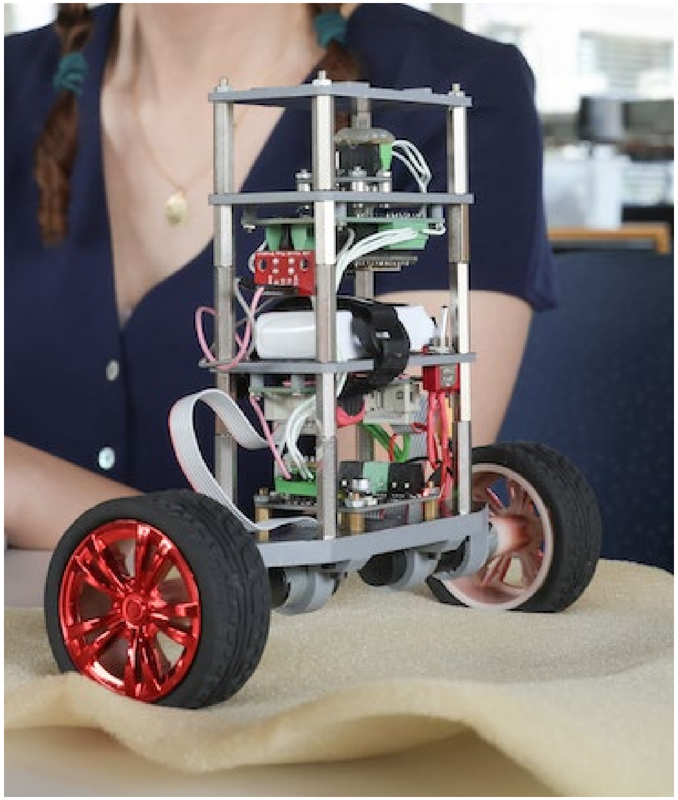
Mini Segway challenge

Multi-years challenge

Year 1 : initial mechanical setup + stand up 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: Vaibhav, Mert

Babyfoot fine control

Improve strategy with moving ball

Programmed in **LabVIEW** !

Nbr etudiants: 2+2

Responsables: Christophe Salzmann

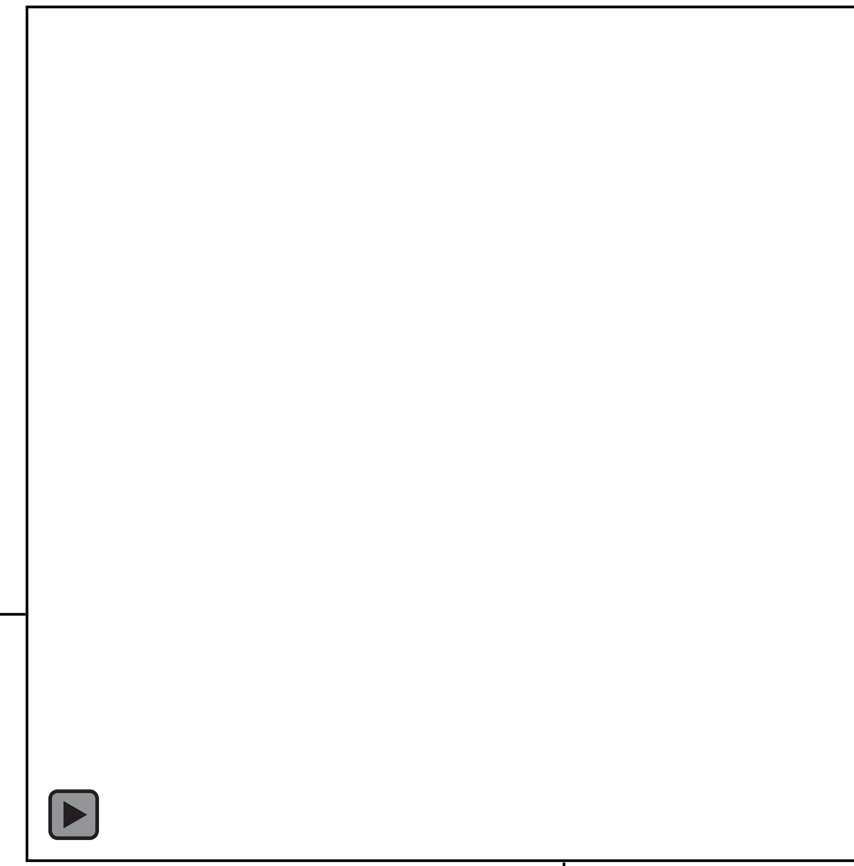
F – lab DECOD

Step-by-Step Locomotion with Neural Controllers

Dependable Control and Decision Group

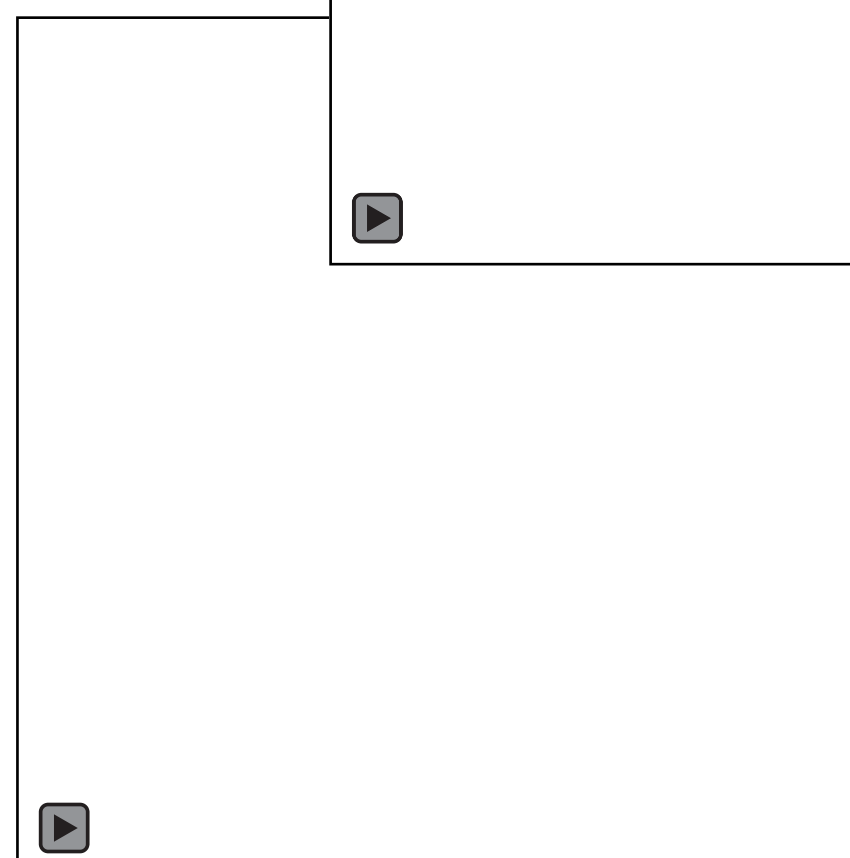
Goal

- Teach a walker how to walk!
- Make sure it doesn't fall

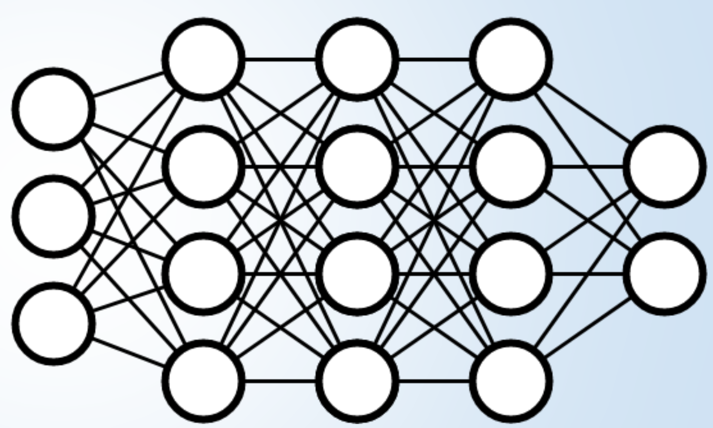


Simulation environment

- MuJoCo: advanced physics simulation
  - Apply forces at joints
  - Observe how the walker moves



How much force?

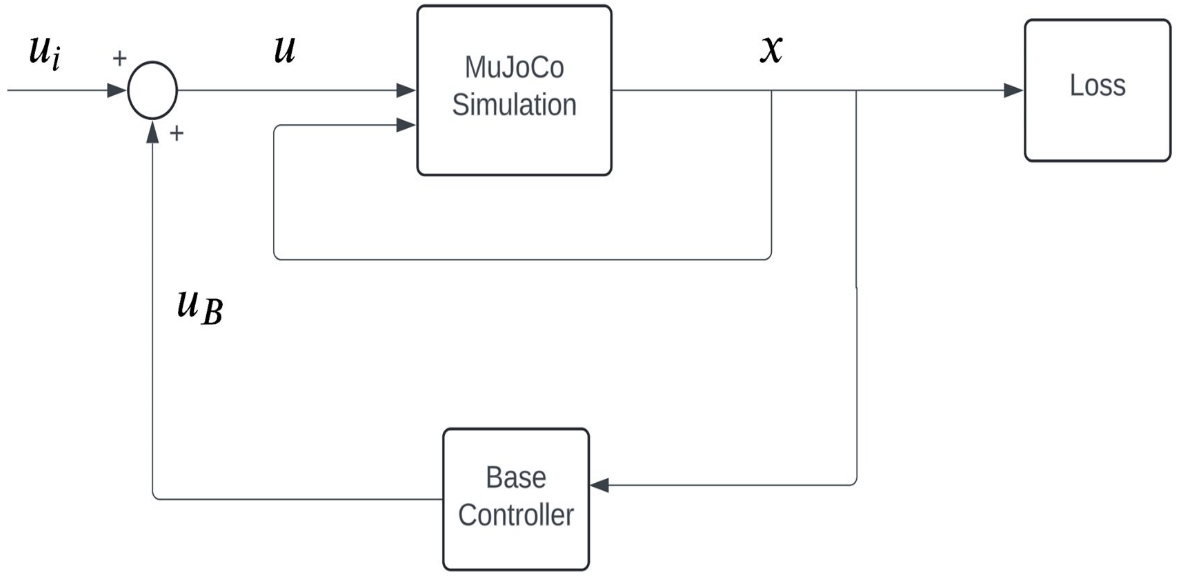


Step-by-Step Locomotion with Neural Controllers

Dependable Control and Decision Group

Methodology: Model-Based Control

- Get a simplified model of the walker
- Train a neural network controller
- Ensure stability ⟶ the walker doesn't fall!



Tasks:

- Understand the simulator
- Implement a stable NN controller
- Experiment with different NN architectures

Team: 3-4 students
Requirements: Basic Python

Supervisor: Prof. Ferrari Trecate
Contact:
mahrokh.ghoddousiboroujeni@epfl.ch
riccardo.cescon@epfl.ch

G – Lab ETA-LAB

Design of vacuum chamber for testing of high performance cooling devices

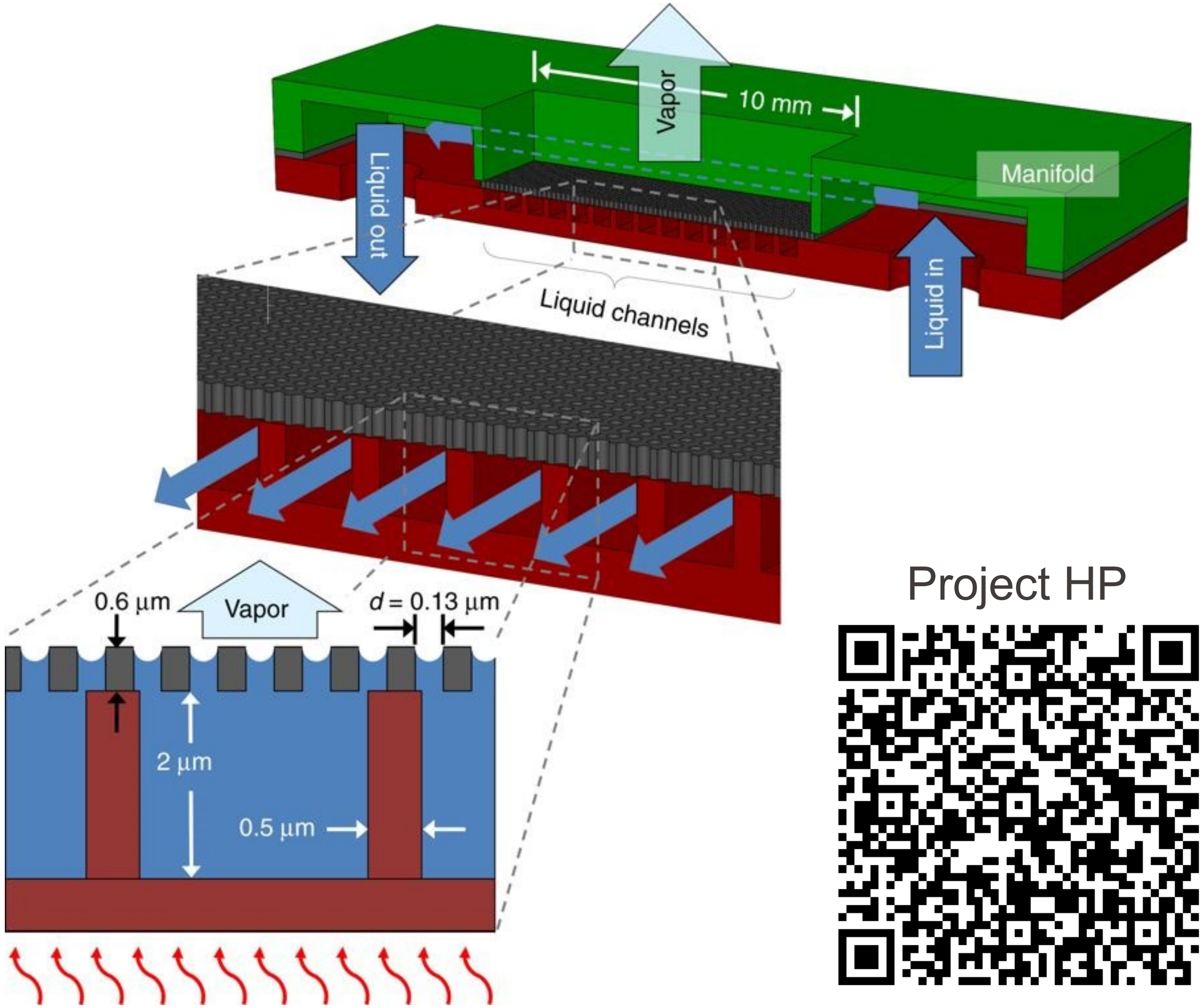
Takehiro Shiraishi, ETA-Lab

Expected activities

- Mechanical design of vacuum chamber
- CAD design in Solidworks

What you can learn

- Practical mechanical design
- Understanding on vacuum systems
- Operation principle of high heat flux cooling devices



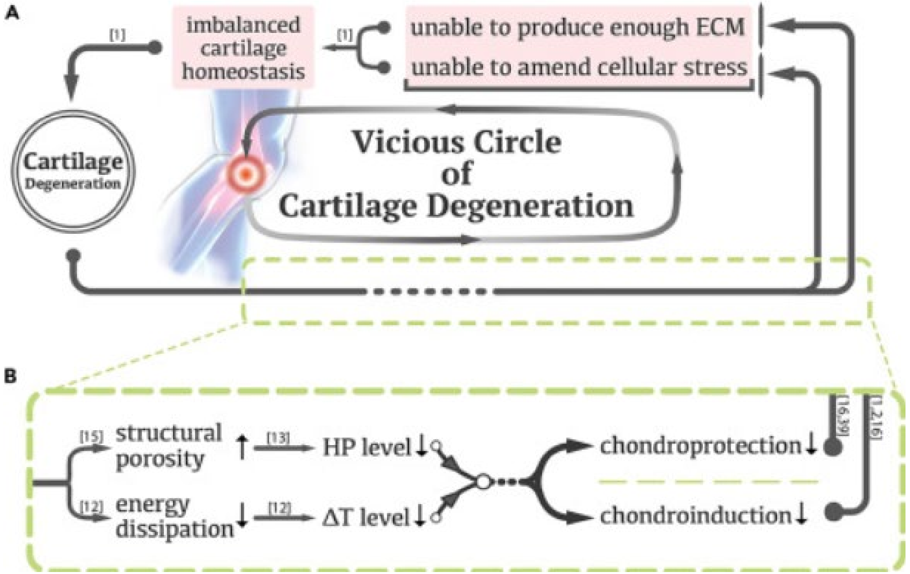
Project HP

H – lab LBO

Breakdown of OA Vicious Circle:
Design of a Mechanical Loading Device

Antoine Reitzel (EPFL-LBO)

- L’arthroses (Osteoarthritis OA) touche entre 20 et 40% des adultes de plus de 40ans aux US.
- Peu affecter toutes les articulations du corps. Le genou est l’articulation la plus touchée par cette maladie.
- Maladie dégénérative de toute l’articulation.
- Touche en particulier le cartilage; tissus peu vascularisé, donc peu emprunt à se soigner.
- N’a pas de traitement. L’arthroplastie du genou est proposée aux patients les plus atteint afin de les soulager.



EPFL

Breakdown of OA Vicious Circle:
Design of a Mechanical Loading Device

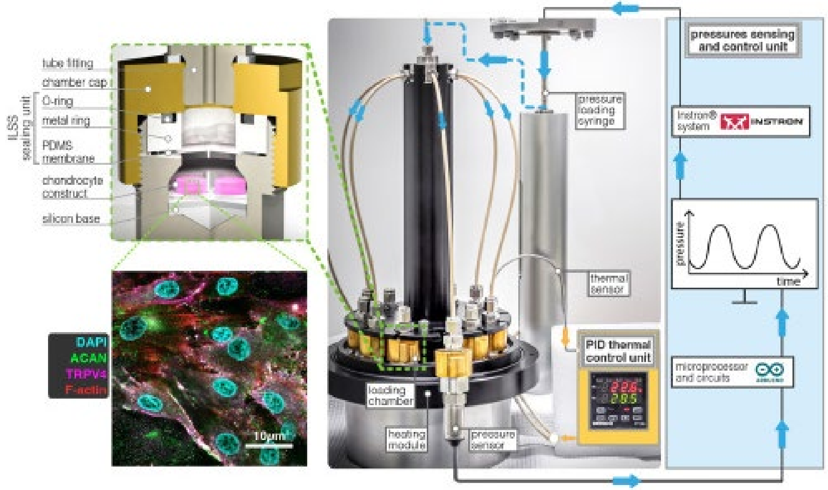
Antoine Reitzel (EPFL-LBO)

Goal:

- Proposer le design d'une machine de stimulation mécanique pour le genou d'un rat.

Tasks:

- Comprendre le problème, les contraintes d'une expérience in-vivo et de la physiologie d'un rat.
- Concevoir une machine de stimulation mécanique.
  - CAD
  - Sélection des différents composants
  - Méthode de contrôle
- Concevoir une méthode de validation pour la machine
- Prototyper la machine



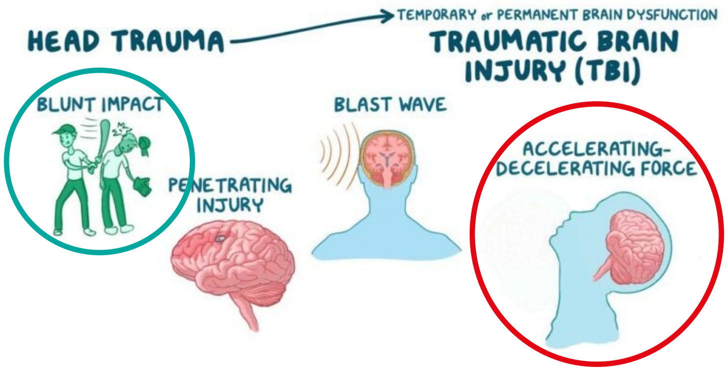
EPFL

Materials optimization for ski helmets: automatization of impacts simulations in LS-Dyna

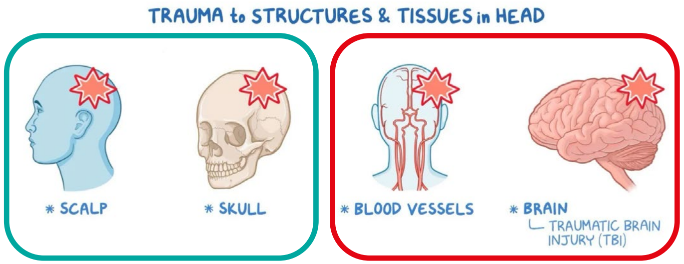
Mi-Lane Bouchez (EPFL-LBO)

- **Head injuries:** 15% of all skiers injuries, main cause of death on the slopes, long-term consequences.
  - Majority of head injuries are **concussions**.
- **Current helmets:** focus on reducing only linear acceleration during impacts on a hard surface at a given speed.

→ Improve inner layer with materials more efficient to absorb shock and reduce both linear and rotational accelerations.



https://explore.rumbleon.com/posts/motorcycle-helmet-guide



https://www.osmosis.org/learn

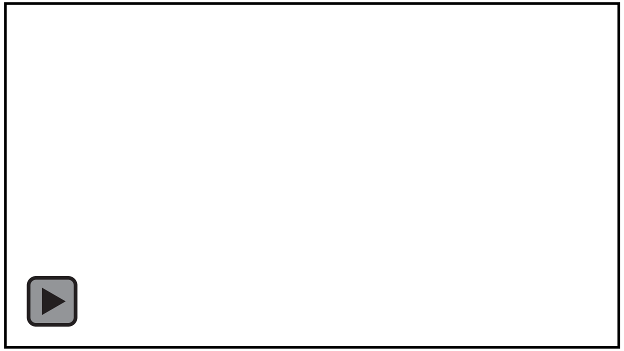
Materials optimization for ski helmets:
automatization of impacts simulations in LS-Dyna

Mi-Lane Bouchez (EPFL-LBO)

https://whitelines.com/archive/news/official-skiing-dangerous-snowboarding.html

Tasks:

- Understand the challenges of designing ski helmets mitigating TBIs
- Learn how to use Ls-Dyna software
- Simulations: simplified oblique impacts with inner layer sample
- Validation: convergence study, compare results to literature
- Automatization: create a python code to test different materials and extract meaningful metrics
- Comparative analysis



https://www.youtube.com/watch?v=MDN0Dm9sd0E

I – SYCAMORE

Deep reinforcement learning for autonomous systems

Bachelor student project

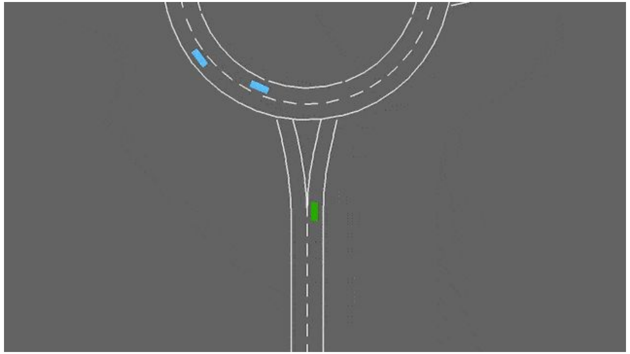
Gabriel Vallat, Kai Ren, Andreas Schlaginhaufen, 05.12.24

sycamore

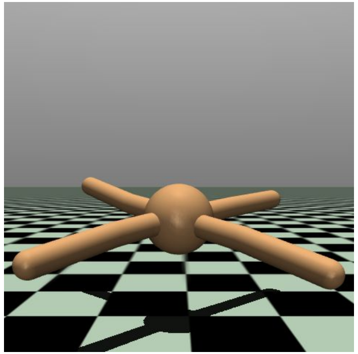
Learning to control autonomous systems

Goal

- Learn to control autonomous systems by trial and error
- Apply reinforcement learning to learn policy $\pi_\theta: \mathscr{S} \rightarrow \Delta_{\mathscr{A}}$



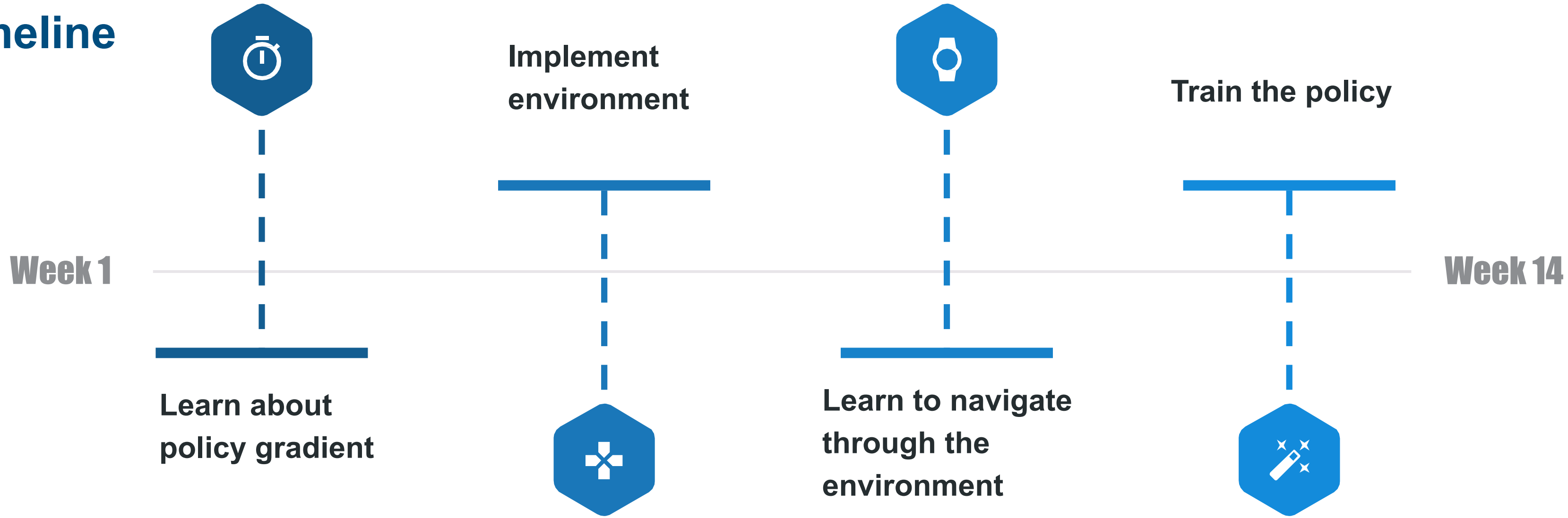
Leurent, E. (2018). An Environment for Autonomous Driving Decision-Making (Version 1.4) [Computer software]. https://github.com/eleurent/highway-env



Farama Foundation. 2023. "MuJoCo Ant Environment." *Farama Gymnasium*. Accessed November 1, 2024. https://gymnasium.farama.org/environments/mujoco/ant/.

Learning to control autonomous systems

Timeline



Requirements:

- Strong coding abilities in python (ideally experience with PyTorch)
- Solid math background (analysis and probability theory)
- Teamwork

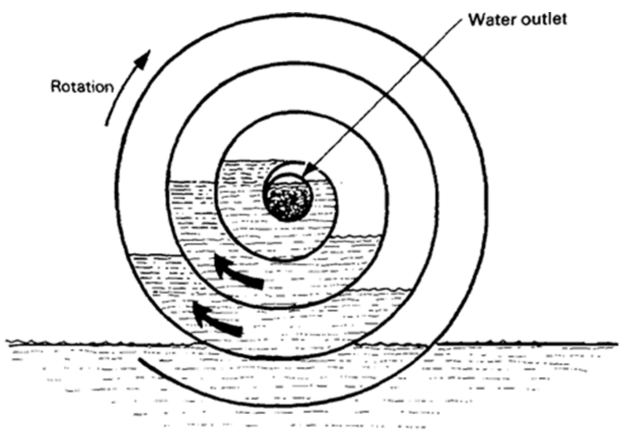
J – lab LFMI

$LFMI_1$ Wirtz pump

- Hydrostatic spiral pump, able to drive alternating water and air plugs up to great heights (more than 10 metres).
- Amenable to be fully hydropowered (passive).

Objectives:

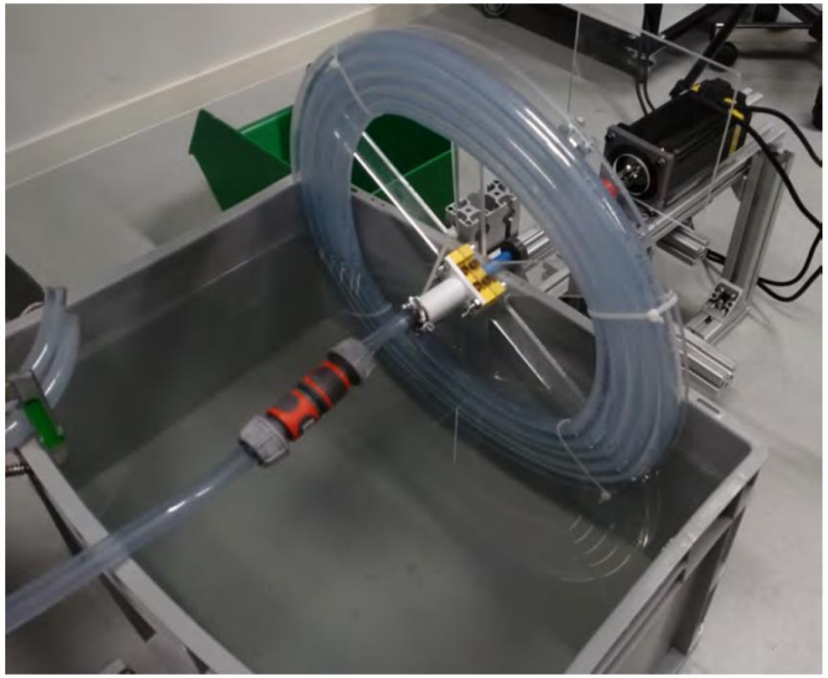
- Understand the limitations and the sources of failure.
- Focus on the form and stability of bubbles



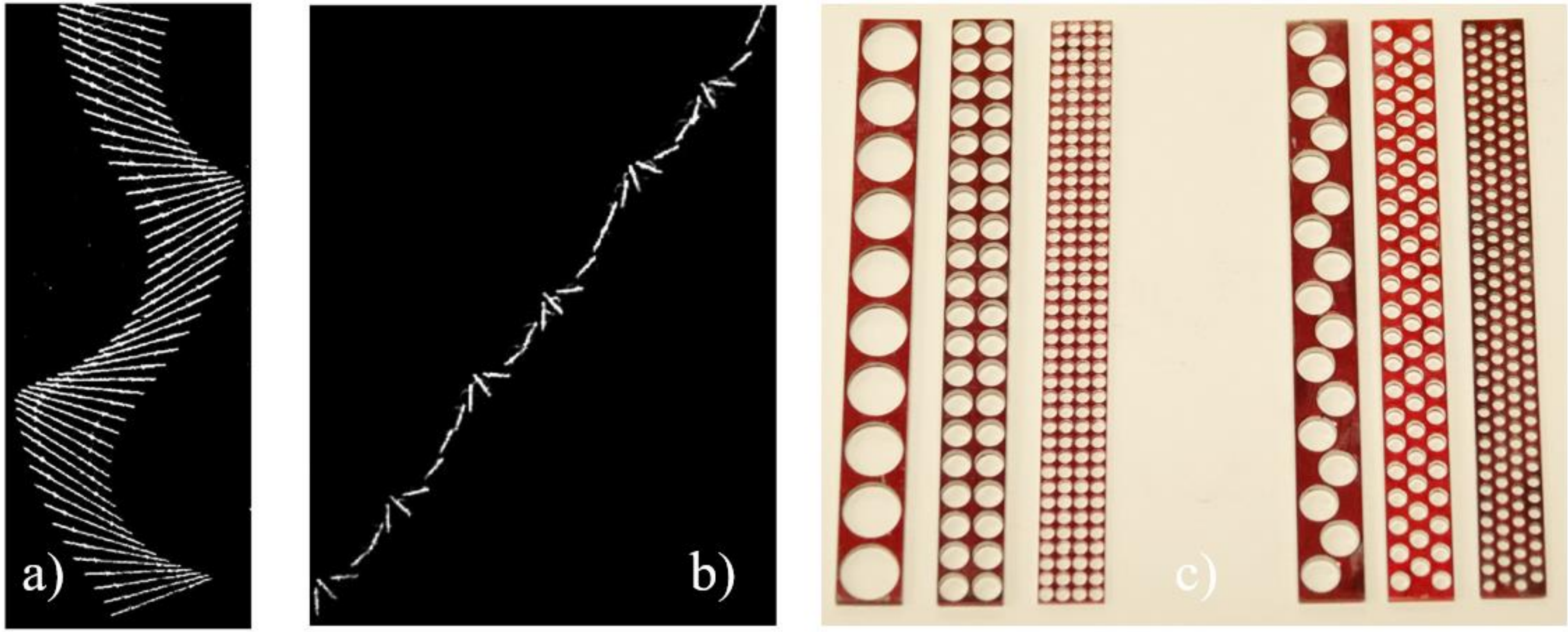
Deane, J. H., & Bevan, J. J. (2018). A hydrostatic model of the Wirtz pump. *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences*, **474**(2211), 20170533.

$LFMI_1$ Wirtz pump

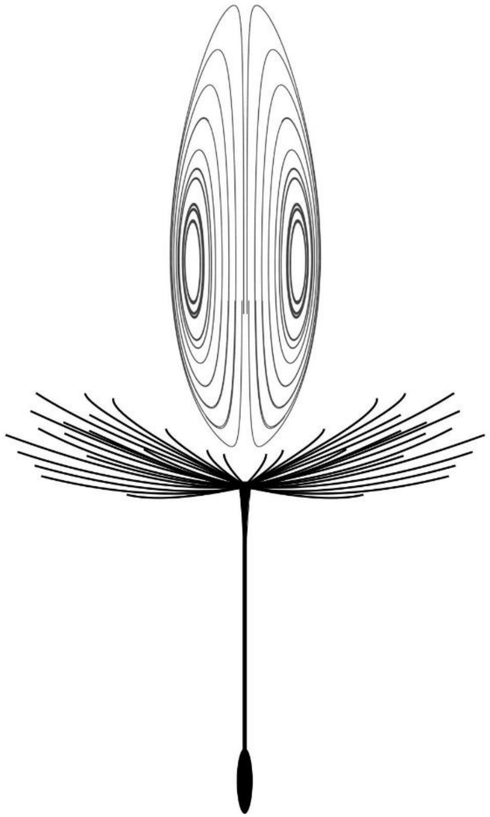
Pump and delivery pipe



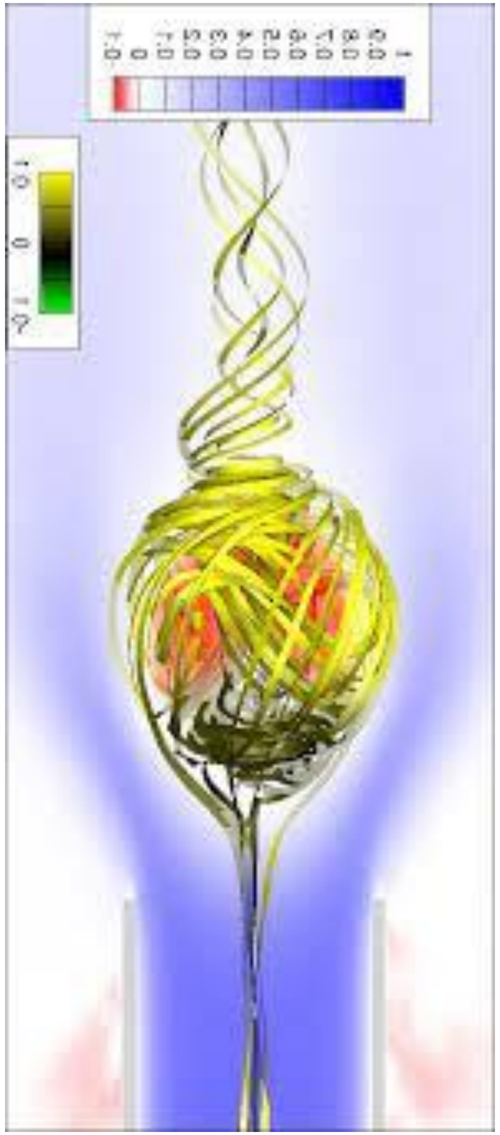
$LFMI_2$ Slow down falling cards



Porosity induces detached wake



Rotation induces detached wake



Combine both by piercing holes in a dobble card

Aven Hart • Marc Thoma • Flavio Noca

Eagle-Takeoff Hood Ornament

Design of a mechanical eagle with wing deployment tied to airspeed

5/12/24

Goals

- Economical to mass produce in either metal or plastic
- Maximum wingspan of around 30 cm
- Should begin positional transition at an airspeed of around 40-50 km/h, and finish at around 80-100 km/h
- Resilient to airspeeds of at least 250 km/h
- Resilient to intense vibrational stresses (e.g. those produced by a motorcycle) for long durations without degradation
- Should include damping to limit chaotic motion produced by turbulent or rapidly changing airflows, such as when passing behind large vehicles

Greater Project Outline

Proof of Concept

Initial prototype produced by HE-Arc in Le Locle — while their design is beautiful, it is also intricate and fragile

Student Prototype Development

The intent of this student project is to either adapt or completely reimagine the existing prototype, with the goals of simplifying its operation and, especially, construction, as well as bolstering its robustness

Refinement and Polish

All prudent further development, adaptation, and refinement of the student's design will be performed to prepare the project for presentation and mass production

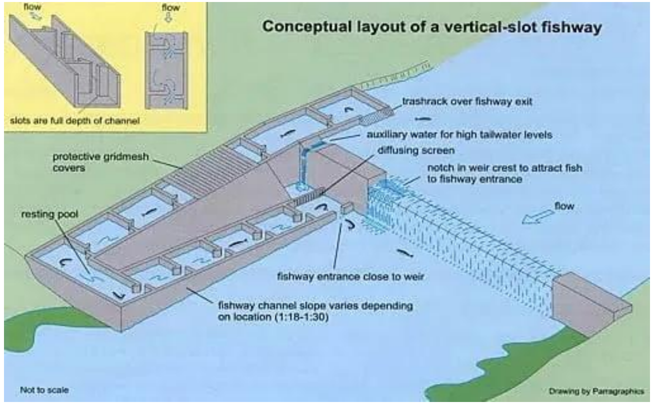
Manufacturer Pitch

When a production-ready prototype is developed, it will be presented to vehicle manufacturers as a potential addition to their vehicles, with the primary target being Harley Davidson Motorcycles

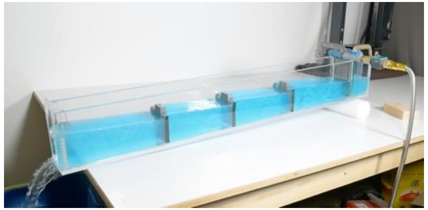
K – lab HEAD

Fish ladder challenge

@ HEAD-lab.



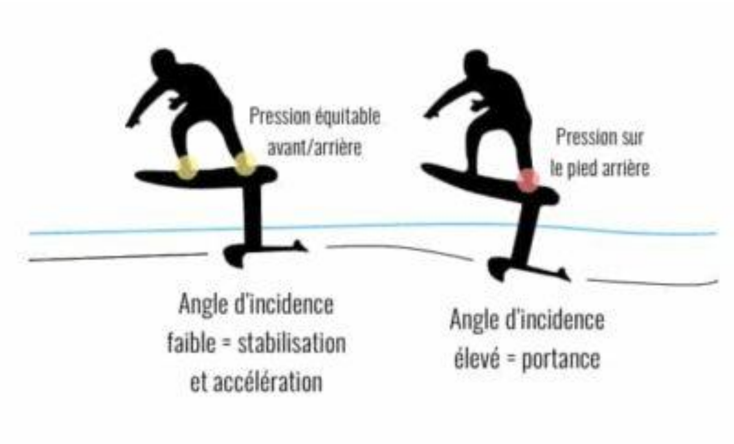
- Build a simple fish pathway



- Look for a different type of fish ladders for different fish types
  - Fish who like to jump
  - Fish who swim near the ground
  - …
- Understand the flow dynamics around it
- Design Swiss-specific fish ladder

Pump foil dynamics

@ HEAD-lab.



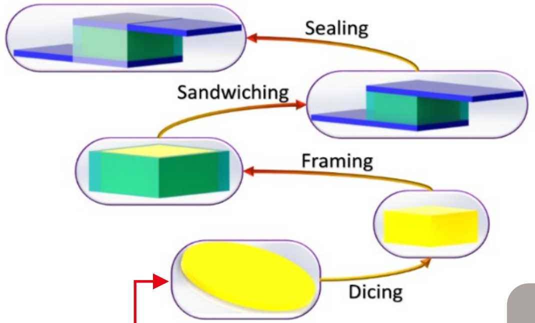
- Do a field measurement with an athlete
  - Video recording
  - Mount accelerometer
  - Do the data analysis

- Understand the pump foil dynamics
  - Compare expert vs. beginner
  - Find the link between control parameters
    - frequency – the weight of the player

  - What are the optimal conditions

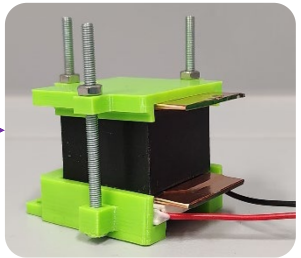
L – lab LNET

Photo-ThermoElectroChemical (P)TEC arrays



TEC Hydrogel

TEC System

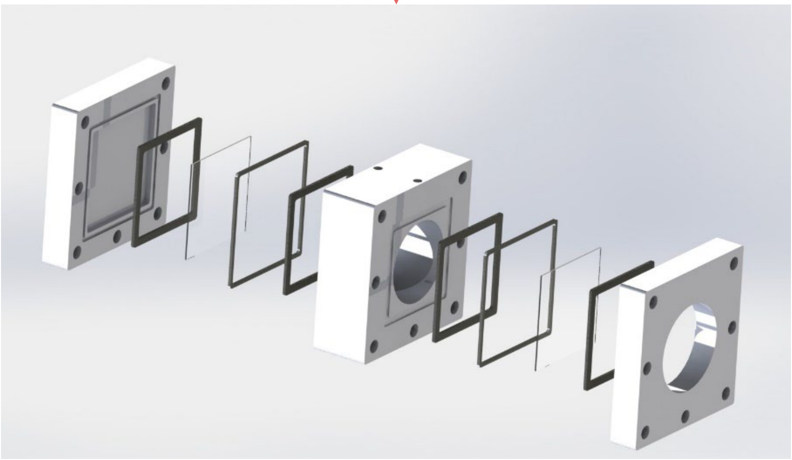


Background:

- Goal: harvest low-grade wasted heat ($\approx 150\ °C$) which is abundant and ubiquitous.
- Thermopower in conventional thermoelectric technologies is tens of $\mu V/K$;
- Thermo-Electrochemical (TEC) thermopower is few mV/K;
- Use of Quasi-solid (Hydrogel) TEC are a promising alternative to liquid:
  - Lower heat transfer and better control on fluid dynamics;
  - Easier packaging;
  - Tunable mechanical and chemical properties.

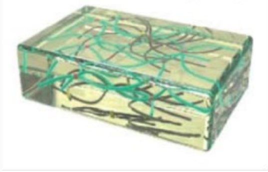
Current Status:

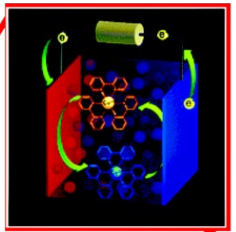
- TEC hydrogel available and fully characterized;
- Light influence and integration is in process;
- Procedure and design of cells available;

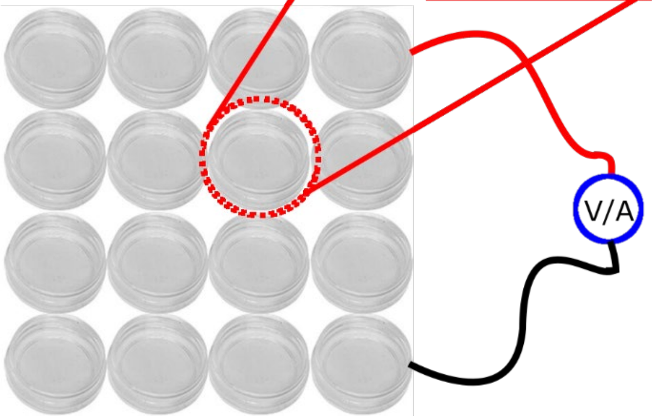


AIM of the project:

- Realize an integrated and fully flexible array (3D printing, machining);
- Achieve an output voltage of approximately 1V and a current around 1mA for $\Delta T = 10K$;
- Analyze performances and improvements;

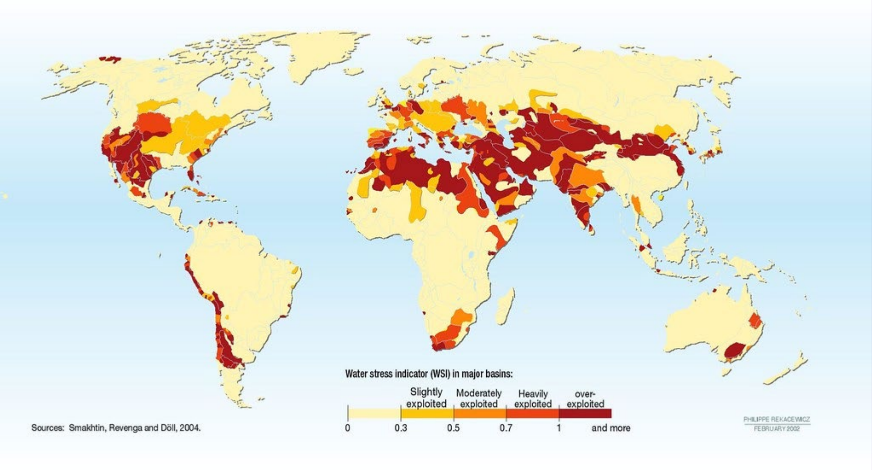






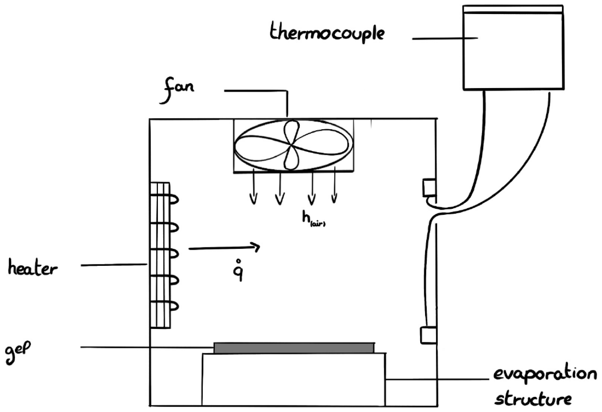
Reference contact: matteo.bevione@epfl.ch Professor: giulia.tagliabue@epfl.ch Laboratory of Nanoscience for Energy Technologies

EPFL Water Evaporation with Hydrogels



Background:

- $\approx 10\%$ of the global population live in countries with high or medium critical water stress;
- ≈ 2 billion people worldwide lacking access to clean drinking water due to overexploitation and environmental factors.

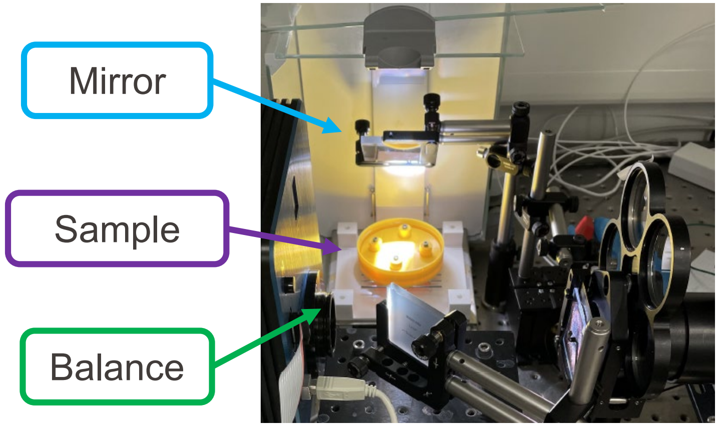


How to address the issue:

- Hydrogels have emerged as a promising tool for achieving efficient water evaporation;
- Hydrogels present an interesting platform for incorporating nanoparticles;
- Plasmonic materials have improved light absorption and photo-thermal capabilities;

AIM of the project:

- Improve the design precisely measure water evaporation rates;
- Evaluate the effectiveness of various hydrogel materials and their hydrovoltaic feasibility;
- Examine and analyze factors influencing evaporation: e.g hydrogel composition, geometry, environmental conditions and plasmonic materials hybrids;

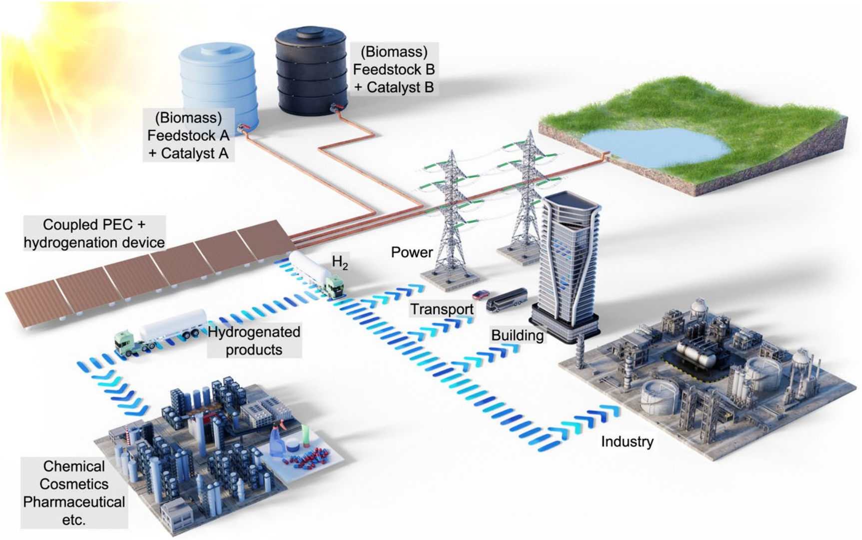


Reference contact: matteo.bevione@epfl.ch, tarique.anwar@epfl.ch - Professor: giulia.tagliabue@epfl.ch - Laboratory of Nanoscience for Energy Technologies

Development of a Temperature-Controlled Photoelectrochemical Cell

EPFL

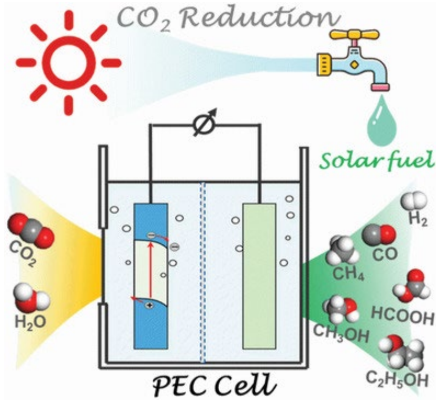
Laboratory of Nanoscience for Energy Technologies



Background

Photo(electro)chemical reactions, such as hydrogen production and CO_2 reduction into fuels and valuable chemicals, offer a promising way to reduce carbon emissions by directly utilizing sunlight.

Photoelectrochemical cells are devices where light activates a material that drives the desired chemical transformation.

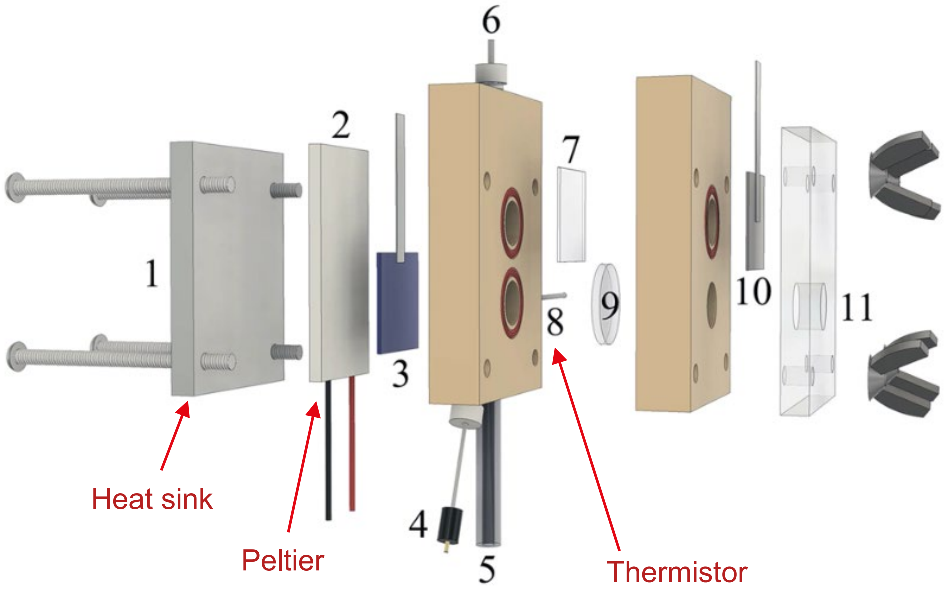


Aim

Light-driven reactions are affected by heat from the illumination source, making precise temperature control essential. **The goal is to develop a temperature stabilization system that enables consistent and reliable experimental results.**

Methods

The setup will be based on an already available custom-made cell. The new design will incorporate a planar Peltier element and a heat sink to regulate the cell's temperature. A thermistor will monitor the liquid temperature, and a PID controller will maintain the desired temperature setpoint.

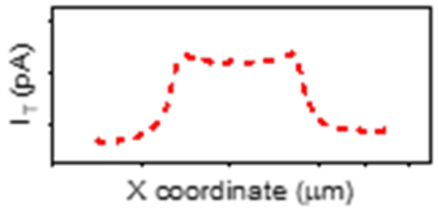


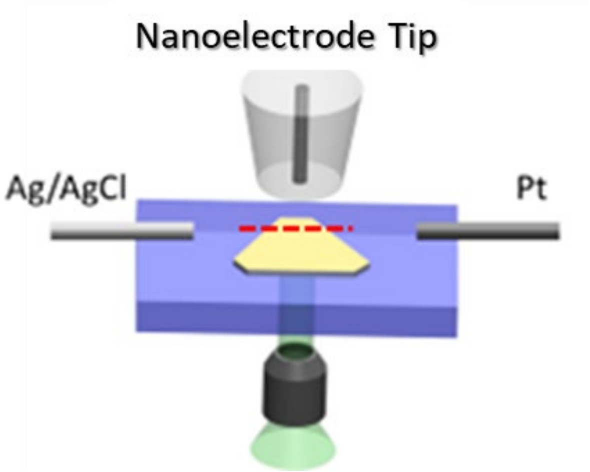
Contact: Priscila Vensaus (priscila.vensaus@epfl.ch), Giulia Tagliabue (giulia.tagliabue@epfl.ch) - Laboratory of Nanoscience for Energy Technologies

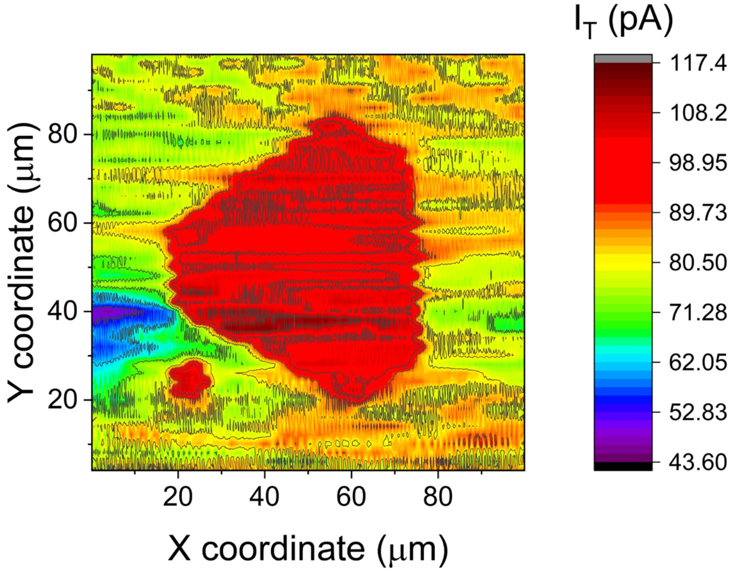
Design and Development of an Electrochemical Cell for Scanning Electrochemical Microscopy

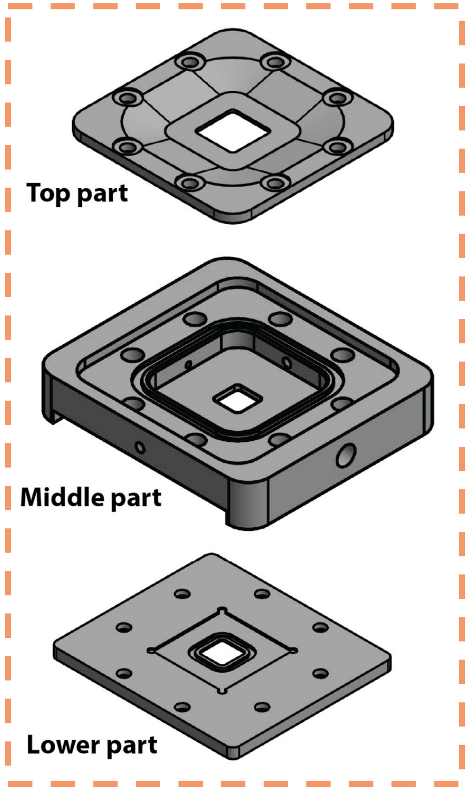
Supervising professor: Prof. Giulia Tagliabue giulia.tagliabue@epfl.ch

Supervisor: Milad Sabzehparvar milad.sabzehparvar@epfl.ch







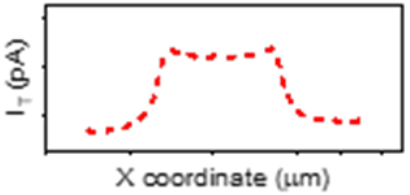


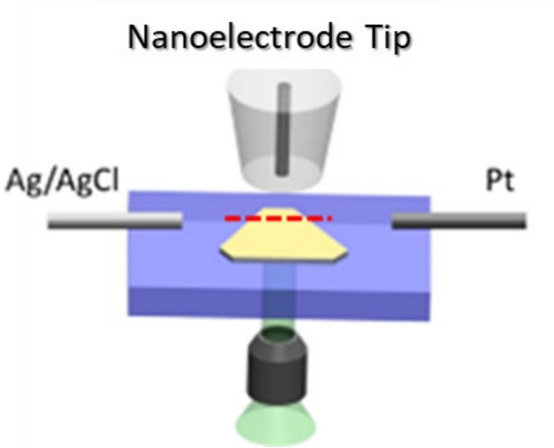
Scanning electrochemical microscopy (SECM) is a scanning probe technology for electrochemical imaging of nano-scale catalytic structures. To enable SECM with high-resolution imaging, we need to design and fabricate a special electrochemical cell for our design considerations.

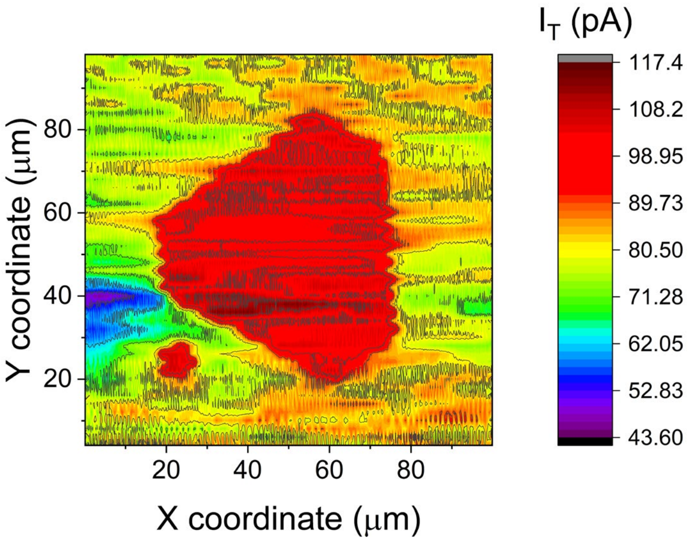
Design and Development of a Tip Holder Assembly for Scanning Electrochemical Microscopy

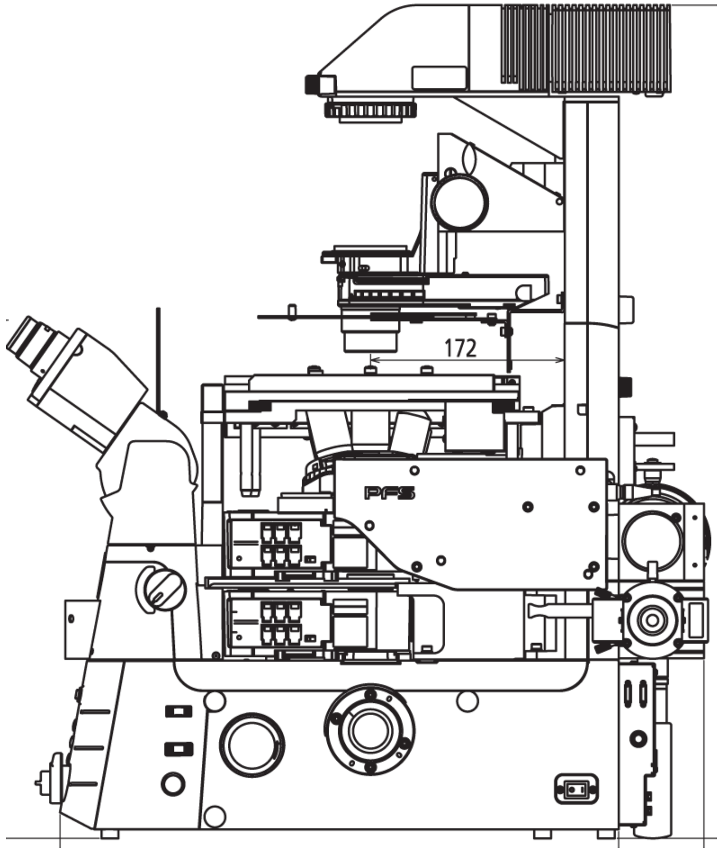
Supervising professor: Prof. Giulia Tagliabue giulia.tagliabue@epfl.ch

Supervisor: Milad Sabzehparvar, Dr. Fatemeh Kiani, Dr. Priscilla Vensaus milad.sabzehparvar@epfl.ch







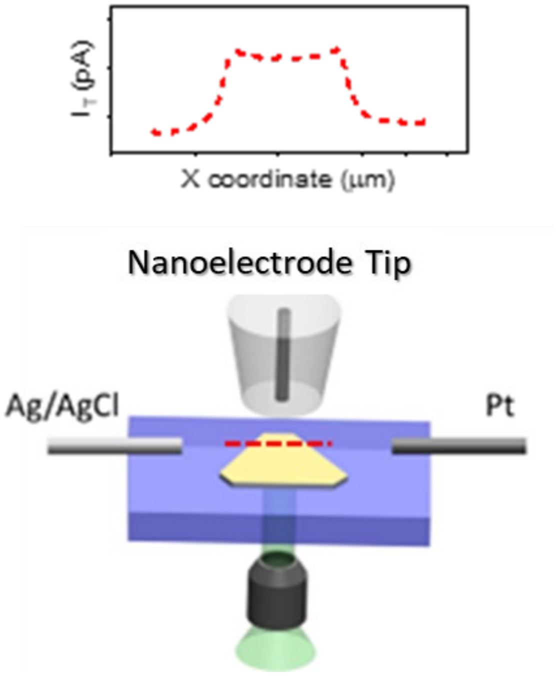


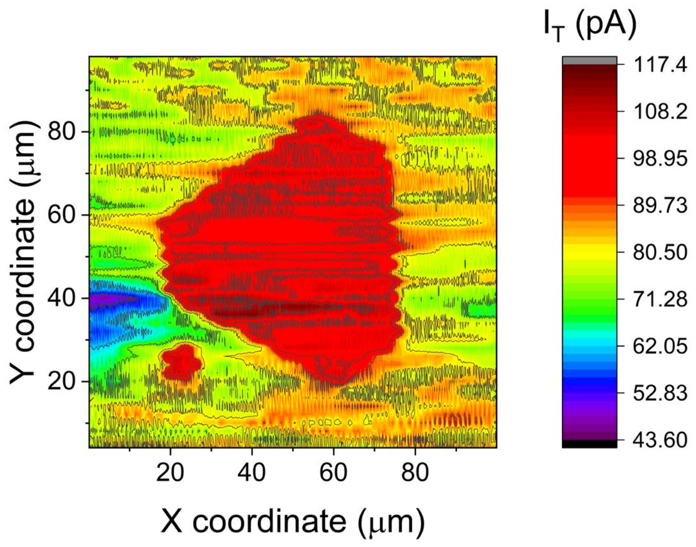
Scanning electrochemical microscopy (SECM) is a scanning probe technology for electrochemical imaging of nano-scale catalytic structures. To enable SECM with high-resolution imaging, we need to design and fabricate a special tip holder to integrate with our microscope.

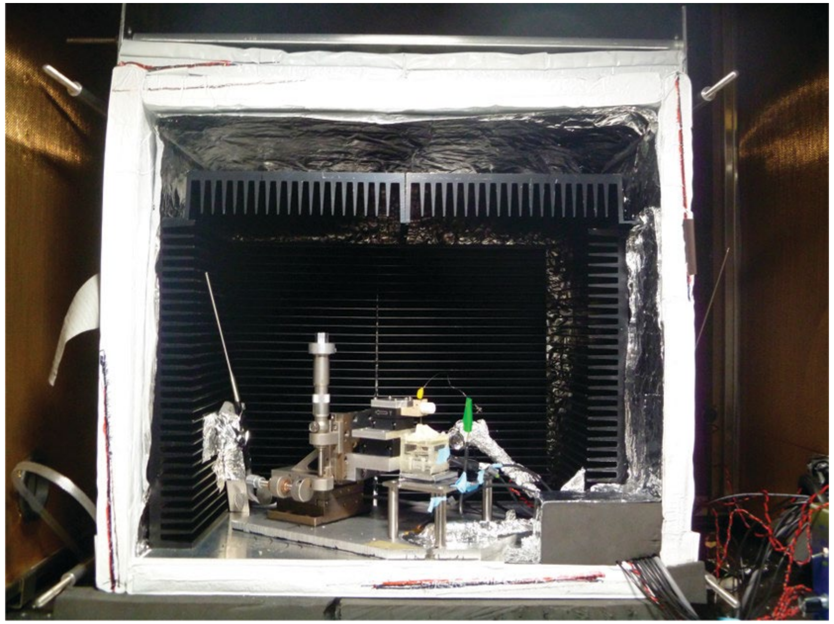
Development of a Controlled Temperature/Humidity Chamber for Scanning Electrochemical Microscopy

Supervising professor: Prof. Giulia Tagliabue giulia.tagliabue@epfl.ch

Supervisor: Milad Sabzehparvar milad.sabzehparvar@epfl.ch







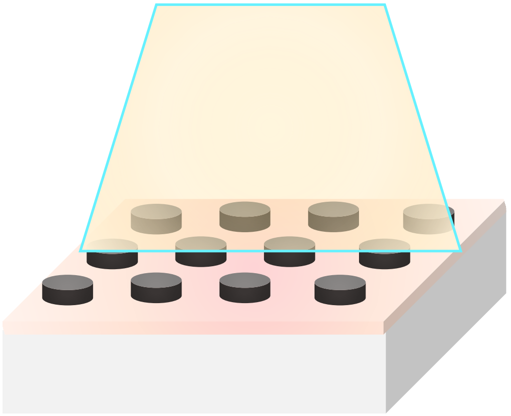
A simple Isothermal Chamber

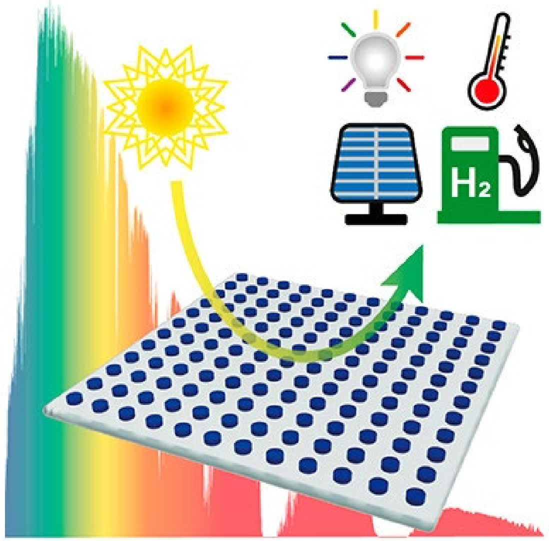
Scanning electrochemical microscopy (SECM) is a scanning probe technology for electrochemical imaging of nano-scale catalytic structures. To enable stable and high-resolution SECM imaging, we need to fabricate a controlled chamber for controlling temperature and humidity.

Analytical chemistry 84.8 (2012): 3489-3492.

Nanofabrication of Optical Metasurfaces for Energy Conversion

LABORATORY OF NANOSCIENCE FOR ENERGY TECHNOLOGIES
EPFL





Cortes et al, ACS Chem Rev. 2021

Motivation

Fabrication of dielectric metasurfaces by nanosphere lithography to study catalytic processes.

Objectives

- Fabricating dielectric and metallic arrays of nanostructures in LNET laboratories and cleanroom.
- Performing structural and optical characterization via several techniques such as microscopy and ellipsometry.

Metasurfaces are arrays of subwavelength nanostructures, engineered to manipulate electromagnetic waves and exhibit unique optical properties. Scaling of metasurfaces to larger area while maintaining uniformity of elements is a non trivial task.

Contact Information

Elif Nur Dayi,
elif.dayi@epfl.ch

Prof. Giulia Tagliabue
giulia.Tagliabue@epfl.ch

Suggested Literature

- List of suggested readings for (P)TEC project:
  - On Themo-electrochemical/Thermo-ionic: https://pubs.acs.org/doi/10.1021/acsenergylett.3c02448, https://pubs.rsc.org/en/content/articlelanding/2022/ee/d2ee01457b#eqn1
  - For Wearable Photo-electrochemical cells: https://onlinelibrary.wiley.com/doi/full/10.1002/marc.202200001
  - For nanoparticle doping of PVA/PAAm gels: https://www.sciencedirect.com/science/article/pii/S014181302300466X, https://www.sciencedirect.com/science/article/pii/S2352492823026727
  - On gel synthesis and properties: https://link.springer.com/article/10.1007/s10924-021-02184-5
  - Hydrogel for energy storage review: https://www.sciencedirect.com/science/article/pii/S2949822823000497, https://pubs.acs.org/doi/full/10.1021/acs.chemrev.0c00345
  - Simulation of the system: https://pubs.rsc.org/en/content/articlelanding/2023/ra/d3ra01463k
  - For the most novel works on photo-thermo-electrochemical cell: https://www.science.org/doi/10.1126/science.adg0164#supplementary-materials

EPFL

Optimisation d’un mur trombe

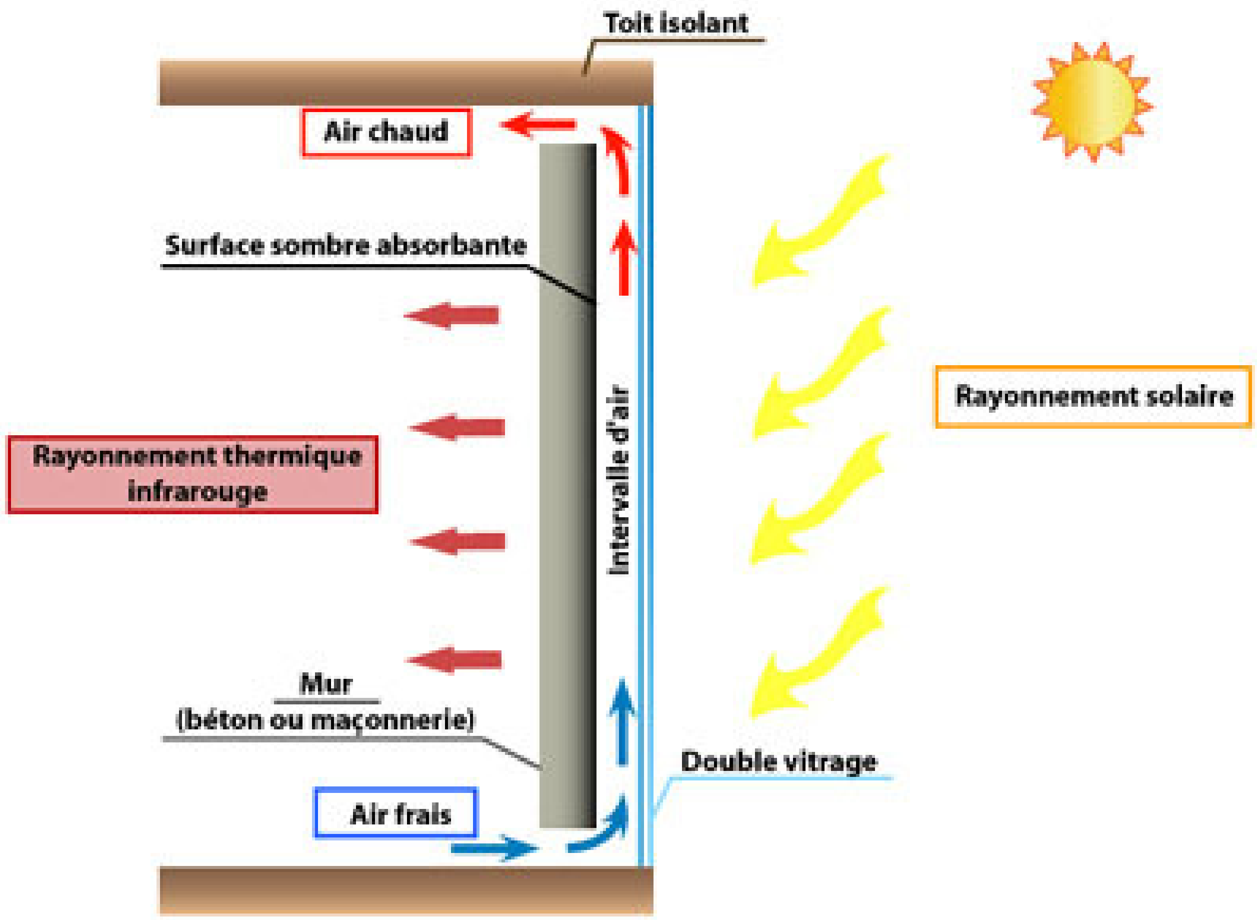
Projet d'ingénierie simultanée - printemps 2025

Projet MAKE RebuiLT

Construction d'un pavillon low-tech

Concept du mur trombe - projet semestre 2023-24

- Effet de serre
- Convection
- Chauffage d'appoint passif

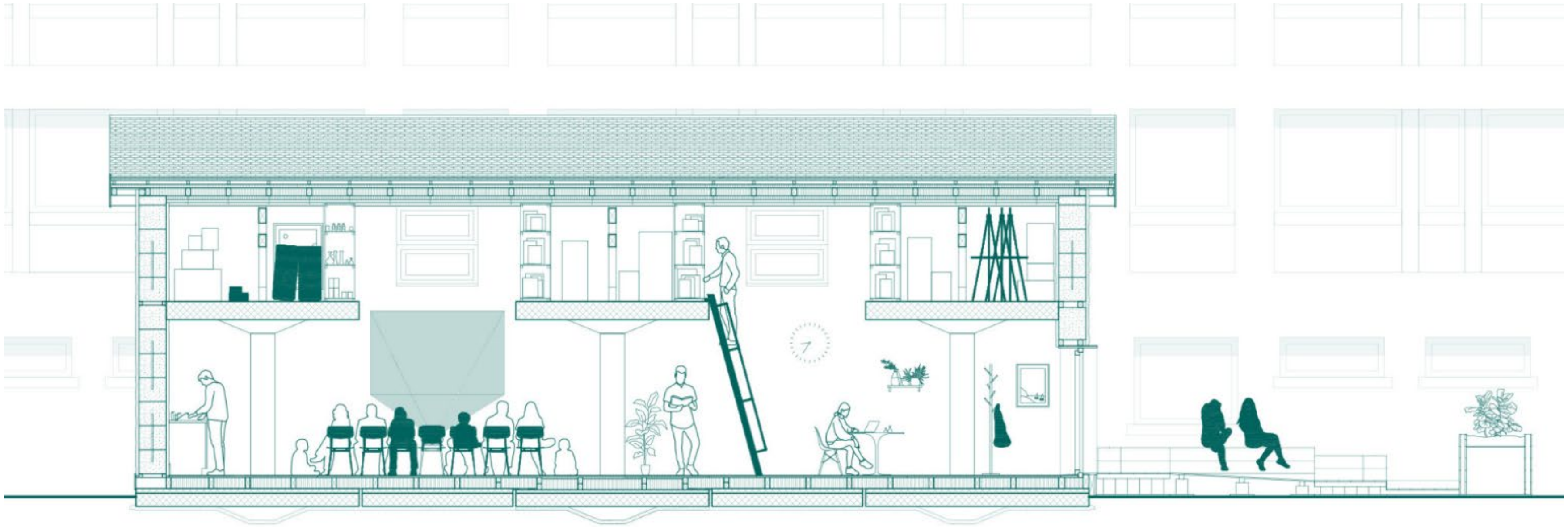


Automatisation et optimisation - printemps 2025

- Données reçues par des capteurs intégrés
- Trappes pour ajuster le flux
- Petite pièce à construire pour isoler l'expérience
- Test de différents matériaux

Collaboration

- Prof. Giulia Tagliabue - Laboratory of Nanoscience for Energy Technologies
- MAKE RebuiLT
- SKIL
- Charge de travail pour 2 à 3 étudiants max.



M – lab sustainability

EPFL

Projets d’outils agricoles Low Tech

Cours
Projet d’ingénierie simultanée

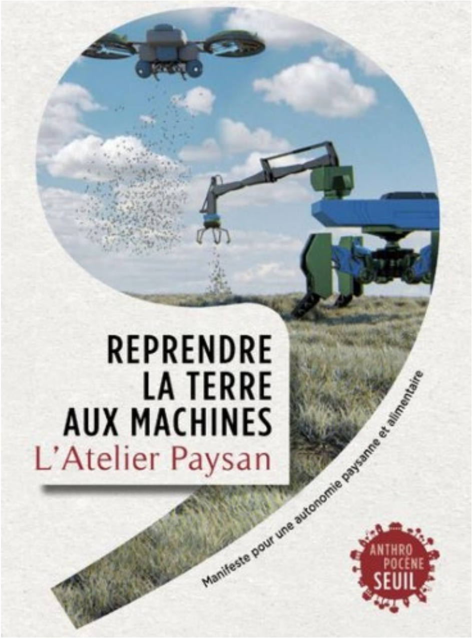
Siroune Der Sarkissian
05.12.2024

Un peu de contexte

EPFL

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 ?
- Avec un aboutissement concret ?



3 projets

1- Epandeur manuel

2- Disposeur de plants

3- Rouleau vélo

Epandeur manuel

Objectif : Epandre du fumier sur des platebandes de jardins de manière homogène.

Fig 1 : Brouette épandeur

Fig 2: Epandage sur une platebande

Source : *https://mrmondialisation.org/lassociation-twende-en-tanzanie-pour-des-machines-qui-reactivent-lhumanite/*

Disposeur de plants

Objectif : Disposer les plants sur les platebandes aux distances optimales de plantation, sur les lignes et entre les lignes

Fig 3 : Plants maraîchers

Fig 2 : Charrette de vélomoteur

Rouleau vélo

Objectif : Rouler les platebandes après avoir fait des semis pour tasser le terrain et casser les petites mottes.

Fig 5 : Rouleau plombeur manuel

Fig 6 : Brise-motte

Aide et suivi des projets

Support EPFL

SKIL
Student Kreativity & Innovation Laboratory

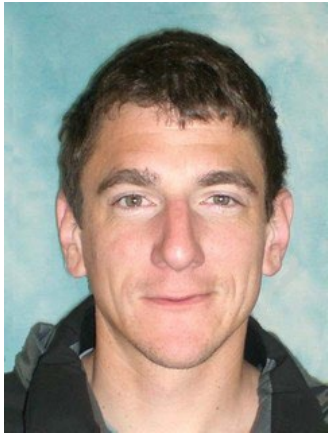
Samuel Cotture
Develop your prototype

DURABILITÉ EPFL

Siroune Der Sarkissian
Coordination

Projet d'ingénierie simultanée

Alain Prenleloup
Support GM



EPFL

Support hors EPFL

David Bichsel
Maraîcher, formateur

Initiateur des projets
Pour redéfinir le besoin

A la Belle Courgette

Ferme “À la belle courgette" à Bussingy

Pour aller tester vos projets

L'atelier paysan
COOPÉRATIVE D'AUTOCONSTRUCTION

Atelier Paysan

Pour promouvoir vos résultats

N – Aether


ÆTHER


SP80
RICHARD MILLE
ÆTHER
SWISS KITE
ÆTHER

OBJECTIVES

2019 - 2024

SP80 Chasing the World Sailing Speed Record

SP80 ASSOCIATION

2024

AETHER SWISS KITE – For a sustainable future

ÆTHER

2025

Autonomous prototype validated

2026

Performance prototype on trimaran boat

2027

Scalable control module & accurate simulator

OBJECTIVES

- INTEGRATION
- PROTOTYPING
- ELECTRONICS
- SIMULATION
- CONTROL
- COMMUNICATION

PROJET 1 : Optimisation du prototype trimaran pour la propulsion par kite

Préparation du prototype trimaran

- Assembler et étudier le trimaran
- Préparer le trimaran à la navigation par kite

Procédures de test

- Definir des procedures de tests
- Analyser la performance du trimaran tracté
- Etudier les composantes hydrodynamiques

Travailler sur l'optimisation

- Tester la flottabilité
- Mesurer la distribution de poid
- Etudier la rigidité structurelle

Conception

- Produire les pièces nécessaires pour ce nouveau mode d'opération
- Conception et production de pièce étudiées : safran, dérive, flotteurs

Superviseur : Philippe Mullhaupt

PROJET 2 : Conception et production du prototype de contrôle de kite v2

ÆTHER | EPFL

Test du Module_v1
- Suivre protocole de test
- Tester différent kites & étudier implémentation du module
- Obtenir valeur de force sur le contrôle et la structure

Optimisation du Module_v1
- Tester différent setup
- Définir la configuration optimale
- Conception du nouveau châssis du module
- Modélisation et étude du Module_v2

Production du Module_v2
- Produire le Module_2 suite à l'étude
- Test du nouveau module sur le terrain

Superviseur : Guillermo Villanueva

ORGANISATION

Suivis

- **Charge de travail :** 10 à 15h par semaine
- **Réunions hebdomadaires** des équipe avec chef d'équipe (TL)
- **Weekly slides** des avancées du projet

- **Réunion hebdomadaire** avec superviseur
- **Design Review** avec superviseur et TL la **semaine 5 et 9**

- **Présentation à l'Association :**
  Kick-Off/ Progress-Meeting/ Kick-Out

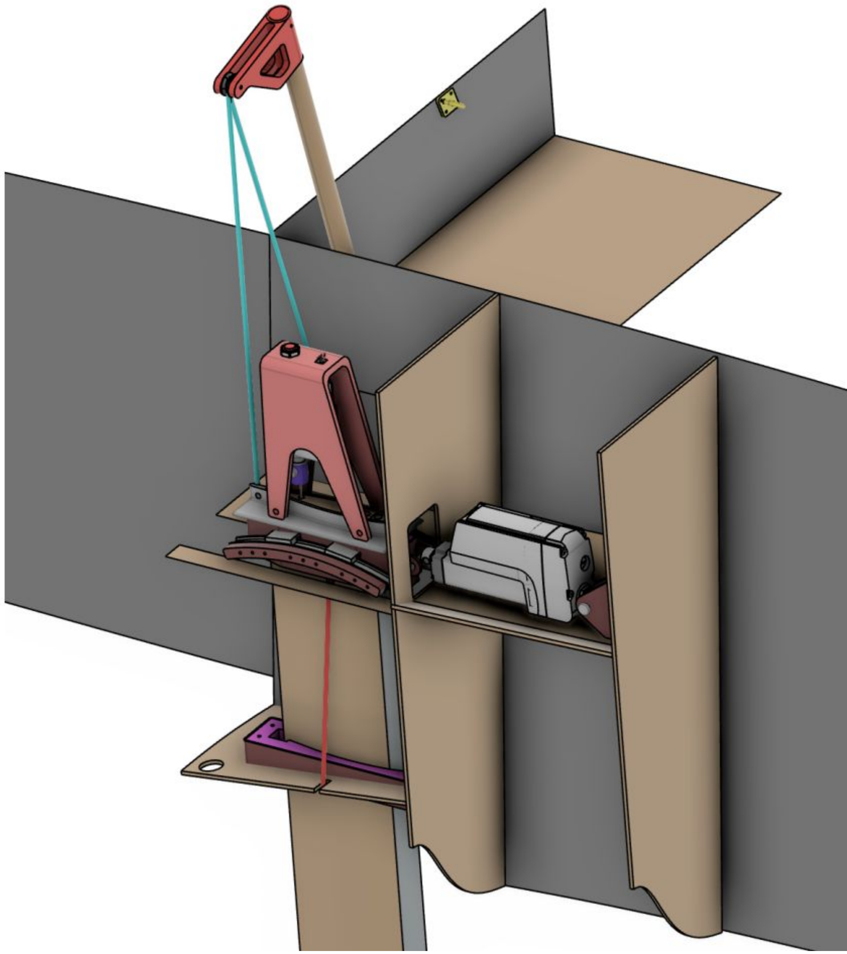
O – Swiss Solar Boat

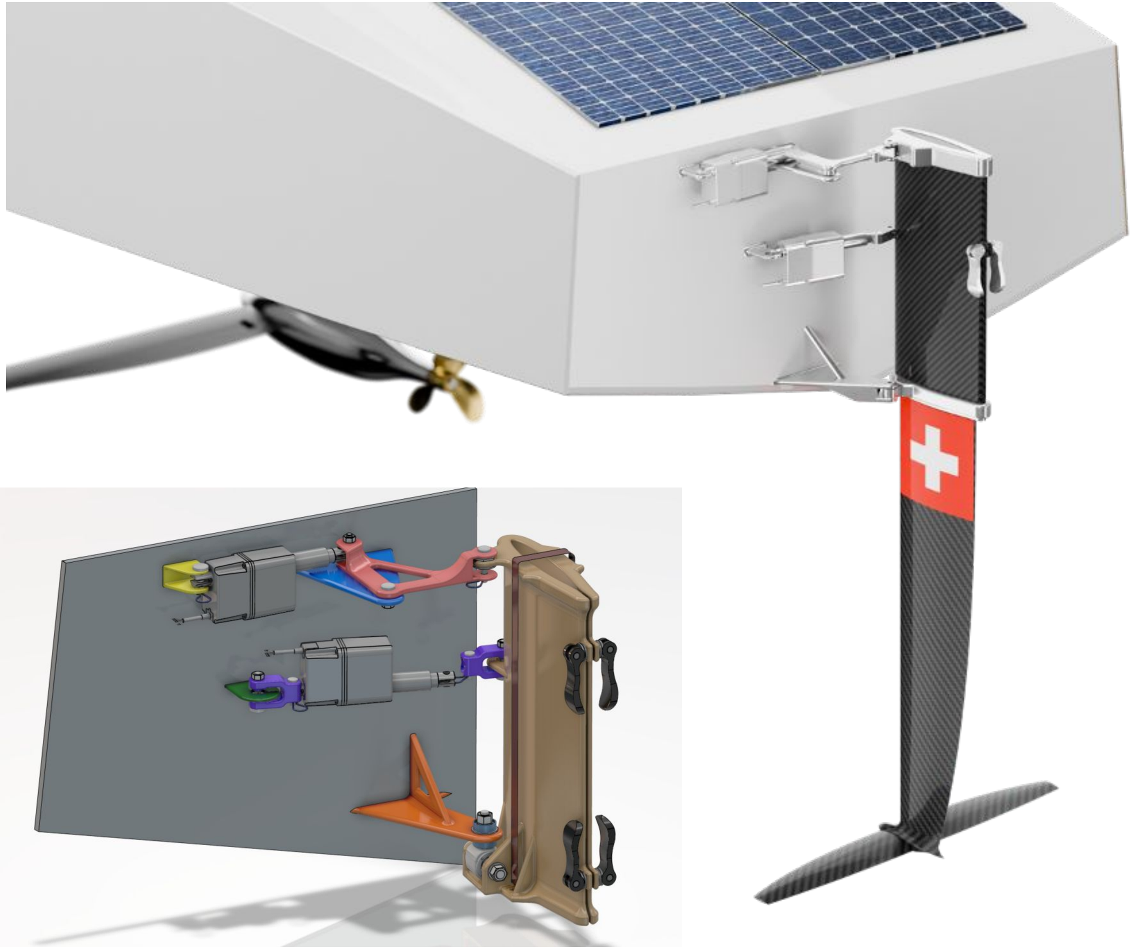

VENTURI
zesst
aventron
EPFL
maxon
Swiss
Solar
Boat
29

The REF: Renewable Energy Foiler

1) Design and production of the actuation/retractation of the gantry

- Finish the CAD design
- Adjust the mechanical system assembly to enable both gantry retraction and incident angle actuation
- Perform structural analysis (FEM)
- Production of composite part and classic machining

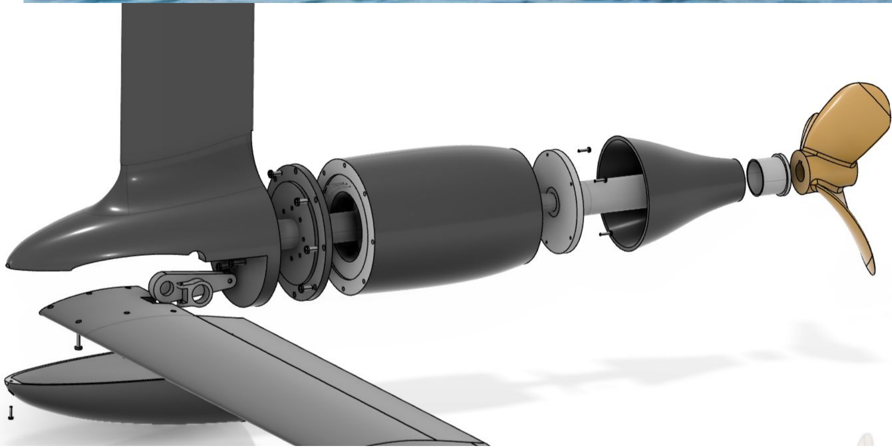




2) Design and production of the actuation/retractation of the rudder

- Finish the CAD design
- Adapt the mechanical system assembly
- Perform structural analysis (FEM)
- Production of composite part

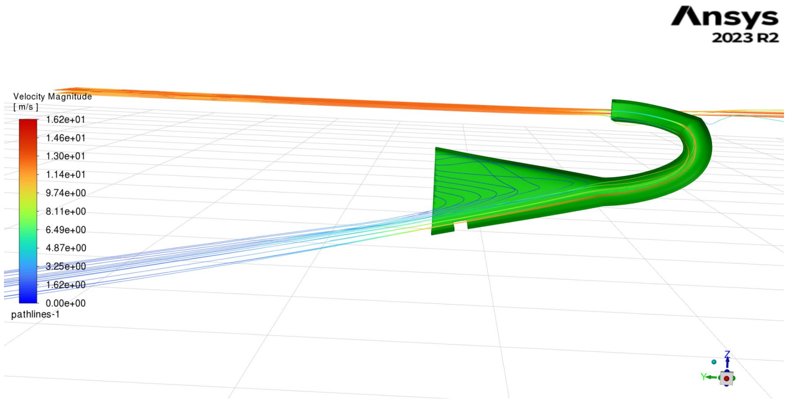
3) Propellers test bench



- Design of a test bench
- Prototyping
- Perform real test on the lake with load cells
- Fluid dynamics
- Data analysis

EPFL aventron zesst ntpt SRG SINERGIA RACING GROUP csem Storedge GOMBOC KISTLER ROHACRYL™ An Evonik product.

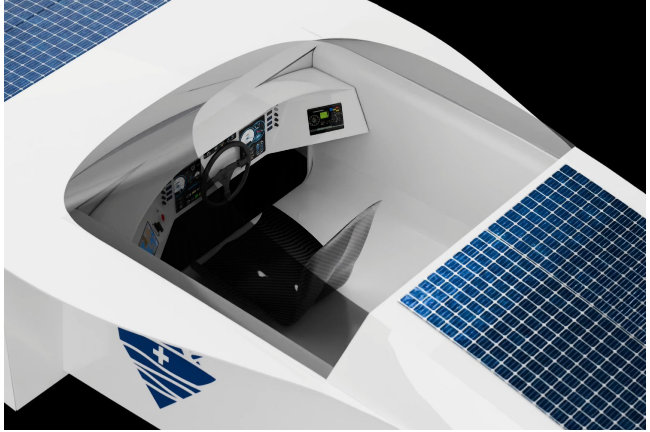
4) Hydrogen zone ventilation

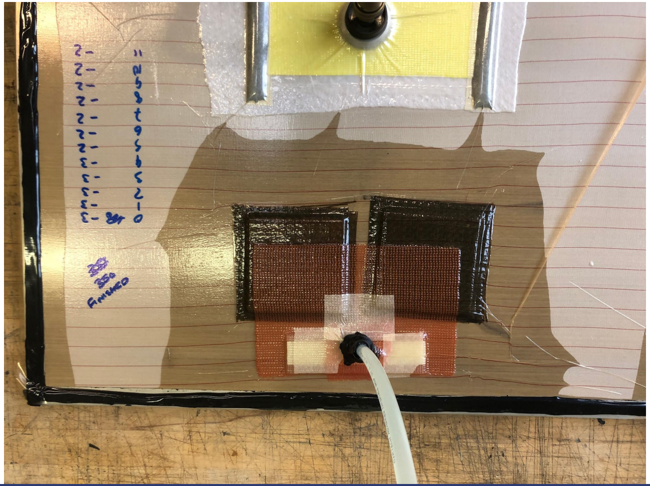


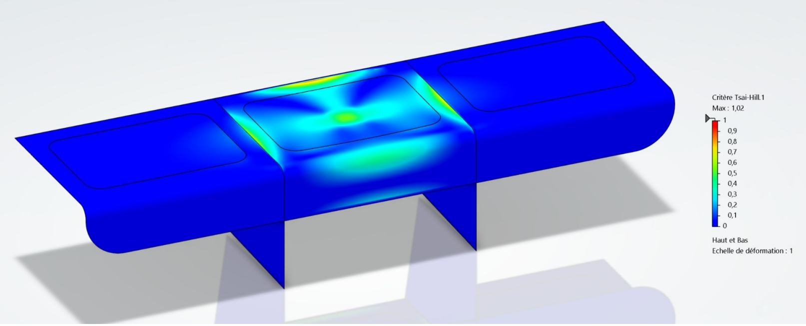
- Allow flow circulation to respect hydrogen standard but also cooling components
- Determine flow characteristic (speed, pressure drop, etc..)
- Design the system with naca duct, pipes and fans
- Fluid analysis (CFD)
- Production of composite part

5) Cockpit design and production

- Finish the CAD design and the FEM analysis
- Production of big composite parts
- The floor
- Integration of pilot seat
- Passenger bench
- Windshield design
- Dashboard design with steering integration







Bachelor projects (Spring 2025):

1. Design and production of the actuation/retractation of the gantry
2. Design and production of the actuation/retractation of the rudder
3. Propellers test bench
4. Hydrogen zone ventilation
5. Cockpit design and production

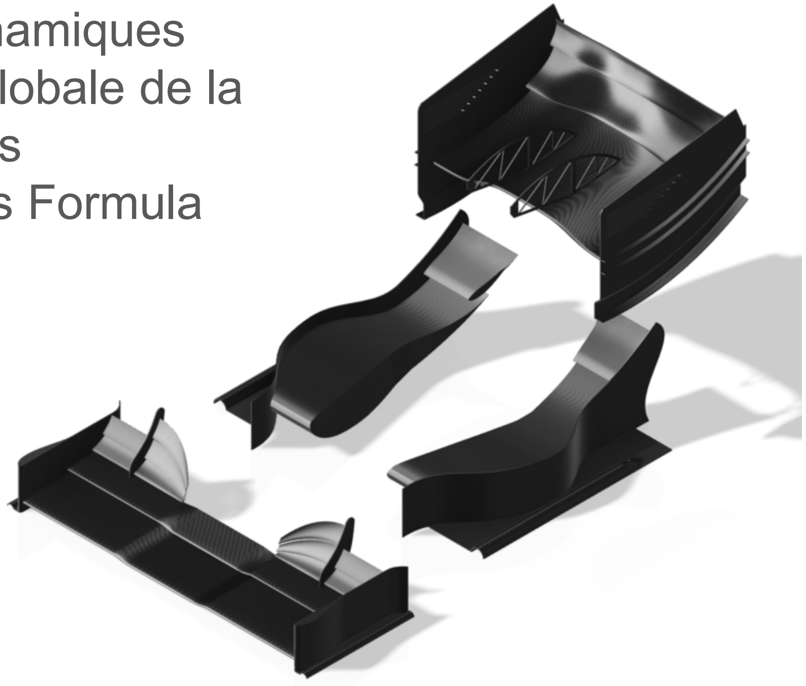
P – Racing Team


EPFL RACING TEAM
127
SIRIUS
BATEMO
UNDERSTANDING BATTERIES
Gotham.
vaudoise aréna
AMKmotion
EATON
DASSAULT SYSTEMES
LEMO

SAISON 2023/24 : SIRIUS

Aérodynamique: *Design Rear Wing et Side structure (2 projets)*

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:

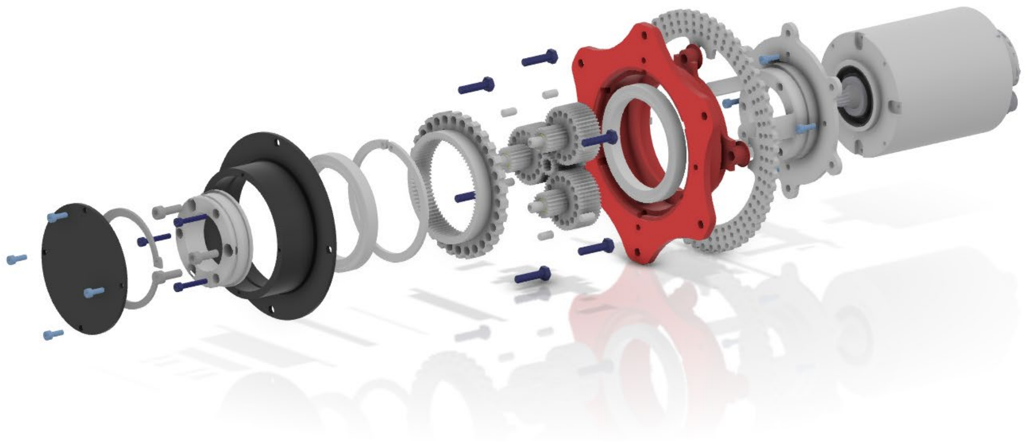
- *Modélisation CAO de géométries complexes*
- *Simulations CFD fiables*
- *Interpréter les résultats et ajuster les designs*
- *Respects des règles de la Formula Student*

Mechanical systems : *Optimisation du Wheel Assembly*

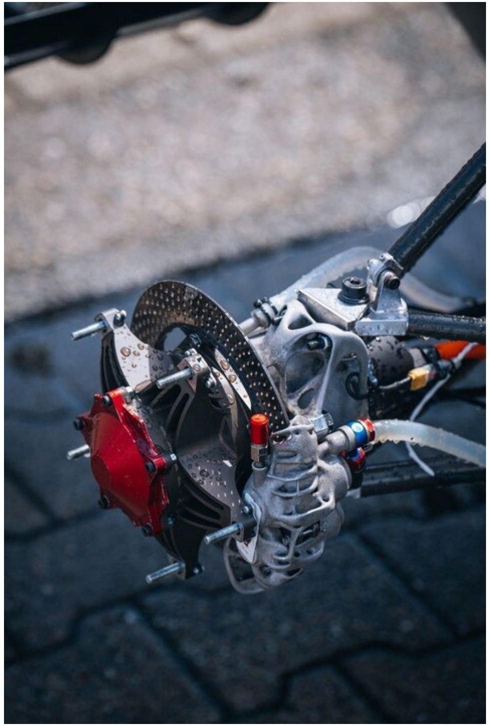
Optimisation du Wheel Assembly de la Racing Team. Le Wheel assembly est un des sous-systèmes le plus important de la voiture, c’est à travers lui que toutes les forces générées par la voiture sont transmises au sol.

Compétences et acquis de formation:

- *Conception d’un design 3D*
- *Etude et calculs des cas de charge appliqués sur le système*
- *Simulations FEM*
- *Analyse des résultats*



Mechanical systems : *Étriers de frein en optimisation topologique*



Conception de nouveaux étriers de frein. Pour ce faire, la méthode utilisée sera celle de l'optimisation topologique : créer une pièce résistante aux cas de charge demandés, tout en étant la plus légère possible.

Compétences et acquis de formation:

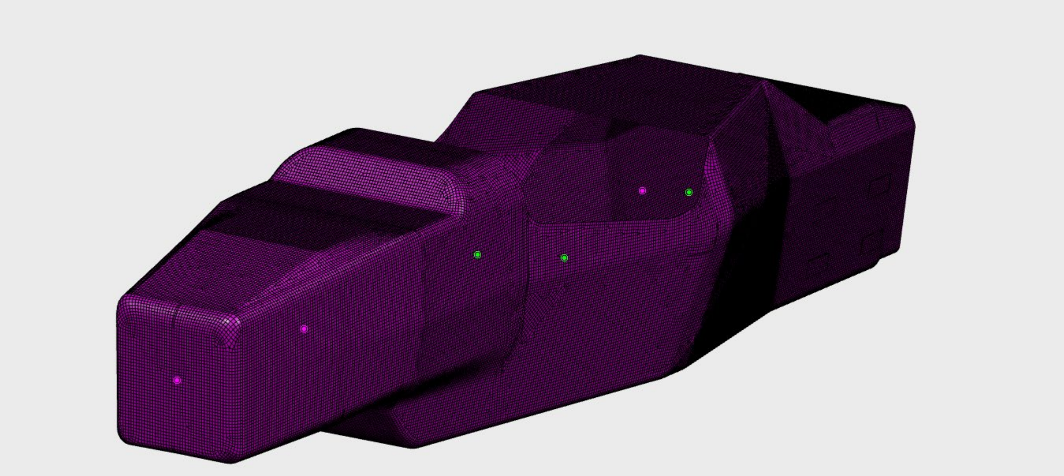
- *Conception d'un design 3D*
- *Etude et calculs des cas de charge appliqués sur le système*
- *Simulations FEM*
- *Optimisation Topologique*

Châssis : *Design d'une monocoque en carbone (2 personnes)*

Concevoir la monocoque de la prochaine voiture de la Racing Team pour la saison 2025/2026. La monocoque est un élément fondamental de la structure du véhicule, servant à connecter et supporter tous les autres sous systèmes de la voiture.

Compétences et acquis de formation:

- *Conception d'une monocoque optimisée*
- *Modélisation 3D*
- *Processus itératif*
- *Communication constante avec les autres pôles*

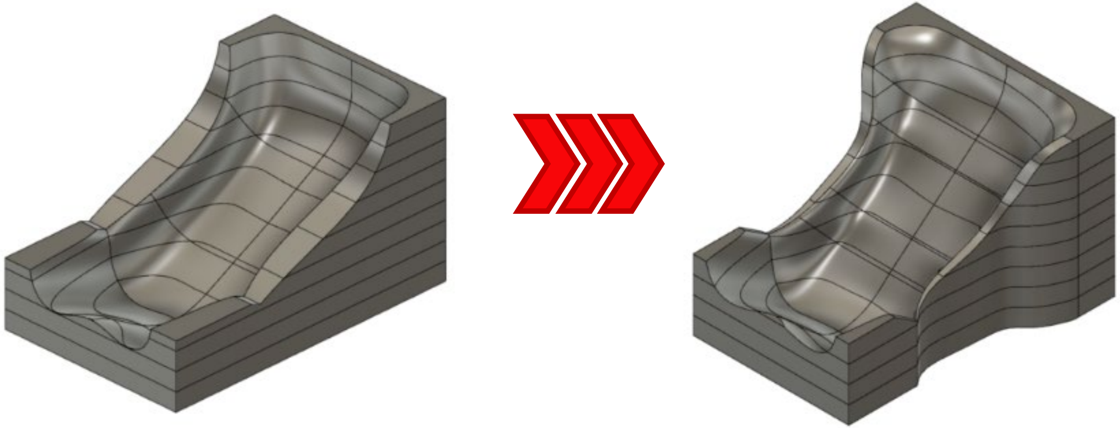


Châssis : *Design et production d'un siège (2 personnes)*

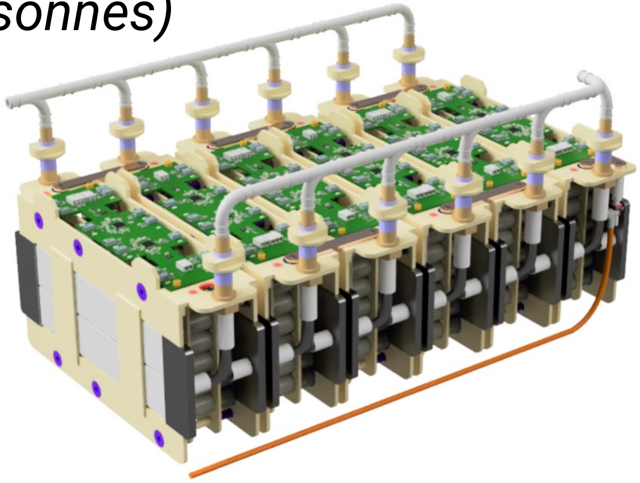
Le projet porte sur la conception et la production d'un nouveau siège pour la voiture de la Racing Team, destiné à remplacer le modèle actuel qui est utilisé depuis plusieurs saisons.

Compétences et acquis de formation:

- *Design et conception selon cahier des charges*
- *Matériaux composites et procédés de fabrication*
- *Modélisation 3D et simulation*



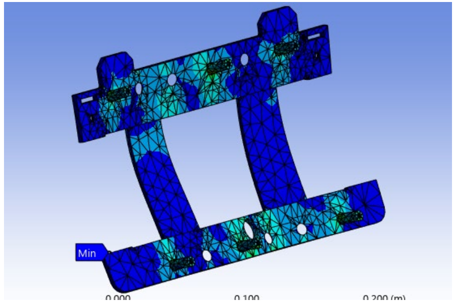
BESS : *Structure interne de batterie (2 personnes)*



Conception d'une structure interne d'une batterie en tenant compte des contraintes et objectifs définis et de la durabilité. Etude de cas de charges : vibrations, accélérations, choix de matériaux

Compétences et acquis de formation:

- *CAD*
- *Comportement de décharge de cellules pouch*
- *Analyse de manufacturabilité*
- *Simulation en éléments finis*



Merci pour votre attention

epfl-racing-team@epfl.ch

Q – Carbon Team

EPFL Carbon Team Semester Projects

Presented by
Alizée André
&
Estelle Baumann

EPFL

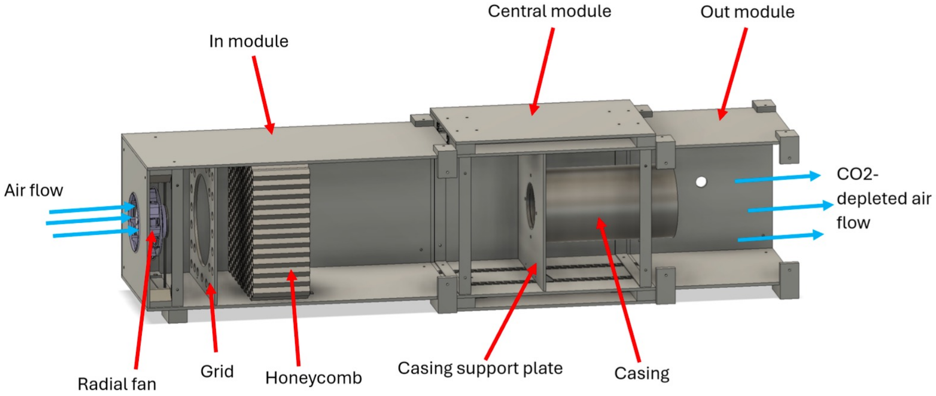
Who are we?

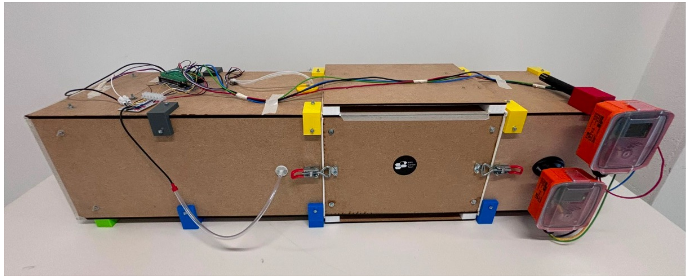
- MAKE project
- We capture CO_2 directly in surrounding air (DAC)
- Our main prototype Astérix:
  - Air flows from one side to another using a fan
  - Adsorbents: Small structures on which the CO_2 sticks when passing through
  - Temperature swing to adsorb the CO_2 (ambient T°) and release it in high concentration (high T°) for storage

1srt Project: Transport of the main prototype, Astérix

- Design, and hopefully build, a device to transport our prototype on long distances (across the campus for example)
- 3 meter long and very heavy (~400kg)

2nd Project: Air flux optimisation





- Reduce pressure drop by designing and testing different casings for the adsorbents
- Testing on smaller version of the prototype
- Small improvements to make on the prototype (adding sensors, etc)

Stay in touch :)

- Contact us:
  - presidentcarbonteam@epfl.ch
- Find the complete descriptions of the projects here:
  - https://drive.google.com/drive/folders/11i91q-3A8S3ZlZ_7i3RjnyPNJ8Z4n6PH?usp=sharing (French and English versions)
- More information on our website:
  - epflcarbonteam.ch

R – Rocket Team

SEMESTER PROJECTS SPRING 2025

EPFL ROCKET TEAM

DESIGN OF A 15 kN BI-LIQUID ROCKET ENGINE (DEMO-C1)

Professor : Eric Boillat

[Link to description]

Design a chemical propulsion engine combustion chamber

Themes

- CAD
- Mechanical Design
- Fluids Mechanics
- FEM
- Thermal Simulations

Timeline

- 3 weeks : State of the art and analysis of past projects
- 8 weeks : CAD design of the engine and simulations
- 3 weeks : Documentation

DEVELOPMENT OF A BARSKE E-PUMPS OF A ROCKET ENGINE

Professor : Pierre-Alain Mäusli

Link to description

Design a barske impeller electrical pump for a rocket engine

Themes

- CAD
- Mechanical Design
- Fluids Mechanics
- FEM

Timeline

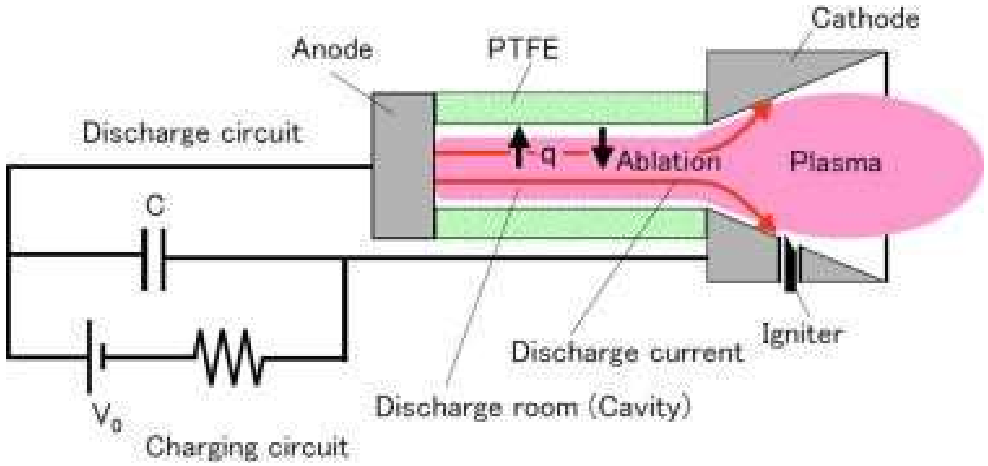
- 3 weeks : State of the art and analysis of past projects
- 8 weeks : Simulations and FEM studies
- 3 weeks : CAD modifications and documentation for production

ADVANCED DESIGN OF A PULSED PLASMA THRUSTER

Professor : Sébastien Soubielle

[Link to description]

Improvement of a pulse plasma thruster (satellite engine)



Themes

- CAD
- Data Analysis
- Manufacturing
- Test Engineering

Timeline

- 3 weeks : literature review
- 4 weeks : translating test data into design flaws
- 7 weeks : design improvements

ARCHITECTURE DESIGN OF A GAS DELIVERY SYSTEM FOR A HALL-EFFECT THRUSTER

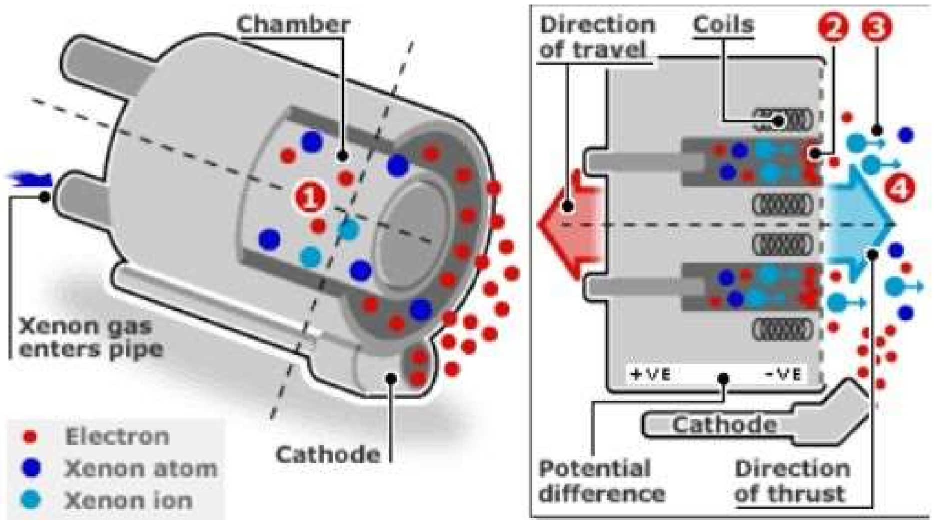
Professor : Flavio Noca

Link to description

Plumbing design of a hall-effect thruster (satellite engine)

Themes

- Fluid Mechanics
- CAD
- Prototyping
- Electromagnetism



Timeline

- 2 weeks : literature review
- 6 weeks : gas injector / plumbing design
- 3 weeks : prototyping
- 3 weeks : testing and iteration

CUSTOM INTERFACE FOR A PLASMA THRUSTER TEST BENCH

Professor : Josie Hughes

Link to description

Design electrical, plumbing and user interfaces for an electrical thruster test bench

Themes

- Electrical Prototyping
- Plumbing Design
- User Interface

Timeline

- 2 weeks : literature review
- 3 weeks : electrical interface
- 3 weeks : plumbing interface
- 4 weeks : testing

COMPETITION

MISSION ANALYSIS FOR THE RECOVERY SYSTEM OF A SUBORBITAL ROCKET

Professor : Volker Gass + Mathieu Udriot

Link to description

Design the early project phases of a recovery (parachute) system of a 100km rocket.

Themes

- Systems Engineering
- Requirements Engineering
- Mechanical Engineering
- Interface Management

Timeline

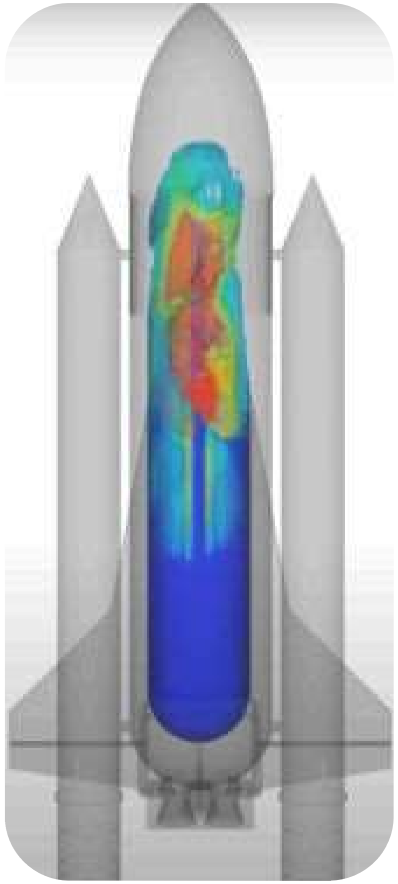
- 3 weeks : literature review
- 3 weeks : Identification of the mission needs, expected performance, and mission constraints
- 3 weeks : establish function tree, system modeling
- 4 weeks : establish technical requirement specification

EXPERIMENTAL ANALYSIS OF ROCKET TANKS SLOSHING AND VORTEX BUILDUP

Professor : Farhat

Link to description

Analyse fuel sloshing inside sounding rocket's tanks and find mitigations



Themes

- Prototyping
- Test Engineering
- Fluid Mechanics
- Mechanical Engineering

Timeline

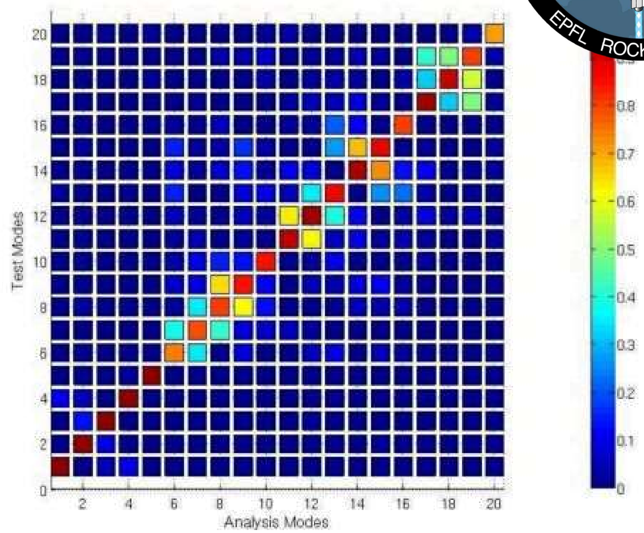
- 2 weeks : literature Review
- 3 weeks : mockup tank production
- 8 weeks : test campaign
- 1 week : documentation

STRUCTURAL ASSEMBLY VALIDATION VIA EXPERIMENTAL MODAL ANALYSIS

Professor : Villanueva, Burzio

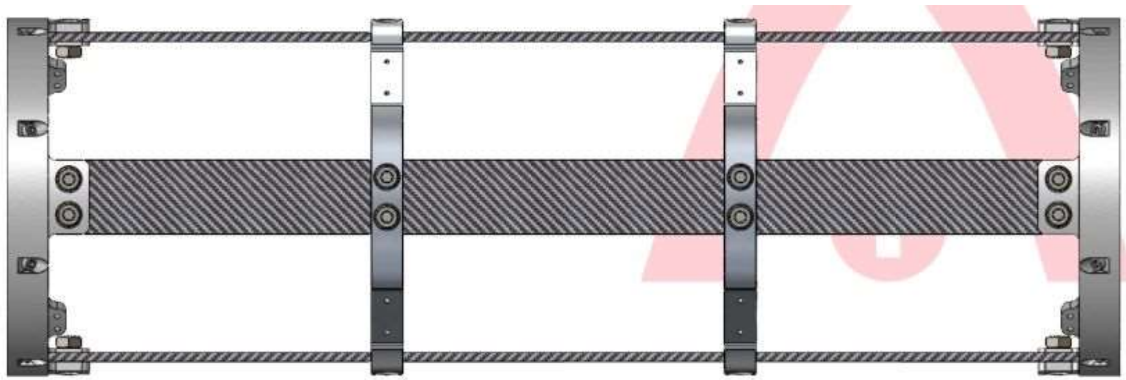
[Link to description]

Modal characterisation of the internal structure of 9 to 30 km sounding rockets



Themes

- Test Engineering
- Finite Element Analysis
- Mechanical Engineering
- Structural Dynamics



Timeline

- 2 weeks : literature review
- 5 weeks : setting up experiment
- 2 weeks : experimental analysis
- 4 weeks : FE Model correction
- 1 week : documentation

MANUFACTURING TECHNIQUE FOR COMPOSITE PARTS

Professor : Michaud

[Link to description]

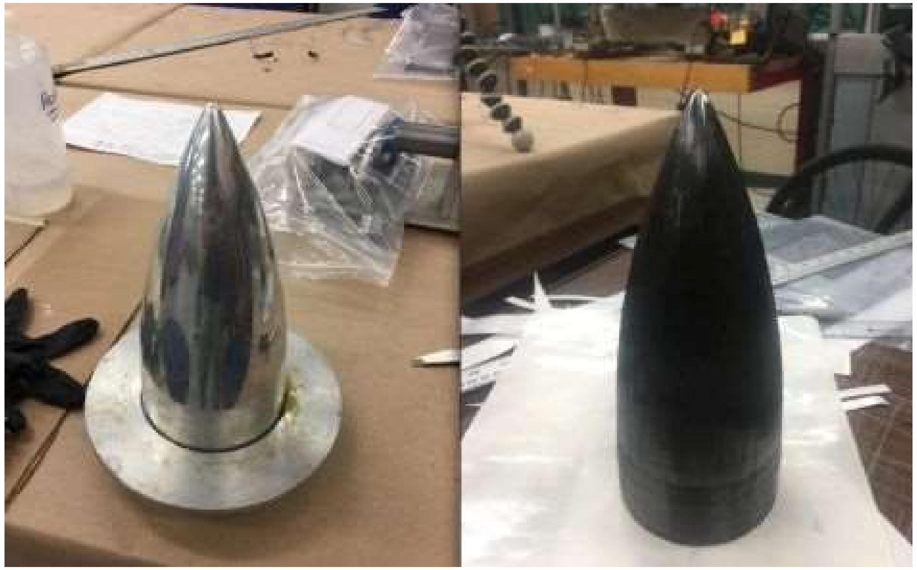
Build manufacturing methods to create large scale composite nosecones

Themes

- Composites
- Material Science
- Test Engineering
- Mechanical Engineering

Timeline

- 5 weeks : design
- 3 weeks : tooling manufacturing
- 6 weeks : parts manufacturing

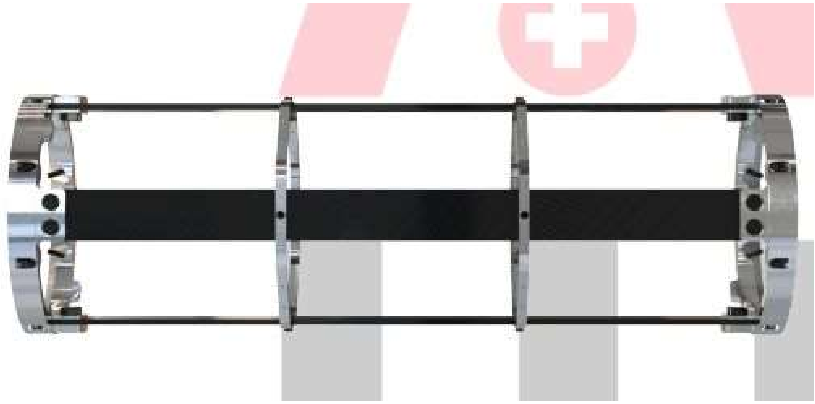


STUDY, DESIGN, AND ANALYSIS OF ANTI-BUCKLING RINGS

Professor : Michaud

[Link to description]

Optimisation of anti-buckling ring parts within the internal structure of the upcoming rocket



Themes

- Anisotropic solid mechanics
- Composites (CFRP)
- Lab work
- Static simulations

Timeline

- 2 weeks : literature review
- 2 weeks : simulations
- 2 weeks : testing samples production
- 6 weeks : mechanical tests
- 2 weeks : result analysis and reports

DESIGN AND MANUFACTURE OF A PROPELLANT FILLING STATION

Professor : Eric Boillat

Design, manufacture and test of a fuel filling station for the upcoming rocket

Themes

- Fluid Mechanics
- CAD Design
- Tests

Timeline

- 2 weeks : state of the art
- 8 weeks : system design
- 4 weeks : assembly, testing

SAFETY ANALYSIS FOR THE ADAPTATION OF AN ENGINE TESTING FACILITY

Professor : Gilles Feusier, Markus Jager

Link to description

Create new simulations for the safety analysis of the EPFL Rocket Team's rocket engine testing facility

Themes

- Simulations
- Risk management

Timeline

- 2 weeks : literature
- 3 weeks : blast analysis
- 3 weeks : scenarios analysis
- 2 weeks : parameter analysis
- 3 weeks : Firehorn II rocket adaptation
- 1 week : documentation

ICARUS

COLD GAS THRUSTER FOR ROLL CONTROL ON A HOPPER

Professor : Pierre Alain Mausli

Link to description

Design, manufacture and test of roll control gas thrusters to control the roll axis of the ERT's hopper

Themes

- Fluid Mechanics
- Compressible Fluids
- Control
- Mechanical Design
- Test Engineering

Timeline

- 2 weeks : literature review
- 4 weeks : system design
- 3 weeks : assembly and integration
- 3 weeks : testing
- 2 weeks : documentation

DESIGN, MANUFACTURE AND TESTING OF A REACTION CONTROL WHEEL

Professor : Pierre Alain Mausli

[Link to description]

Design a reaction wheel to control the roll axis of the ERT's hopper

Themes

- CAD
- Mechanical Design
- Manufacturing
- Tests on subscale drone

Timeline

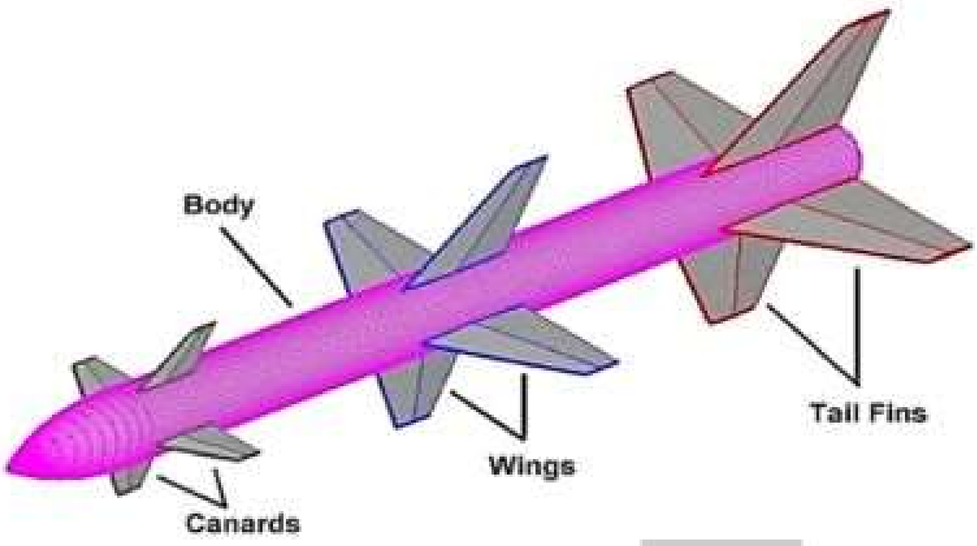
- 2 weeks : literature review
- 4 weeks : system design
- 3 weeks : assembly and integration
- 3 weeks : testing
- 2 weeks : documentation

PRELIMINARY DESIGN OF ACTIVE CONTROL ON A SUBORBITAL ROCKET

Professor : Sébastien Soubielle

[Link to description]

Design canards (small fins) to control a sounding rocket



Themes

- Systems Engineering
- Requirements Engineering
- Mechanical Engineering
- CAD
- Subscale prototyping

Timeline

- 3 weeks : literature review
- 4 weeks : technical requirements and deliverables
- 2 weeks : sizing tool creation
- 4 weeks : mechanical design