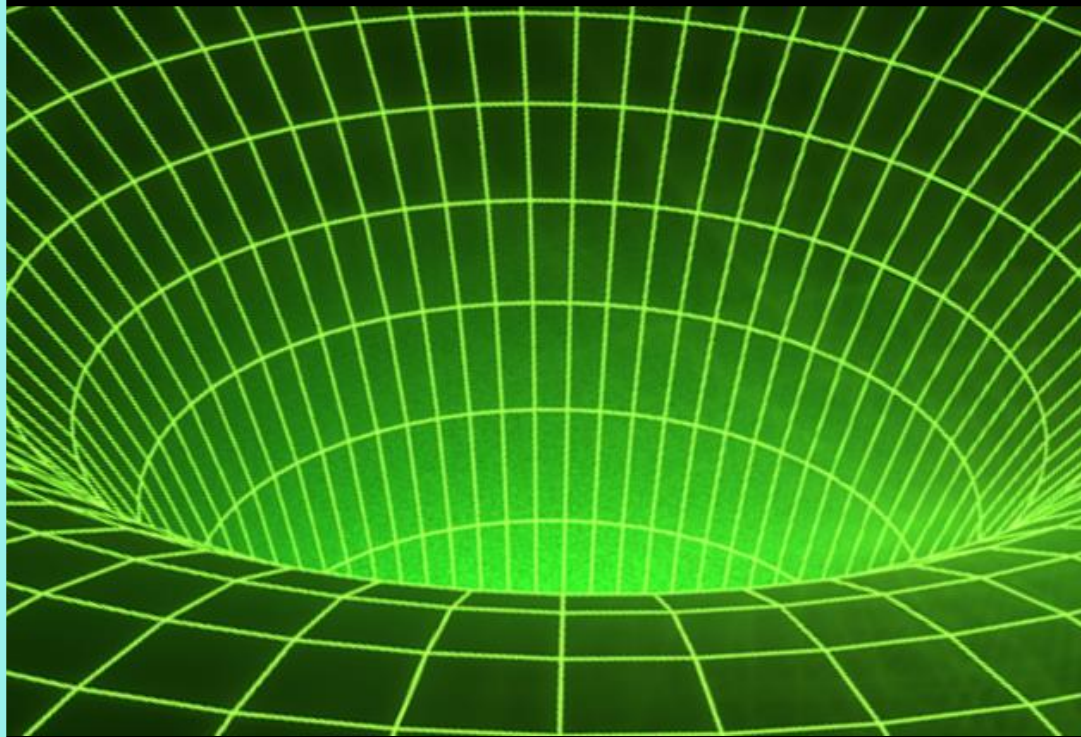


HARDWARE  
NOTEBOOK



iGEM CONCORDIA



## Rolling SMG/ Hardware Minutes

### Oct 14

- Wiki needs:
  - Reviewed in the Oct 7 minutes
- Rough timeline in projects of GH
- Keep GH or go to GL ()
- ITP timeline: set meetings and milestones
  - start/20% design/80%/final review/...
  - 20% quick troubleshoot/review of design
    - From 20 to 80: produce BoM
  - 80% movable target: design advanced,
  - Final: before manuf ~dec 19
  - Possible next steps (test + manuf)
- Manufacturing/sourcing:
  - PDMS/Acrylic
  - (hydrophobics) Coatings to avoid reaction.
- Tasks:
  - Fill up wiki sections in SMG Hardware team documentation
  - Timeline: Aurélien + Tim
  - Book Work session to book for filling up wiki section: add points meanwhile, meeting next wednesday to finish.

### Oct. 7th

- Google scholar: how to access documents.
- Wiki freeze: in two weeks, need a hardware page for this year:
  - Introduction/Definition of SMG, specify it is hardware, Usage
  - Why HARV + graphs
  - Rough timeline
- HW team: more coming for next year
- Timeline: how to structure, tasks can be parallelized
- Project management:
  - Documentation in a single document + folders: if it overflows we'll advise
  - github/gitlab no easy alternative known by us for milestones+tasks. Also wiki is not available for private github projects. If needed we can move to Gitlab which has it for free.
  - OK for tech team: code and mechanical

- give their name, get invited and push their name in the Readme
- Todo for end of weekend:
  - Aurélien: add details in the document, for use in the wiki page.
  - Aurélien: ask for team members github account.
  - Maher: start wiki, there will have a pres/meeting at some point to show it to the team.

## Oct. 5th

- Objective of meeting: Data acquisition & interesting metrics & find answers to these questions
- Notes
  - Simulated Microgravity is NOT microgravity  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3549630/>  
 (Compares different ground-based simulators)
  - However some organisms show similar effects in both situations:
    - Increased byproducts
    - Change in rate of proliferation
    - Gene expression

### Look at papers:

- Find out what biomarkers to analyze
- Find out what strain of yeast we will be working with (will we use yeast?) (is our yeast mobile?)
- Is there yeast mentioned in the papers (did they use a specific approach)?
- What do we need to have in the media to keep yeast happy?
  - O2%?
  - Nutrients?
- What temp range to keep the media at?
- How do we expose yeast to O2 without affecting the environment conditions (microgravity)
- Materials used to construct the bioreactor (autoclaving?)
- What RPM? 60 +-5?
- How long to run the experiment?
- Find out more about effects of shear forces during simulated micro-g? Do we want to minimize them?
- Is turbulence problematic?
- How does rotating media simulate micro-g?

### Objective for next meeting:

- Create a separate doc for all the questions with the found answers.
- Find answer to the questions above and below
- Start drafting timeline/deadlines for the project

## Sept. 30th

- Recapping bioreactor design
  - Meet design requirements
  - Does it cause issue for RPM vs RWV
  - RWV
    - Duration has to be three weeks? Accelerated evolution (200 gens)
    - Why three weeks? Adaptive evolution for yeast
    - Snapshots by taking samples
    - How many in parallel (18 total)
  - 200 gen of yeast in the same container?
    - Dead yeast vs fresh yeast
      - Outflow is crucial for the time duration
      - The idea of expanding volume based on population increase
      - Inflow and outflow circulate media
      - Oxygen flow in a bioreactor? Need to check more
        - Some use HARV with membrane on the outside, not sure how it works, but oxygen go in, waste go out, but not know the mechanism
        - Not the gas is the problem, the bubbles
          - Prevent bubbles, What bubbles affect in the microgravity simulation?
          - Oxygen somehow needs to be in the media, and cells get exposed to it
        - The media is always full, need to check and know how to input the oxygen
          - 3D clinostat
      - Zotero has info for RPM and HARV
      - Bioreactor design, some of them run exactly, temp
      - [https://synthecon.com/pages/perfusion\\_bioreactor\\_system\\_rccmax\\_synthecon\\_39.asp#](https://synthecon.com/pages/perfusion_bioreactor_system_rccmax_synthecon_39.asp#)
      - [https://www.nasa.gov/vision/earth/technologies/f\\_spacecells.html](https://www.nasa.gov/vision/earth/technologies/f_spacecells.html)
      - <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5127018/>
      - Need to assign a leader, recruitment coming up and can focus engineers to help out with HARV
      - Make milestones, with clear objectives
        - We know components “roughly”
        - Can create timeline to help understand needs
        - Resource allocation
      - Outro
        - Make sure everyone understand the basics
        - Timeline (rough and basic) and break down next meeting

- Rotating note taking
- RWV
  - Want sedimentation, rotation counteracts sedimentation (same as ISS in orbit around Earth)
  - Yeast survival 2-3weeks
  - How measure growth of cells? OD
  - Container could grow with cell growth? Pressure alleviation as well = good
  - How to deal with dead cells?
  - Input and Outputs of gases & liquids
  - 3D mixing
  - No bubbles!
  - Research Rotating Wall Bioreactor- flow rates
- We are building a Rotating Wall Vessel yay!
  - Literature list to go out today & presentation

## Sept. 23th

- Talk to Kenza about microfluidics
- RWV (rotating wall vessel) named, not a 2D Clinostat
- How many samples does Genetics need?
- What is the exact medium?
- Biocompatible materials?
- If build Random Positioning Machine could run RWV experiments by only running one axis
- Quote from Synthecon
- Check into cross contamination if stack compartments.

Pros/Cons Doc:

<https://docs.google.com/spreadsheets/d/1xDXT0v3qeelenWocjnrk0rnAks6NSVvHbHIuInZ7JMY/edit?usp=sharing>

## Sept. 19th

- Capstone updates
  - RPM (3D-clinostat) Miriam's team
  - HARV(2D-clinostat) J's team
- Teams
  - Clinostat - Nathaniel
    - Research
    - Make PPT of proposed design or thoughts
    - Send Edval documents
  - Bioreactor - Aurélien
    - Research

- PPT proposed design or thoughts
  - Preparations - Maher
    - Hardware layout for wiki
    - Required documentations for hardware part
    - Split tasks by next week

## Sept. 14th

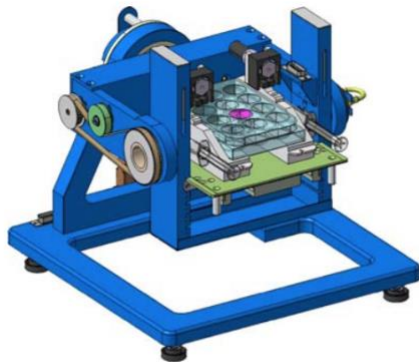
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    - Hardware layout for wiki
    - Required documentations for hardware part
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## Sept. 9th

- **This week:** Read, research and familiarize yourself with the field. Bring some designs you think are great to Felipe
  - Fill out the when to meet for a new meeting time [link]
- iGEM Team is creating a rotating cellular culture system/ rotating wall vessel with a bioreactor.
  - Look at microgravity simulators FOR YEAST
  - Then look at yeast bioreactors
- Capstone team will be on Clinostat
  - Miriam is interested
  - Follow up this week with interested teams
- Lancia → Share translated Edval doc.

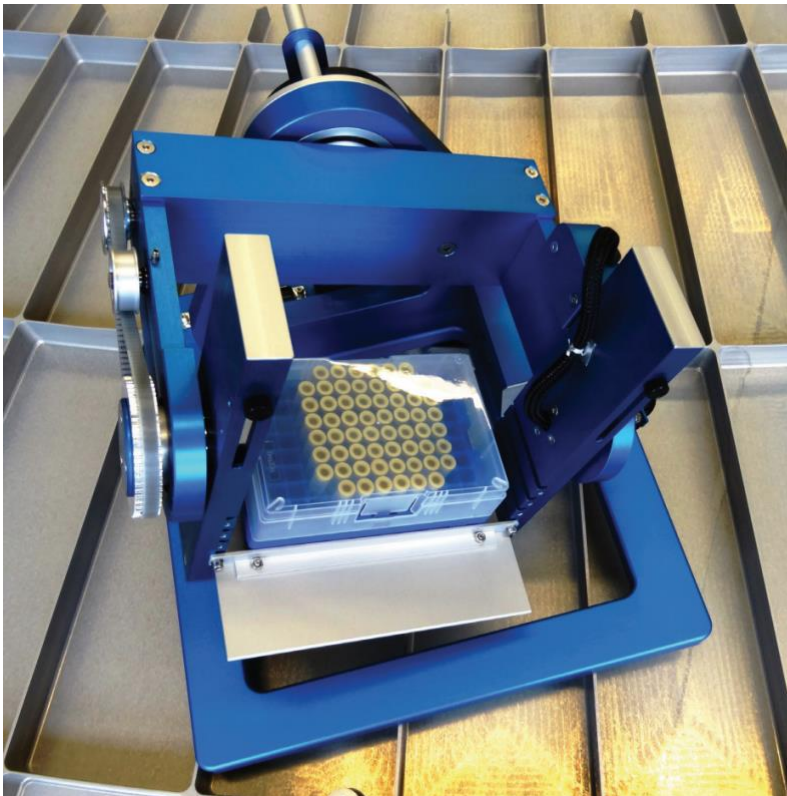
## Aug. 17th

- 3D Clinostat with bioreactor, 96 well plates, nutrient flow
- *And* RWV with or without nutrient flow
- Bioreactor:
  - Calgary (Mackenzie ?)
  - Determine: Flow rate & rate of consumption of nutrients, what nutrients, what kind of membrane, what gases, growth rate of yeast, viscosity of media
  - Rate of consumption by yeast [Genetics]
  - Nutrient pack/ modularity → weight, ug, rate of consumption, how does exchange occur,
  - Tufenkji, Nathalie, McGill [Lancia→ set up interview, concept first]  
<https://www.mcgill.ca/study/2017-2018/courses/chee-474>
  - Kamen, Amine  
<https://www.mcgill.ca/study/2019-2020/courses/bien-590>
  -
- Absolute requirements: [Hardware team]
  - Temperature monitoring
  - Media flow- bioreactor
  - Reduce vibrations mechanical side & from environment (shared lab benches)
    - Dampening/ optical table w/ vibrational monitor (Shih lab?)
  - Microgravity detector
  - Measuring OD (optical density) to monitor growth rate → could be external
- Other requirements:
  - Fluorometer (GFP)
- iGEM teams bioreactors? Fluorometer?
  
- It is important to accommodate an experiment exactly in the center of an RPM. The rotation of the sample induces also centripetal acceleration. Placing the sample in the centre of the RPM this effect will be negligible but when using larger samples volumes or multiple samples especially in combination with high rotation speeds these residual accelerations may become relevant (van Loon 2007).
- file:///Users/Conepine/Desktop/Borst-Loon2008\_Article\_TechnologyAndDevelopmentsForTh.pdf



**Fig. 6** COBRA facility on a desktop RPM. In this set up fibroblasts cells were used attached to round micro slides placed in the central cell of the multiwell plate

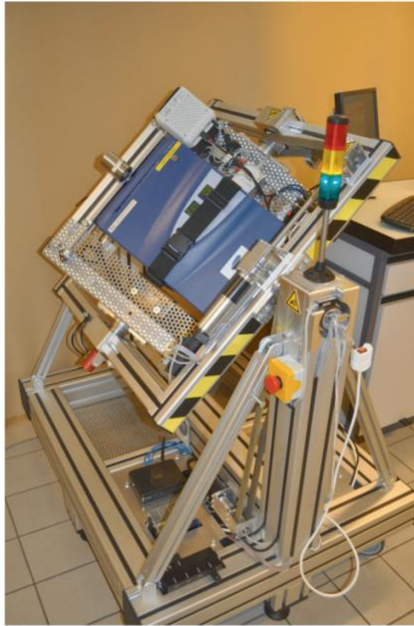
- 
- Detector
- <https://www.airbusdefenceandspacenerlands.nl/dsstuff/uploads/2018/02/RPM-2.0-10-2017.pdf>



- Bioreactor
- <https://www.hslu.ch/en/lucerne-school-of-engineering-architecture/research/competence-centers/bioscience-and-medical-engineering/ground-based-facility/>



- <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1016.4982&rep=rep1&type=pdf>



**Figure 1.** A recent version of the random positioning incubator (RPI) as designed and developed by the project partner FHNW based on collaboration and requirement specifications of ETHZ. The RPI consists of two gimbal-mounted frames, which are driven by electrical motors, and a CO<sub>2</sub> incubator mounted at the center of rotation of both frames.

- A unique feature of our present RPM, the RPI version, is the integration of a miniaturized CO<sub>2</sub> incubator including a 14 L test chamber, mounted at the center of rotation of both frames (Fig. 1). The specially functionalized incubator is supplied with electrical power and CO<sub>2</sub> (and other experimental supplies) throughout the experiment's duration. Important data such as temperature, CO<sub>2</sub> levels, and mean gravity values are monitored automatically.
- The cells were loaded at a concentration of 1 to 2 · 10<sup>6</sup> cells/mL inside the "LYCIS" hardware, which has been developed specially for space experiments. This hardware is based on the principle of moving pistons that allows the loading of cells in the absence of air bubbles and the injection of substances rapidly without opening the hardware.
- <https://europepmc.org/article/pmc/pmc6560652>  
Space, static, RWV, RPM

## Aug 10

- Richard Barker Wednesday pm
  - Did he confirm? Send a reminder
  - What would we like to cover?
- Canadian Space Agency
- Shaking speed- yeast settles quickly

## Aug 3

- RPM or 2-axis : find papers and defend choice
- Code pattern into software and test to see which one simulates microgravity best
- Replicate experiments in the lab and see if the results are the same.
- Stepper or not
  - Vibration deal breaker
  - Decrease vibration in code
- Cost and simplicity of execution
- Why 3D printing? Is it cheaper and easier? Or go buy pipes?
- What size culture dishes?
- Recruit : Capstone?
  - Electrical/ Computational Engineering, Space Concordia special projects
  - Computer, electrical and mechanical
  - Do you want to build a microgravity simulator for biological researchers? Join us!
  - Space field
  - System to SMG to test microorganisms
- Richard Baker

### Edval Rodrigues de Vivieros & Dyogo Henriques

- Humidity, **temp**, luminosity
- Share designs

Recruitment for 2021 Hardware Tem Sent:

<https://www.concordia.ca/ginacody/students/associations.html>

**CSCE (Concordia Society for Civil Engineering)**- Facebook

**CSME (Canadian Society for Mechanical Engineering)**- Facebook Group pending

**ECA (Engineering and Computer Science Association)**- private gmail

**IEEE (Institute of Electronic and Electrical Engineers)**- private gmail

**Women in Engineering- Facebook**

**SCS (Software Engineering and Computer Science Society)**- gmail

**Space concordia- Facebook**

**UAV Concordia- Facebook**

Size of multiple containers **NOT FINALIZED**

