

# DECEL Project

## Training activity C2

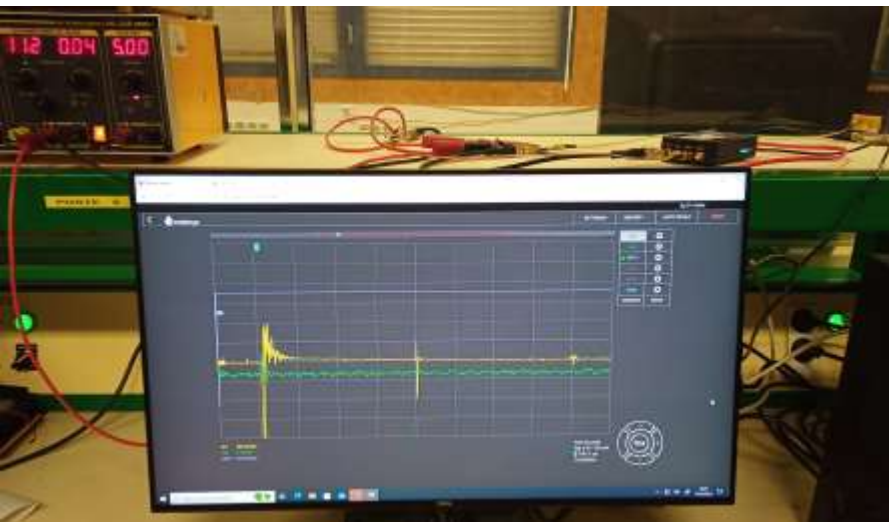


### *Ultrasound & ecosystems*

### *Remote course before DECEL Festival:*

Tours, June 28<sup>th</sup> 2023

[etienne.Lemaire@univ-tours.fr](mailto:etienne.Lemaire@univ-tours.fr)



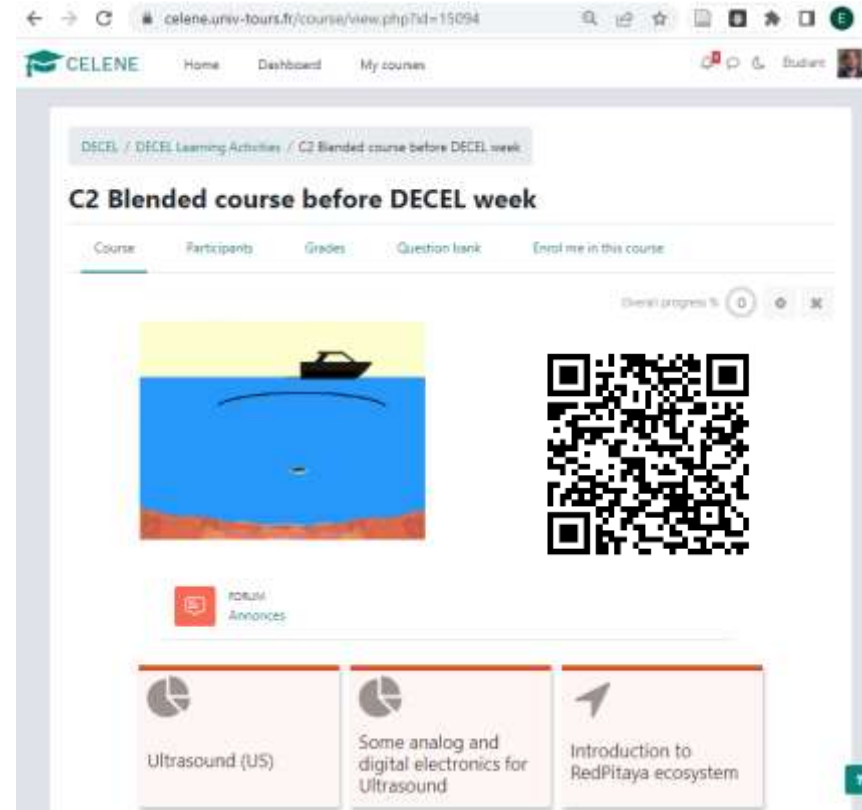
Co-funded by  
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# DECEL remote course before C2



## Introduction pitch (synchronous session by E. Lemaire)

- Online course
  1. Ultrasound
  2. US Electronics A&D
  3. Redpitaya ecosystem
- Project overview
- Teams
- Useful info



# DECEL remote course before C2

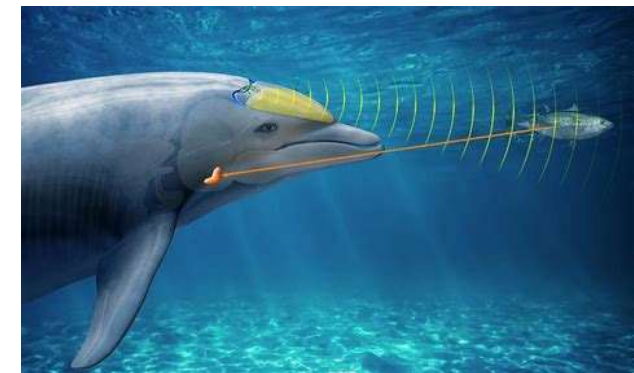
Introduction pitch (synchronous session by E. Lemaire)

- Online course

1. Ultrasound

- a. Basics:

- ✓ Mechanical wave ( $>20$  kHz)  $\approx \approx \approx \rightarrow c_{\text{air}} = 340$  m/s ;  $c_{\text{water}} = 1500$  m/s
- ✓ Applications: sonar, echography, etc.
- ✓ *The only way to vision in opaque water-based media*



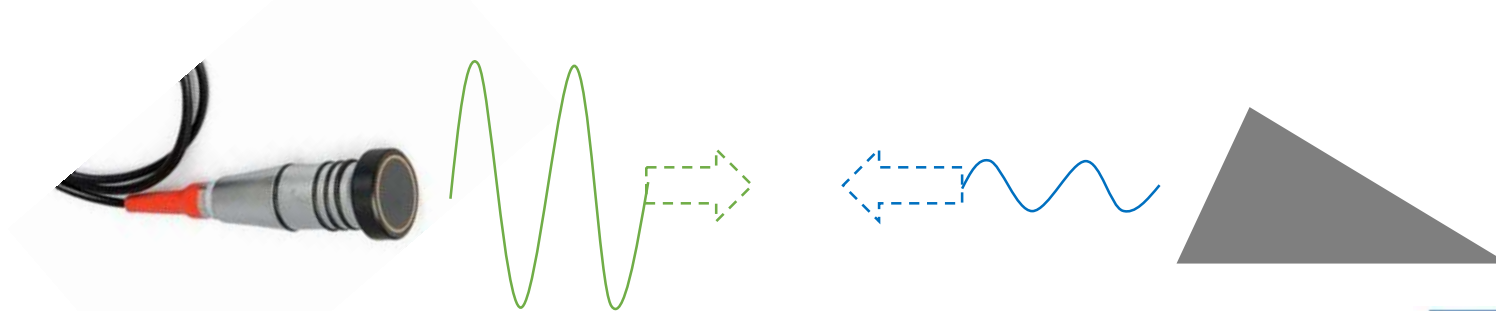
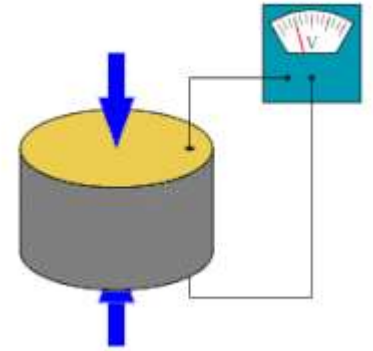
# DECEL remote course before C2



## 1. Ultrasound

### b. Probe:

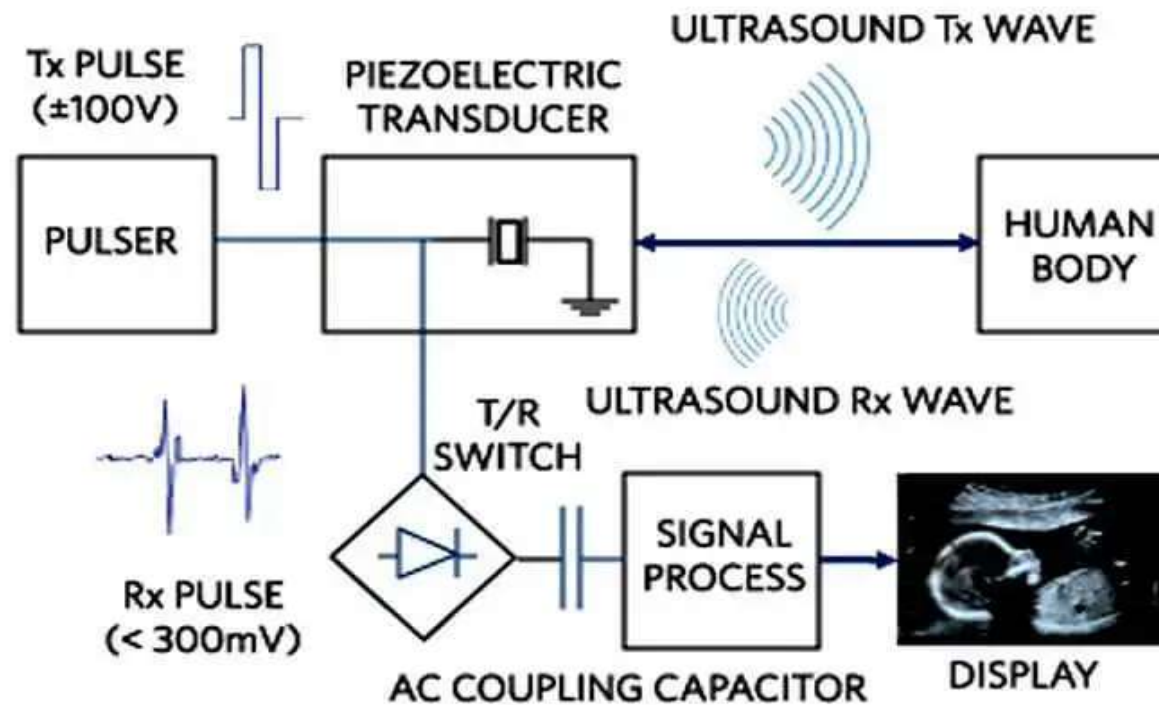
- ✓ Electro-mechanical transducer => Piezoelectric material
- ✓ Ultrasonic probe => 1 or more piezoelectric ceramic(s).
- ✓ Probe as actuator/**emitter**: large electrical pulse => (focused) acoustic signal
- ✓ Probe as sensor/**receiver**: small acoustic signal incoming => small electrical signal



# DECEL remote course before C2



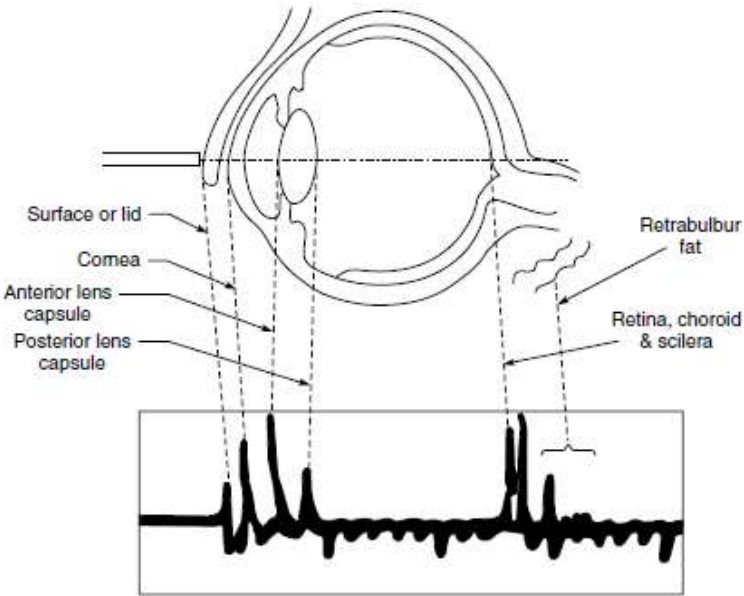
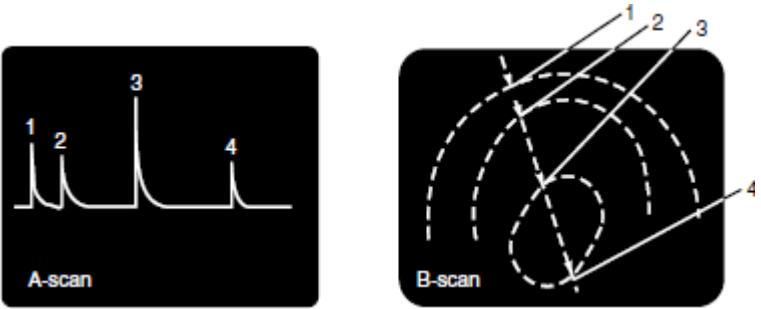
1. Ultrasound
  - b. Architecture:





# DECEL remote course before C2

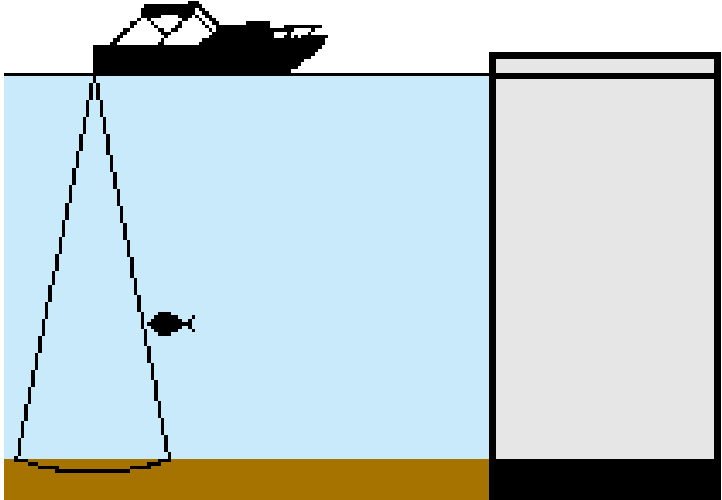
## 1. Ultrasound d. Signals:



A-mode scan



B-mode scan



# DECEL remote course before (C2)



## More information ?

- Online course

1. Ultrasound
2. US Electronics A&D
3. Redpitaya ecosystem



⇒ Go on our Moodle platform

⇒ <https://celene.univ-tours.fr/course/view.php?id=15094>

The screenshot shows a Moodle course page for 'Remote course before DECEL week (C2)'. The page includes a navigation menu with 'Course', 'Participants', 'Grades', 'Question bank', and 'Enrol me in this course'. Below the navigation is a large image of a boat on water. There is a 'FORUM Announces' section and three course modules: 'Ultrasound (US)', 'Some analog and digital electronics for Ultrasound', and 'Introduction to RedPitaya ecosystem'.



# DECEL course during the week (C2)



## @ Tours

- Online course for the week
  1. Tuto1 : acquire US signals
  2. Tuto2 : 1<sup>st</sup> US scan
  3. Tuto3 : dedicated hard&soft

⇒ Go on our Moodle platform

⇒ <https://celene.univ-tours.fr/course/view.php?id=16438>



DECEL / DECEL Learning Activities / DECEL week (C2)

### DECEL week (C2)

Course Participants Grades Question bank Enrol me in this course

Overall progress % 100

Red Pitaya ecosystem

1 Ultrasound board and Redpitaya ecosystem

2 Ultrasound imaging with Arduino and Redpitaya

3 FPGA reconfiguration for fast ultrasound recording

Basics of Verilog FPGA programming language

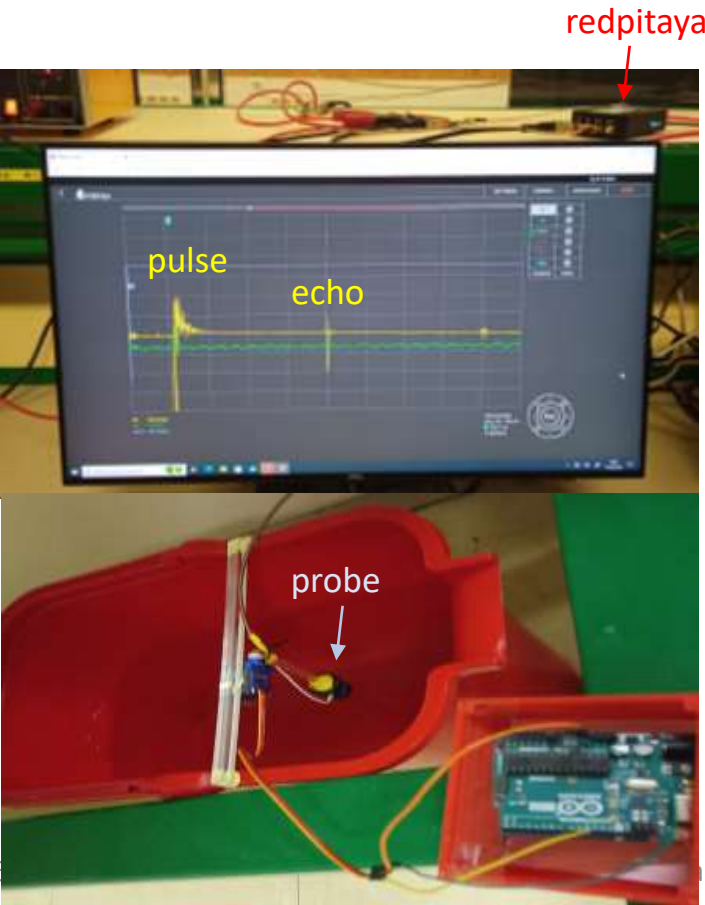
Related FPGA activities for RedPitaya

Other Videos and References

# DECEL festival project proposal



- What's in the opaque liquid (muddy river, etc.)?



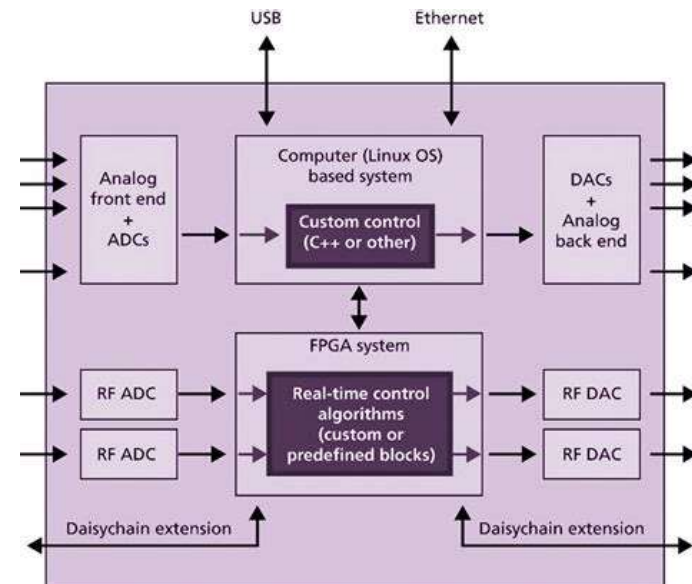
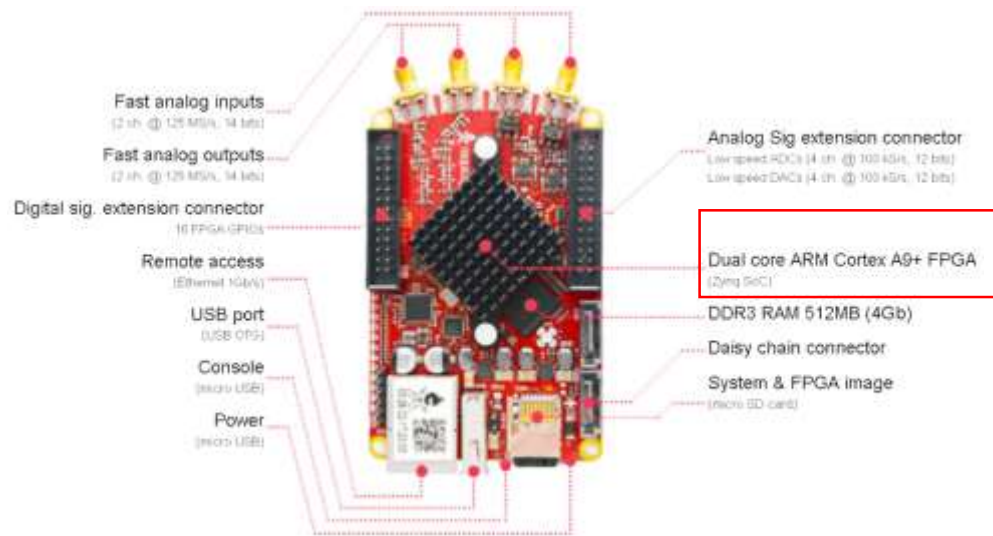
**Goal : get an Ultrasound 2D image**

- Scan driving  
⇒  $\mu$ C driving
- Ultrasound signal treatment ( $\Leftrightarrow$  « A-mode scan »)  
⇒ FPGA /  $\mu$ P
- Image reconstruction  
⇒ FPGA /  $\mu$ P
- Optimisations paths (team work/level)  
⇒ Signal & image processing, architecture, scan velocity, etc.

# Redpitaya board



- Redpitaya : « all in one Digital Board » =>  $\mu$ P + FPGA
- Programmable from HDL to Python



Introduction to RedPitaya ecosystem

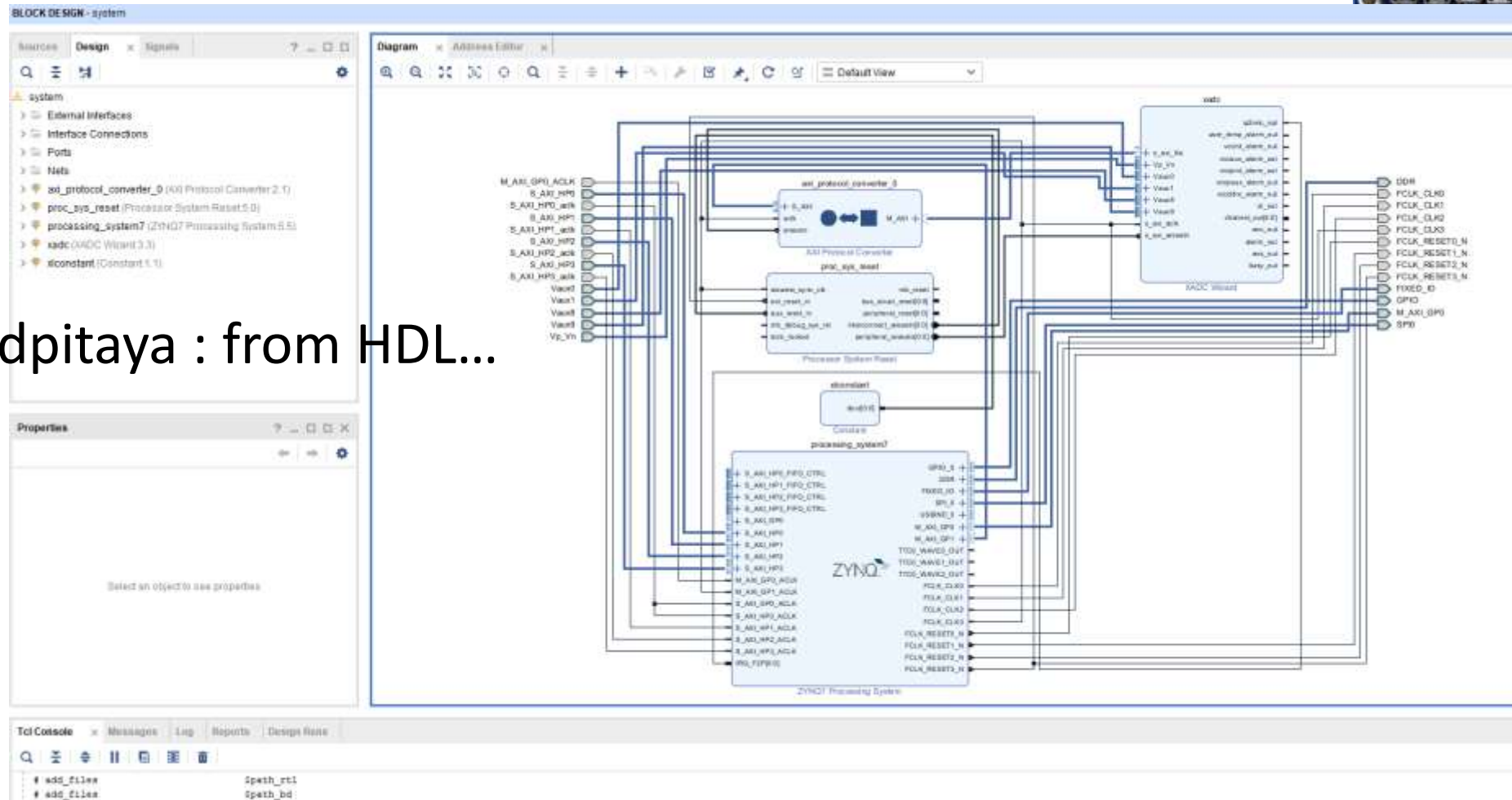
<https://celene.univ-tours.fr/course/view.php?id=15094>



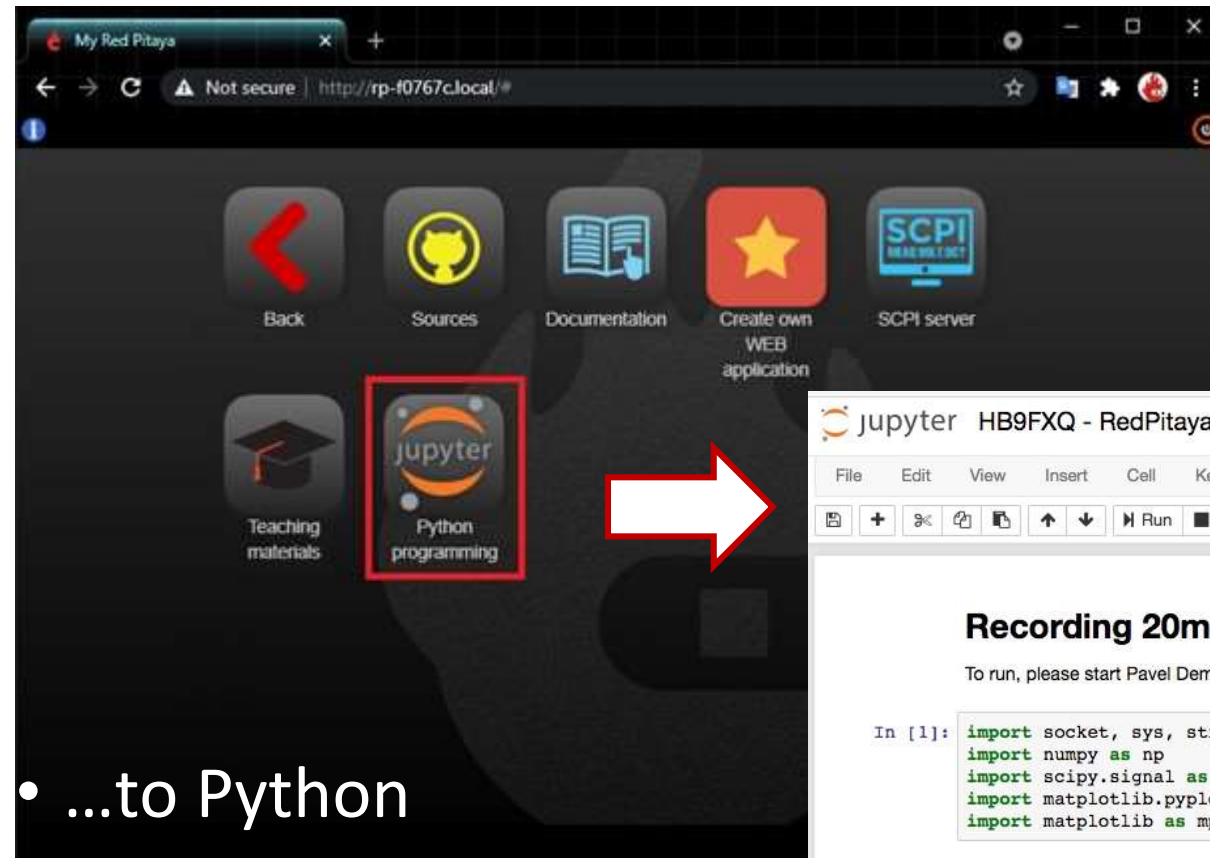
# Redpitaya board



- Redpitaya : from HDL...



# Redpitaya board



• ...to Python

jupyter HB9FXQ - RedPitayaCapture Last Checkpoint: Last Sunday at 18:24 (autosaved) Logout

File Edit View Insert Cell Kernel Widgets Help Trusted | Python 3

Run Code

**Recording 20m band, Fs = 250e3, Fc 14.1e6 -> Fc interest 14.075e6**

To run, please start Pavel Demin's 'SDR\_Transceiver' on redpitaya

```
In [1]: import socket, sys, struct, argparse, signal, os, time, scipy
import numpy as np
import scipy.signal as signal
import matplotlib.pyplot as plt
import matplotlib as mp
```

Parameters

```
In [2]: arg_addr = "192.168.92.195"
arg_fc = 14.1e6
```


# Software list





[optional] You may want to install some of these software programs on your laptop computer:

## Software List

 URL  
Vivado 20.1 (for redpitaya projects)

 URL  
Arduino IDE

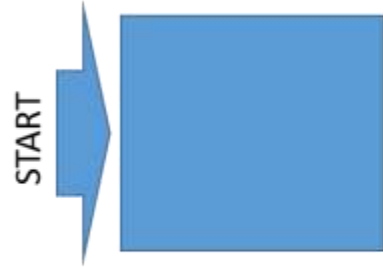
 URL  
Tera Term

 URL  
Notepad++

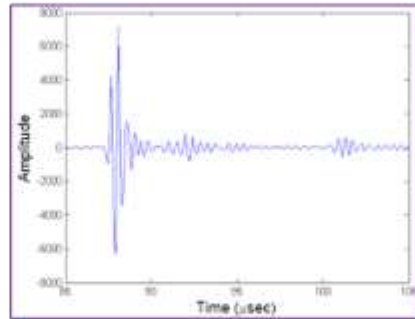
 URL  
Python (Spyder)

# Challenge

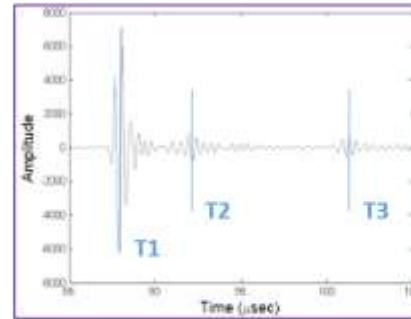
Don't worry, it is a Game ... You will go step by step ... And learn a lot (we hope!)



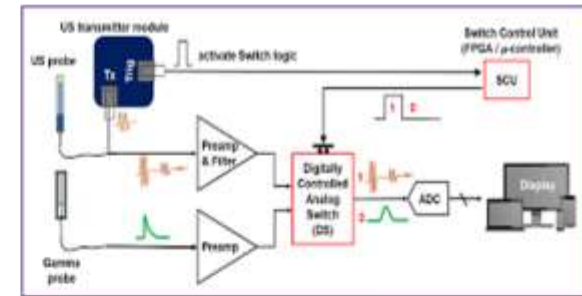
Step 1



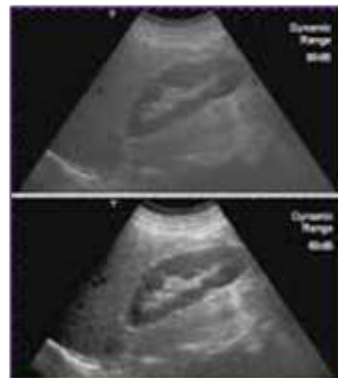
Step 2 (optional)



Step 3 (optional)



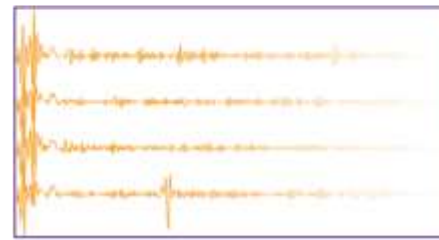
Step 5



END



Step 4



# DECEL Festival

## Teams ?

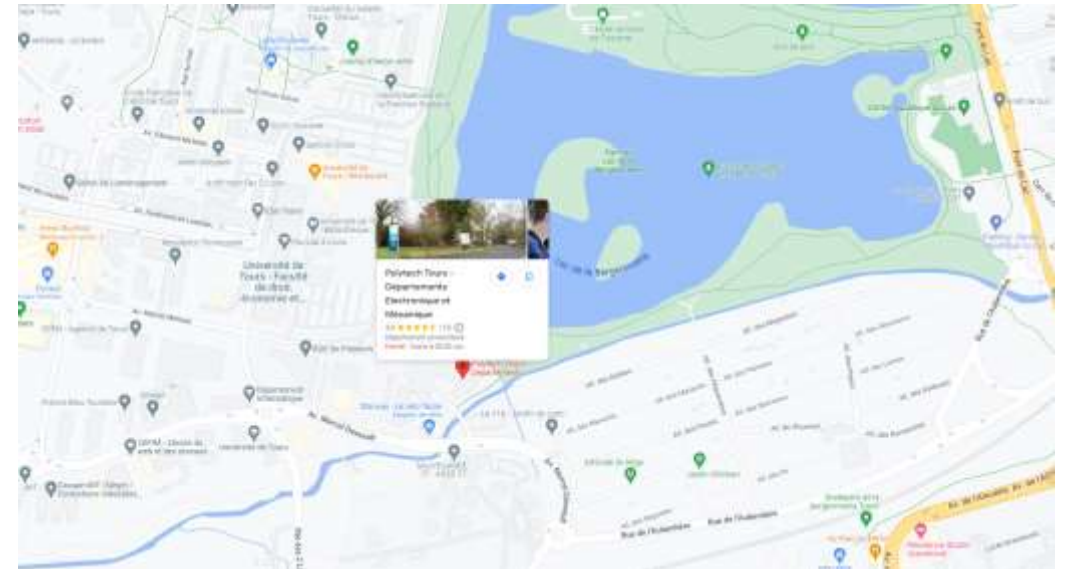
- 5 teams of 4 students



## Location:

- At Polytech Tours,  
Electronic department (Tours Sud, France)

More info : [decel.eu](http://decel.eu)





# DECEL Festival

## Teams ?

- 5 teams of 4 students



Villandry
Sakji Islem
Iris Hoxhaj
Pedro Afonso de Sousa Vieira
Rubén Gil Vera

Blois
Aubry JACQUENOD
Giulia Nenna Ufondu
Maria Francisca Fontes da Silva
Abelardo Hernandez Cortizo

Clos Lucé
ABUDUJIASUER Yilihamu
Andrea D’Antona
Ivan Cojocararu
Pablo Almagro Dávila

Chenonceau
Jiacheng CHEN
Enrico Rizzi
Jorge Miguel Lopes Pais
Jaime Leal Peñasco

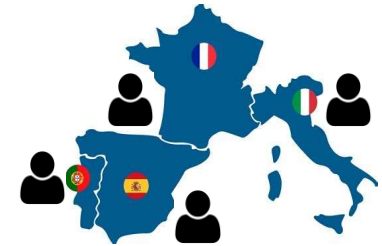
Amboise
Juline Cloet
Matilde Cotta-Ramusino
Pedro Osswald Claro
Mario Robles Salamanca

Say hello to your team ?  
Share your email now ?

# DECEL Training C2

## Teams

- 5 teams of 4 students



Villandry
Sakji Islem
Iris Hoxhaj
Pedro Afonso de Sousa Vieira
Rubén Gil Vera

Blois
Aubry JACQUENOD
Giulia Nenna Ufondu
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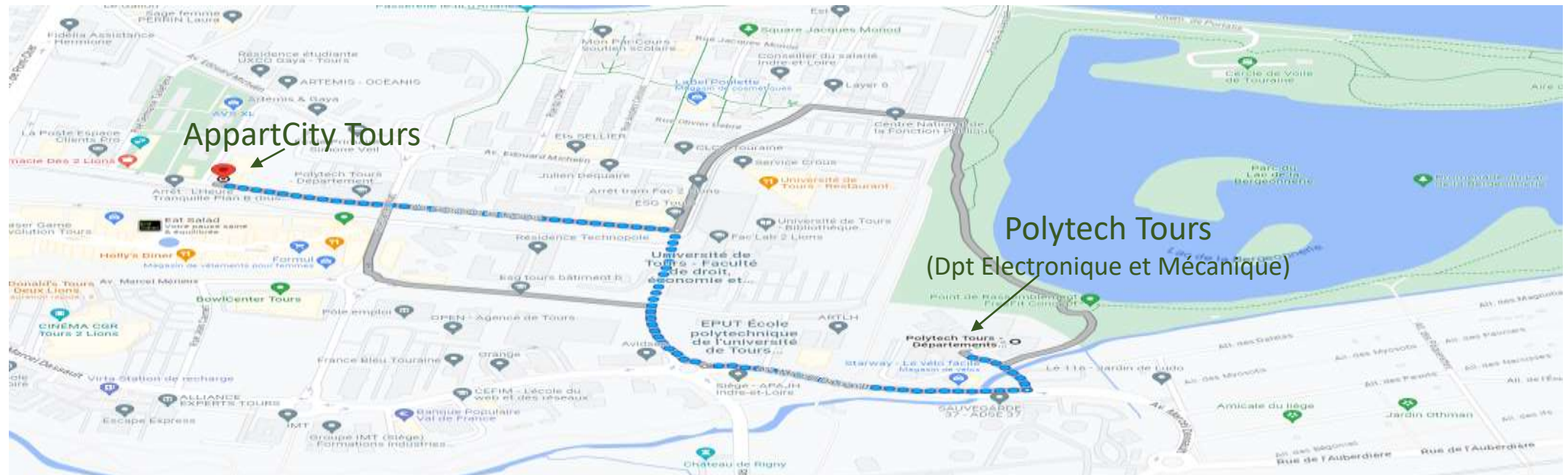
Chenonceau
Jiacheng CHEN
Enrico Rizzi
Jorge Miguel Lopes Pais
Jaime Leal Peñasco

Amboise
Juline Cloet
Matilde Cotta-Ramusino
Pedro Osswald Claro
Mario Robles Salamanca

# DECEL Festival

## Accommodation ?

- 4 apartments
- **AppartCity Tours, 12 Rue Paul Nizan, 37200 Tours, France**



# DECEL week program

3-7 July 2023



Co-funded by  
the European Union



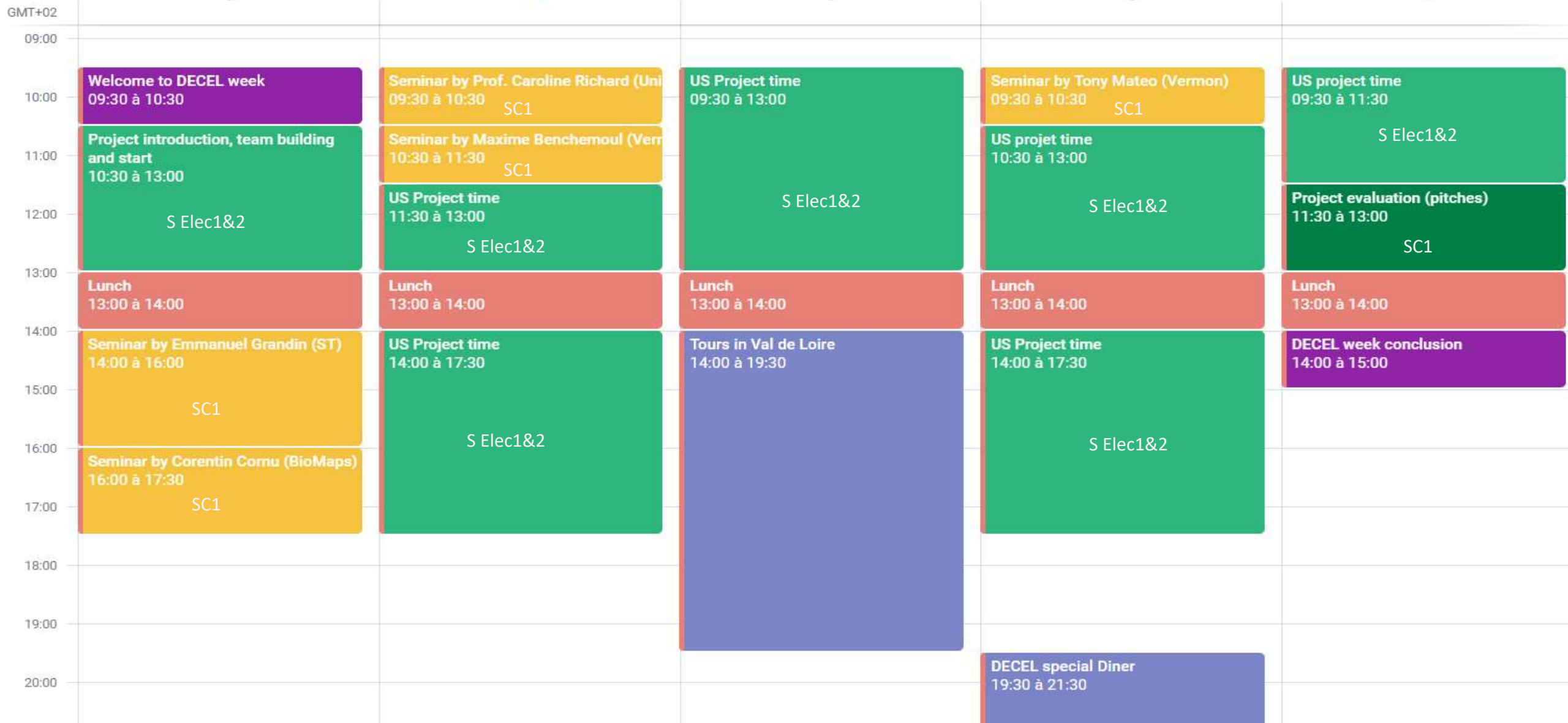
3

4

5

6

7



# Questions



- What would you like to ask me?

Google Maps

