COSMOS Educational Toolkit

Abhi Adhikari

Department of Electrical and Computer Engineering, Columbia University

https://cosmos-lab.org/outreach

August 2022

COSMOS Outreach

- Global economy changing via technological advances

- ***All students*** should have quality access to science, technology, engineering, and math (STEM) precollege coursework

- Higher education is **critical** in preparing the next generation of STEM professionals

- **This work** → Develop a teacher's professional development (PD) program and an educational toolkit, using wireless communications and Next Generation Science Standards (NGSS)
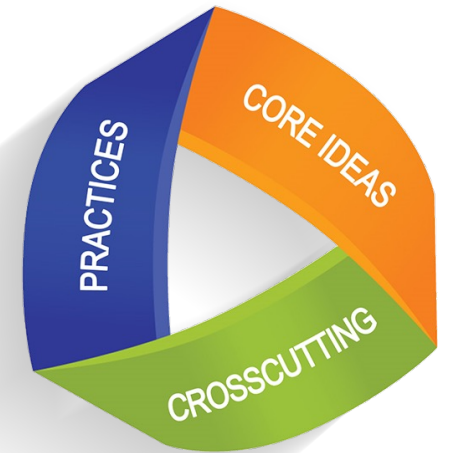
How could engineers and educators collaborate to create a wireless communications teacher PD program in order to develop NGSS lessons with STEM teachers?

Program Overview (1/3)

a. **Lecture and lab phase:** The participants are introduced in fundamental and some advanced concepts in wireless communications and networking
    - $8K stipend for summer

b. **Design phase:** The participants conduct research on potential educational NGSS STEM lessons with a hands-on wireless labs using the 'COSMOS Educational Toolkit'
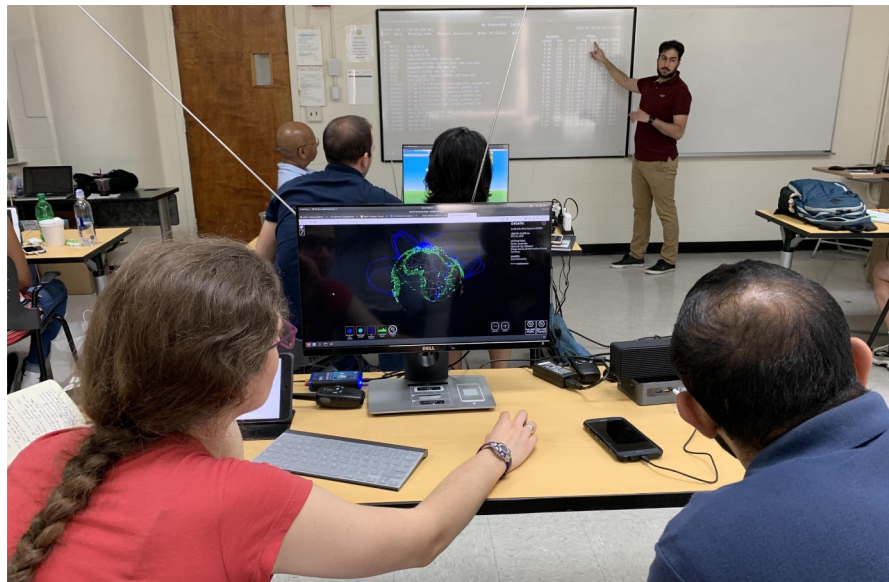

Fig: Participants attend an instructor-led lesson using the 'COSMOS Educational Toolkit'

Fig: Participants conduct research using sensors

Program Overview (2/3)

c. **Development phase:** teachers co-develop with the researchers their best ideas on how to use the wireless labs for NGSS-aligned STEM lessons

d. **Implementation phase:** teachers and students use the developed lessons in the class during the school year

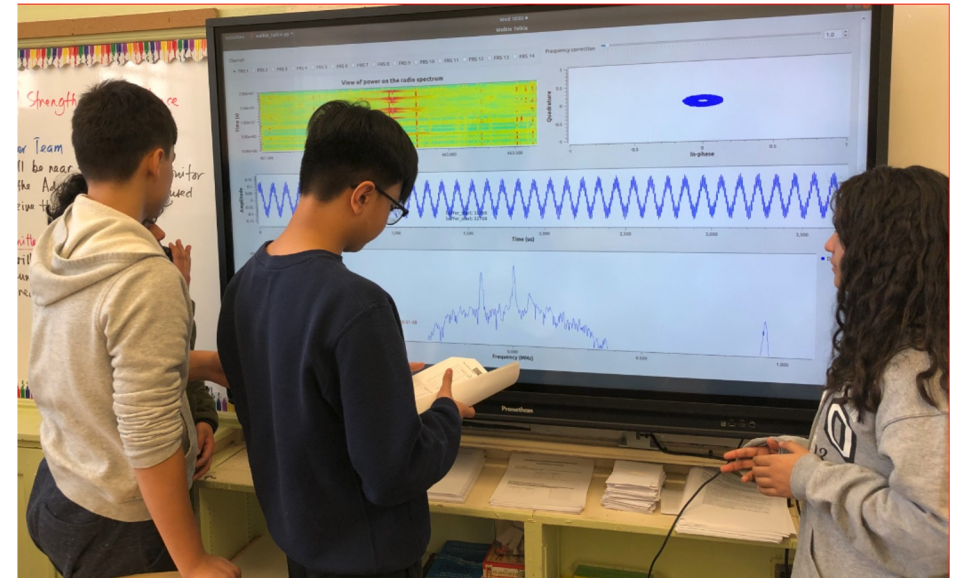**Fig:** Teachers present their developed NGSS lesson plans at Silicon Harlem

Fig: Middle school students using the 'COSMOS Educational Toolkit' in a Mathematics Class

Program Overview (3/3)

e. **Feedback phase:** teachers provide feedback in order to improve the NGSS STEM lessons and develop new ones
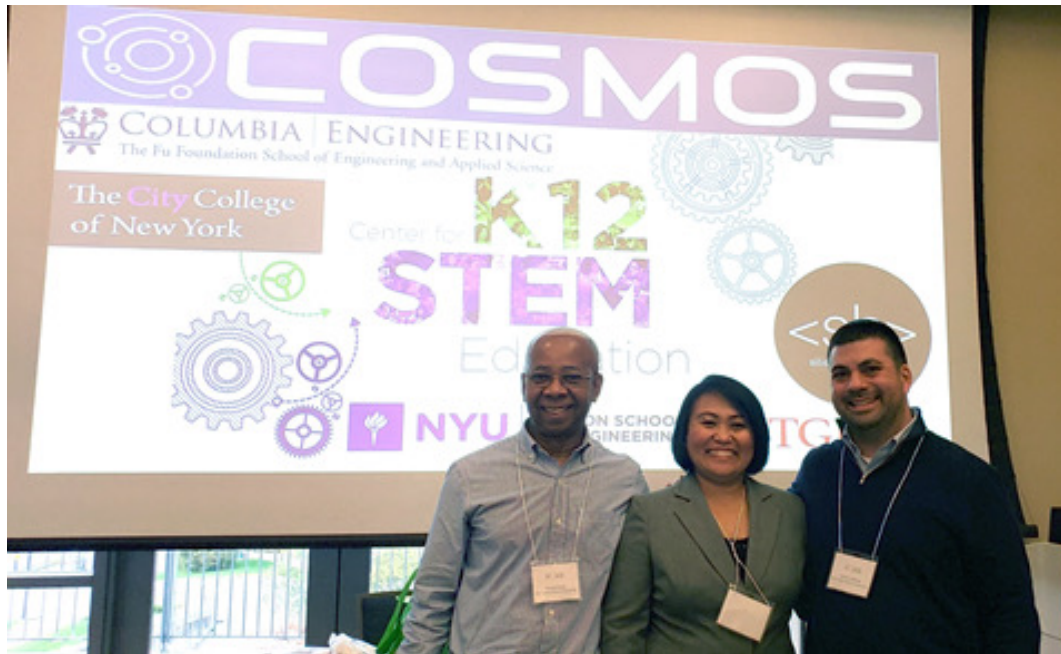
Fig: Teachers present the PD Program and the developed NGSS Lesson Plans at the NE-ASTE Conference 2018

COSMOS Educational Toolkit

- Hardware components:
  - **Processing Units:** Intel NUC, Raspberry PI
  - **Software Defined Radio:** ADALM Pluto SDR, RTL-SDR
  - **IoT Nodes:** Arduino/Micro:bit, XBEE/BLE, sensors
- Software components:
  - **Web front-end interface:** HTML, CSS and Javascript
  - **Web back-end server:** Python
  - **SDR Software:** GNU Radio
  - **IoT management:** influxdB and Chronograf

Fig: Hardware components of the 'COSMOS Educational Toolkit'

Example Lab: Destructive Interference

Example Lab: Photosynthesis

outdoor sunlight
bkgnd CO_2 = 715 ppm

COSMOS tool kit

Mobile Node & IoT Gateway

Wireless

background CO_2 = 1.44 kppm

plant photosynthesis CO_2 = 1.40 kppm (3%)

No Results

M Pluto R
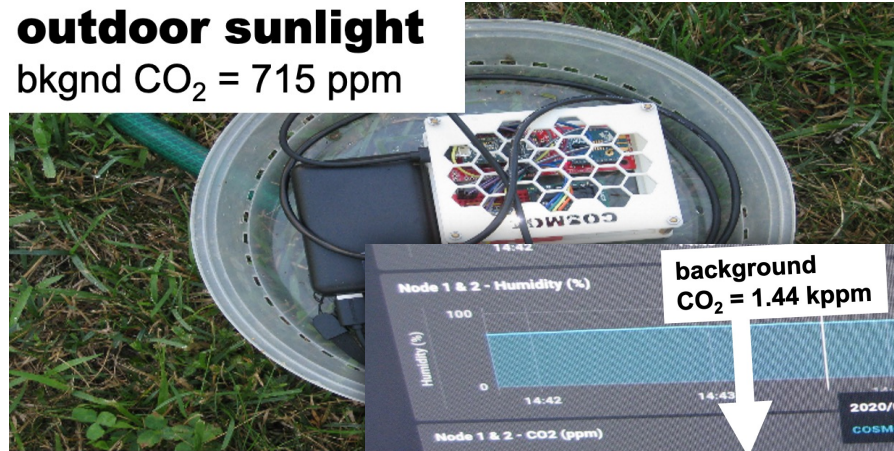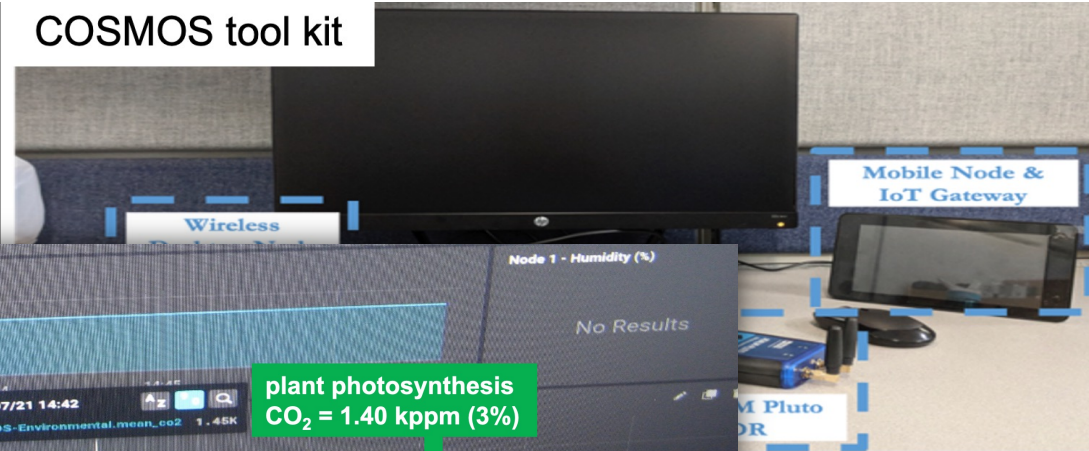
Japanese boxwood
CO_2 = 700 ppm (4%)

light bulb lit indoors +CO2 (exhale)
bkgnd CO_2 = 32.4 kppm
Magnolia CO_2 = 31.0 kppm (5%)
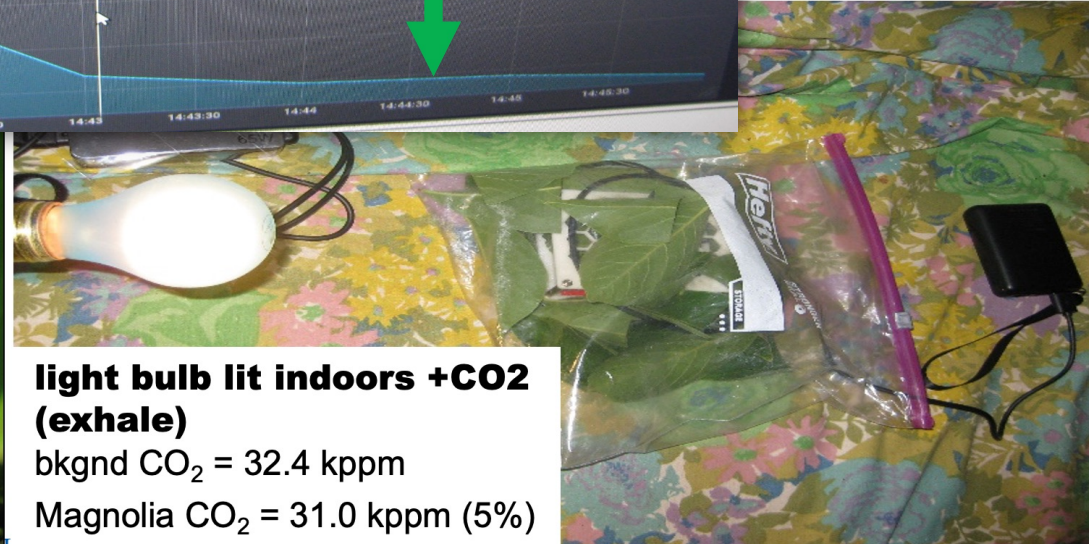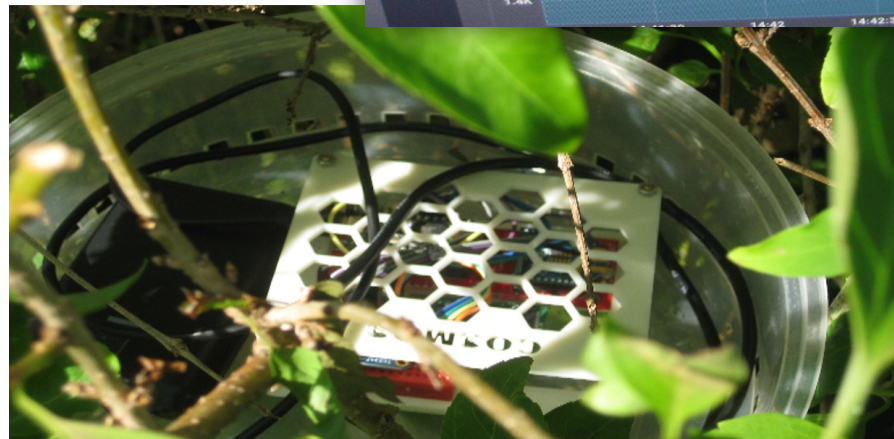
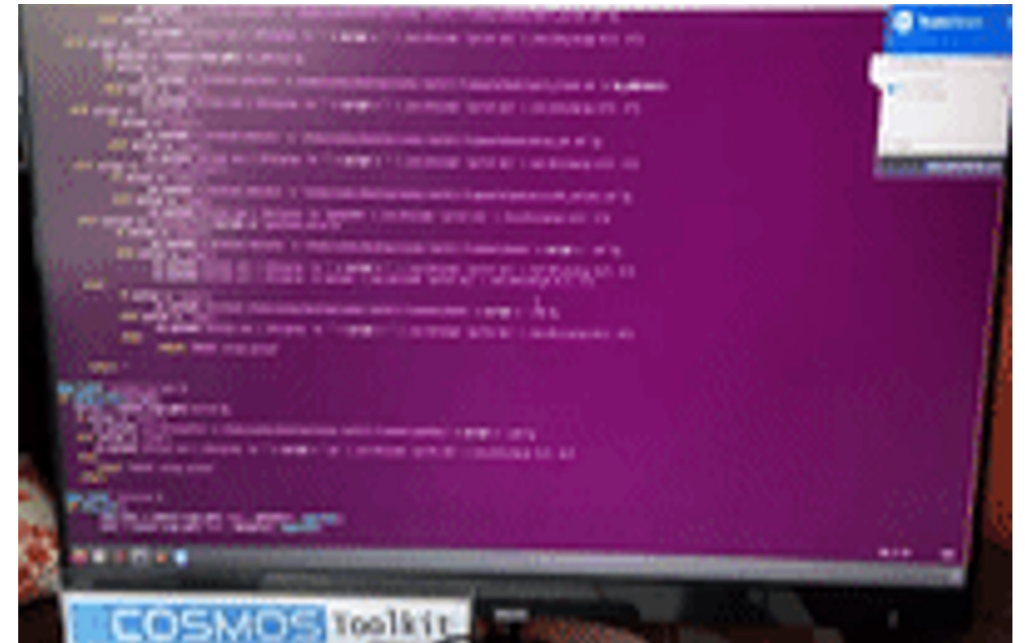# Example Lab: Bandwidth

Student Worksheet
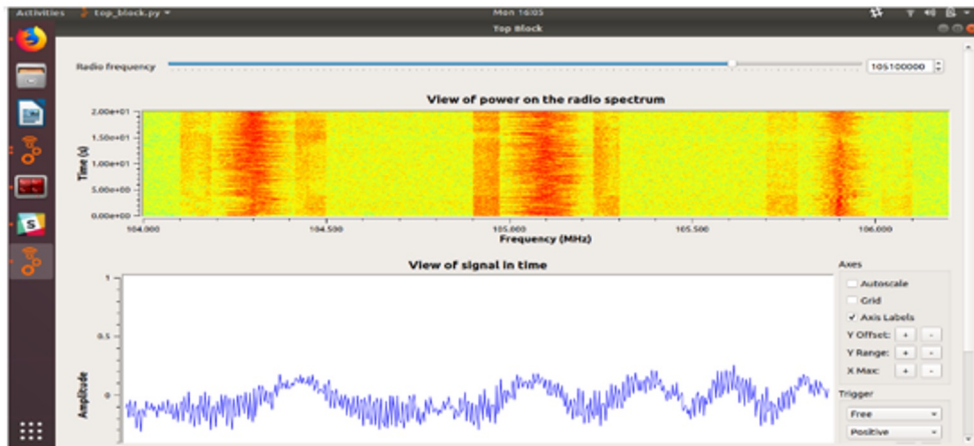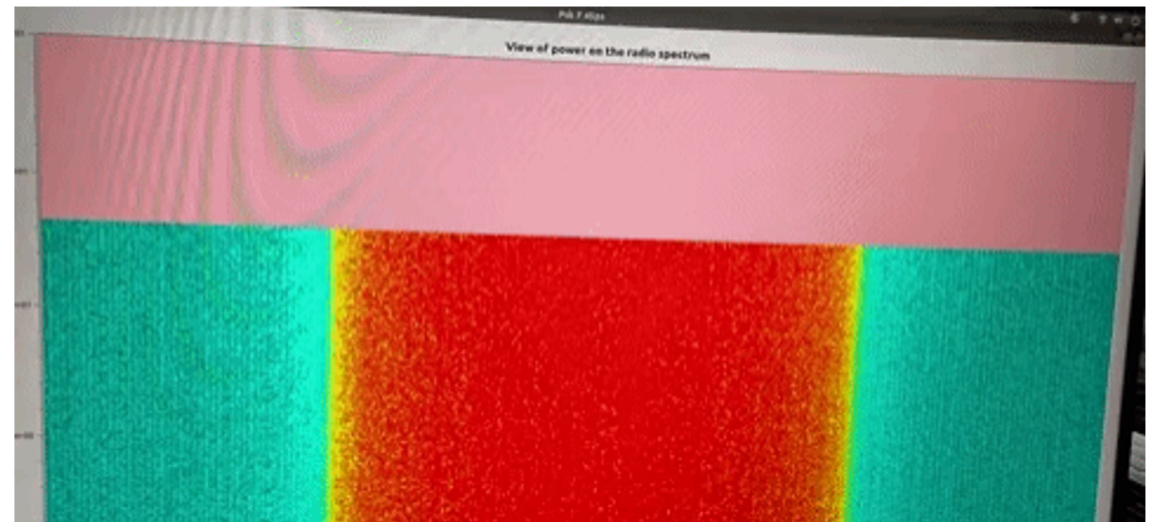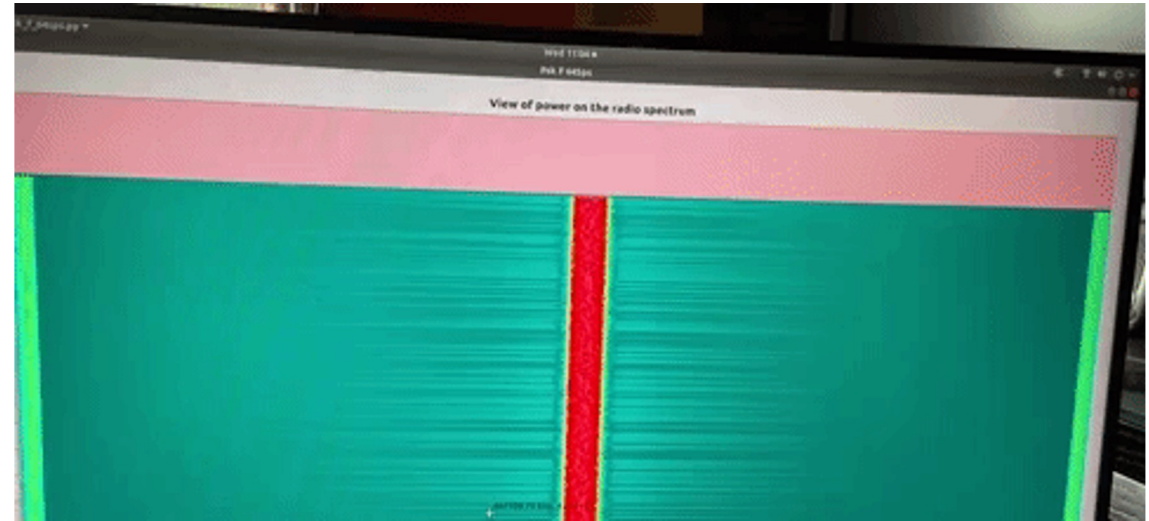
During COVID-19 Pandemic

"Everyday we would work on our labs and constantly communicate with our mentors to help us fix any problems we encountered with the toolkit. They are extremely knowledgeable and very helpful. We would be lost without them."

- Richard Foster (Parkside Preparatory Academy MS2)
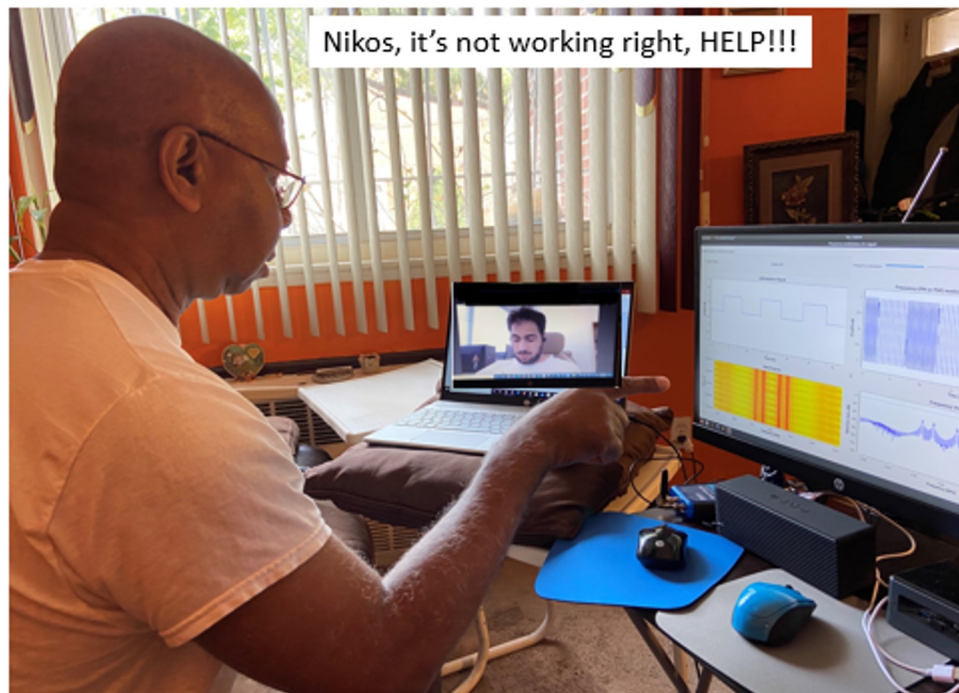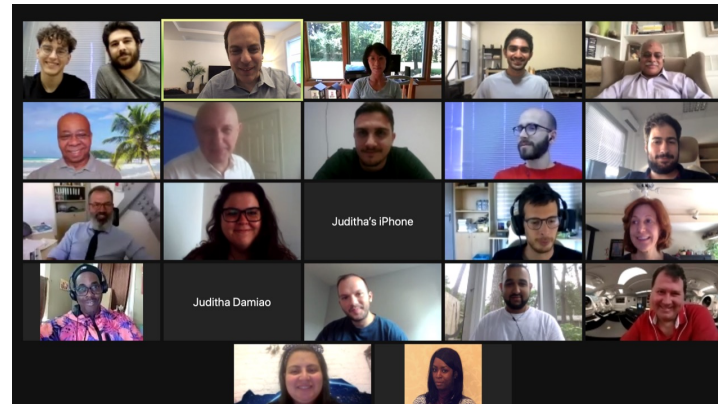

"Panagiotis is adjusting my Toolkit remotely. WOW!!!"

Conclusion

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2022

2021

2020

2019

2018