The SpectrumX Summer School for Undergrads

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BACKGROUND

- Spectrum issues are inherently interdisciplinary: wireless communications, digital signal processing, physics/astronomy, remote sensing, policy and economics, AI/ML/data science.
- Undergraduate curriculum focuses on isolated topics; no crosscutting curriculum across the disciplines, that focuses on understanding stakeholders' needs and ensuring harmonious coexistence.

GOALS and OBJECTIVES

Overarching goal: Develop a comprehensive program that introduces students to interdisciplinary spectrum stakeholders and the issues that surround them without requiring prior knowledge in spectrum or wireless.

Objectives:

- Support students' ***foundational understanding*** of (i) wireless networks and link characteristics, (ii) commercial wireless communications – WiFi and Cellular, (iii) radio astronomy, (iv) remote Earth sensing, (v) issues surrounding spectrum coexistence.
- Train students' ***hands-on skills*** during (i) a WiFi lab, (ii) a spectrum Hackathon and (iii) technical presentations.

METHODS AND MATERIALS

- 4 days (2.5 days lectures; 1.5 days hands-on activities)
- 10 speakers
- One government/industry panel
- One WiFi lab that trained students to use network measurement tools to understand wireless deployments, interference and link performance.
- One hackathon that trained students to build a spectrum sensor, collect data following target requirements, process data and analyze it.

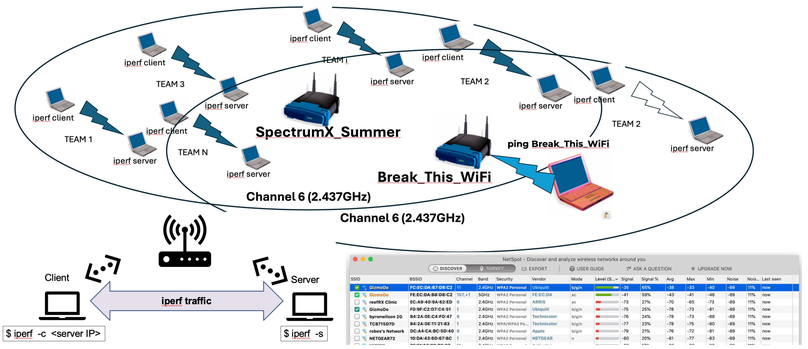
Agenda and recordings available on the website.

METHODS AND MATERIALS

Topics and speakers:

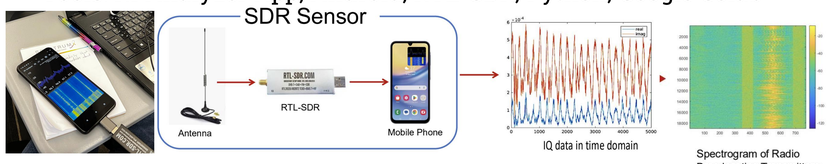
- Wireless fundamentals, ***Mariya Zheleva***, UAlbany
- WiFi and Cellular, ***Mariya Zheleva***, Ualbany
- Radio Astronomy, ***Chris DePree***, NRAO
- Remote Earth Sensing, ***Joel Johnson***, OSU
- Spectrum Coexistence, ***Andy Clegg***, Valo Analytica
- Spectrum Markets and Econ., ***Randy Berry***, Northwestern
- Cellular Network Measurements, ***Monisha Ghosh***, Notre Dame
- An industry and govt. panel: ***Chris Anderson***, NTIA; ***William Webb***, Consultant; ***Andy Clegg***, Valo Analytica

WiFi Lab: *"Make a WiFi -- Break a WiFi"*



Hackathon: *"RF Scavenger Hunt"*

- Learn (i) how to assemble and use a sensor to monitor target signals, (ii) types of spectrum data, and (iii) data processing principles
- Tools: RFAnalyzer App, Android, RTL-SDR, Python, Google Colab



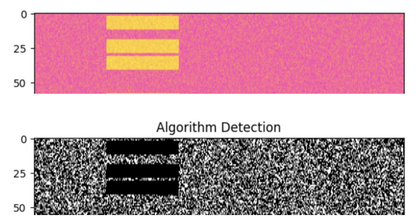
- Learn about spectrum analytics
- Tools and data: Python, Google Colab, synthetic and controlled data, students' own hackathon data

Input sample

```
#reading spectrogram from a csv.
spectrogram = pandas.read_csv(testFile, header=N
spectrogram = spectrogram.to_numpy()
fft_size = 1024
sample_rate = 1e6
print(spectrogram)
```

Naïve baseline

```
#simple thresholding
rows = spectrogram.shape[0]
columns = spectrogram.shape[1]
detectionImage = np.zeros((rows,columns))
for i in range(rows):
    for j in range(columns):
        if spectrogram[i][j] < -110: #adjust threshold
            detectionImage[i][j]  = 0.0
        else:
            detectionImage[i][j]  = 1.0
print(detectionImage)
```



RESULTS







	NRAO	UA	UPRM
Registered	38	18	13
Attended	36	15	7
Certificate Awarded	35	12	5
Grad Students Trained	2	2	2

* 15 students traveled to attend. 12 travel grants awarded.



"Thank you so very much for the opportunity - it truly opened my eyes to a whole new industry that I am **seriously considering pursuing as a career**."

"It **definitely sparked an interest** in me that I would not have had prior. It was also inspiring that we were able to go over so much content so quickly. It makes me feel confident that by engaging with programs like Spectrum X, I might **learn more than I expected** in a short period of time."

"... but also **grew my interest in fields I didn't know too much about**, in particular the economics/policy of spectrum allocation in the US, and also my favorite being the deep space exploration with radio waves and just learning more about the Universe. This experience has **solidified my experience with pursuing higher education**, ..."

NEXT STEPS for SUMMER SCHOOL 2026

Get involved by reaching out to: mzheleva@albany.edu

- Host a site – call for sites coming out late Fall'25
- Become a speaker – see topics of interest
- Design a lab
- Encourage your undergrads to participate

ACKNOWLEDGEMENTS

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