

114-1 電工實驗（通信專題）

Electrical Engineering Lab
(Topics on Communication Systems)
Fall 2025

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National Taiwan University

A Hands-On Course on Communication Systems

Theory \Leftrightarrow **Experiment**

Signals and Systems

Fourier transform
Filter
Sampling
:

Principle of Communications

Modulation
Optimal detection
Channel model
Error control coding
:

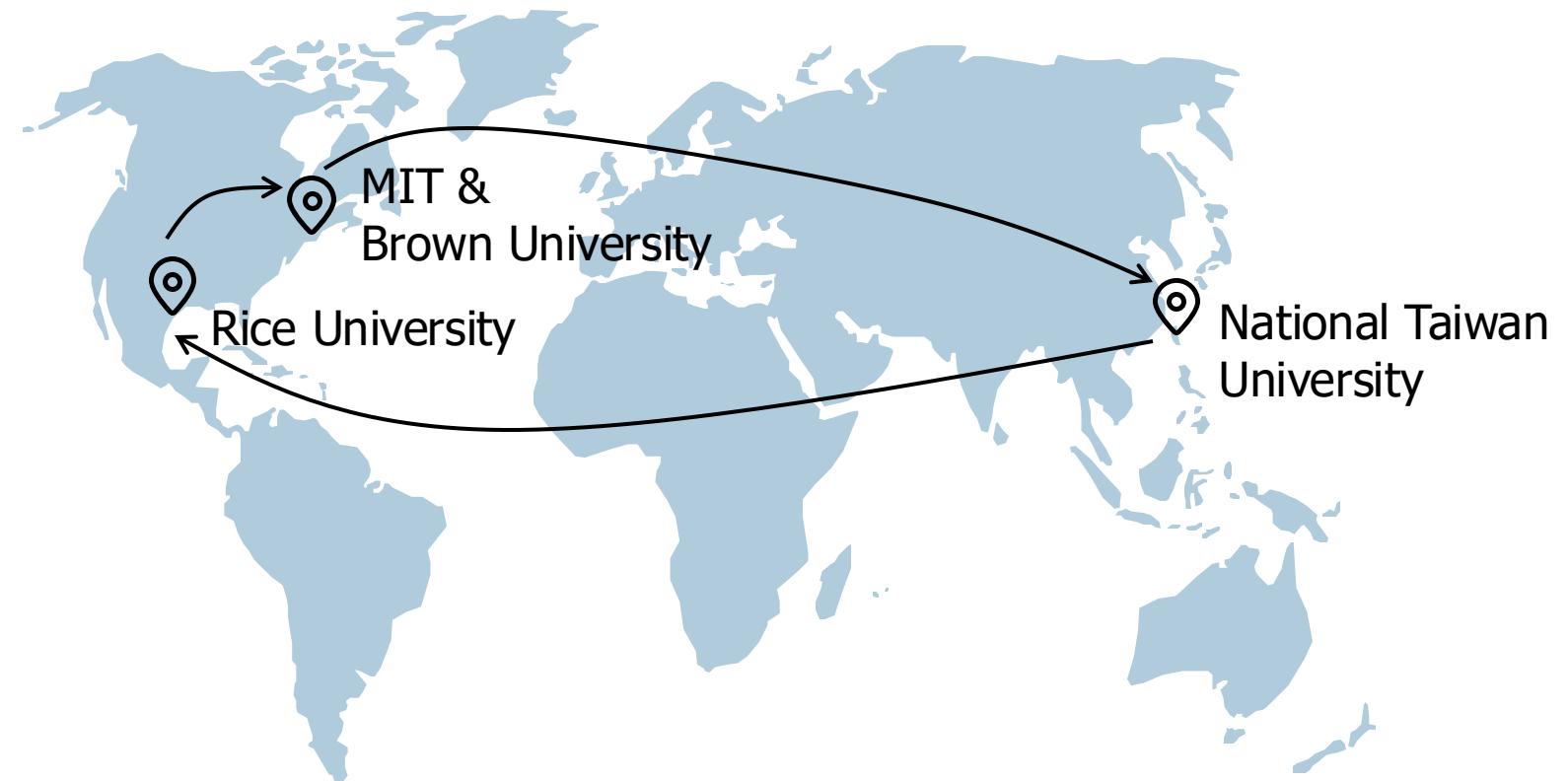
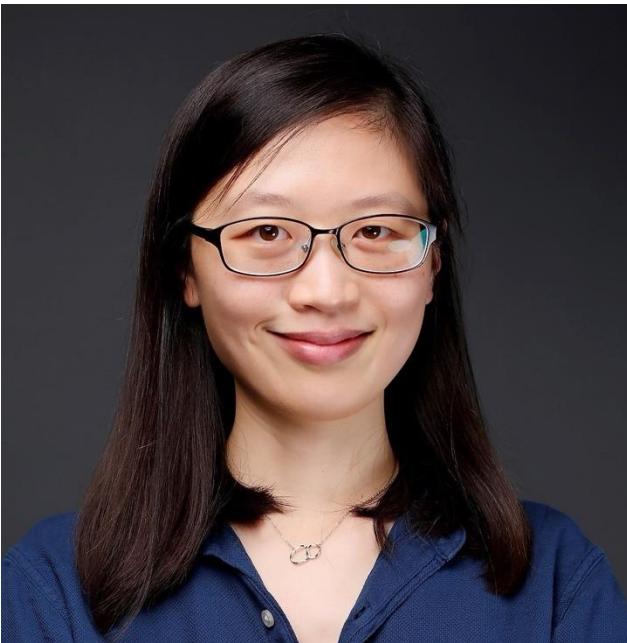
This Course

Modulation / Demodulation
Up/down-sampling
Frequency conversion
Filtering
Synchronization
Channel estimation
OFDM
WiFi frame
Carrier frequency offset
:

Who am I to teach this?

Chia-Yi Yeh (葉佳宜)

mmWave and terahertz wireless communications, sensing, and security

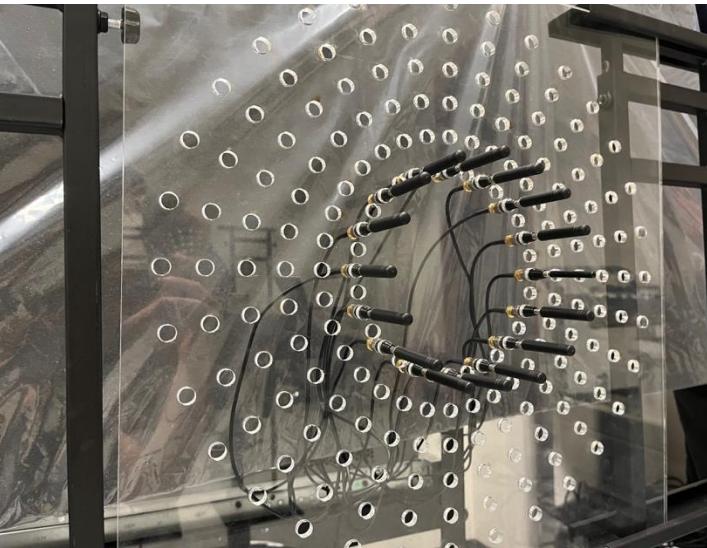
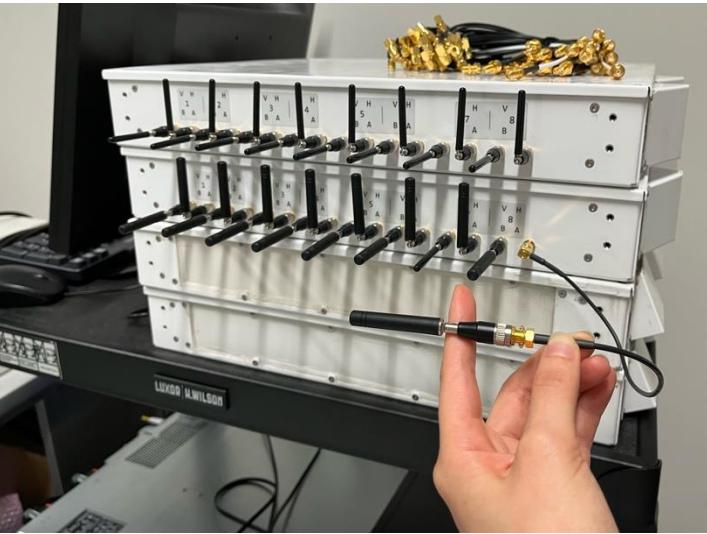


Experiments I have done



@ Rice University

Experiments I have done



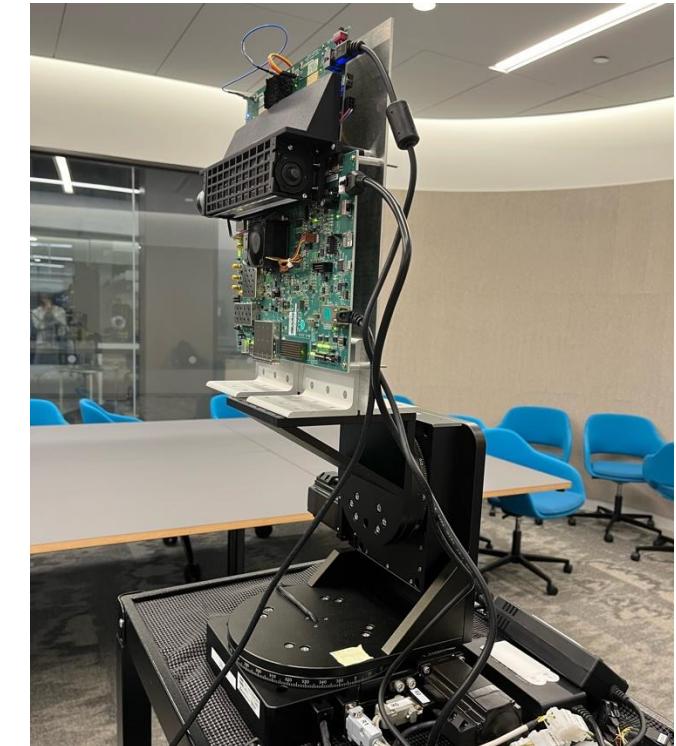
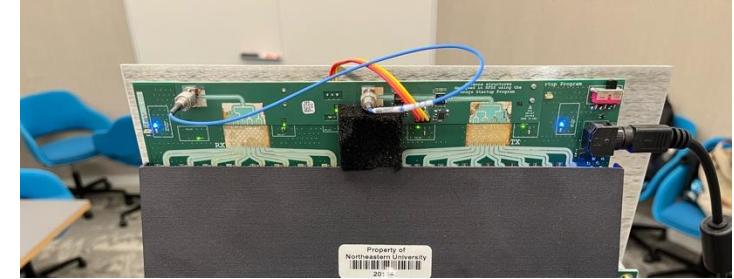
@ Rice University

Experiments I have done



Experiments I have done

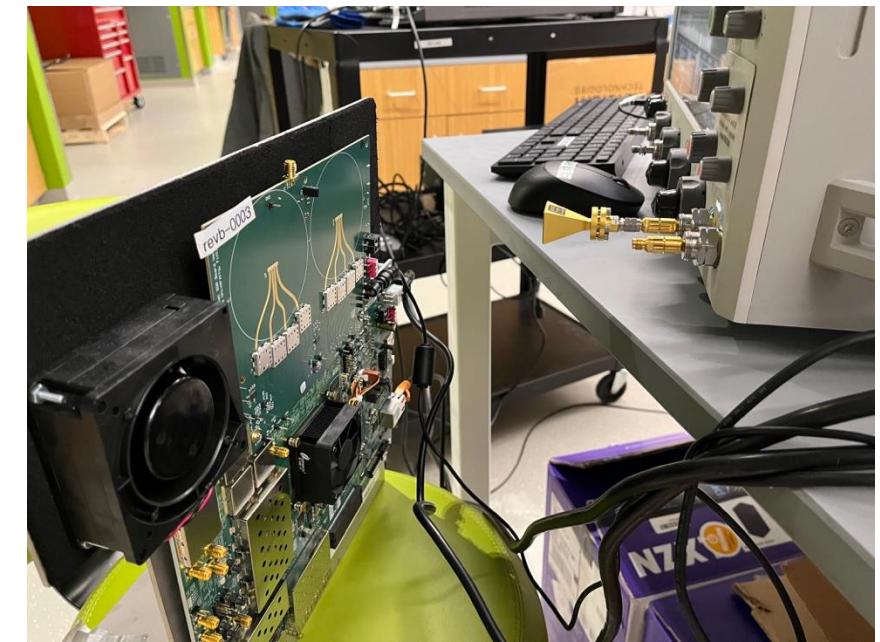
@ Northeastern University



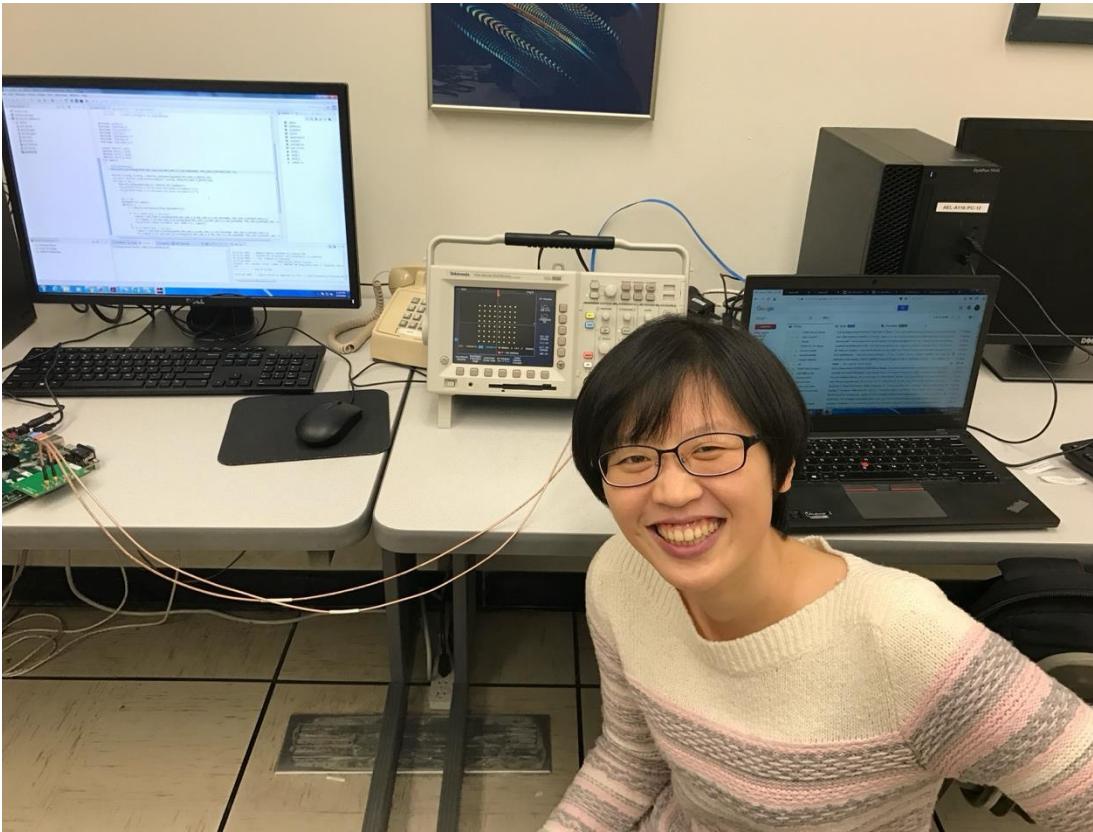
Experiments I have done



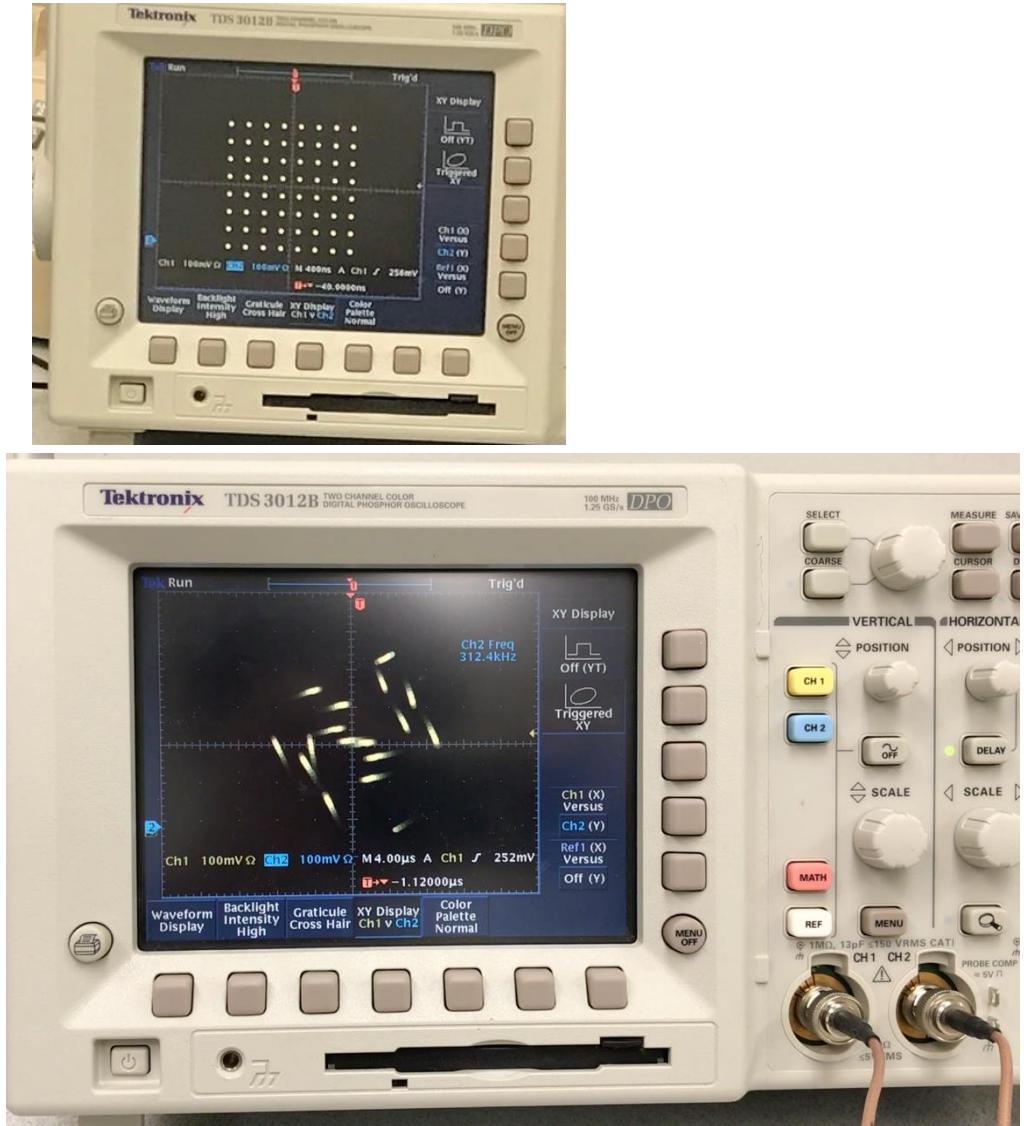
@ Northeastern University



Experiments I have done



@ Rice University

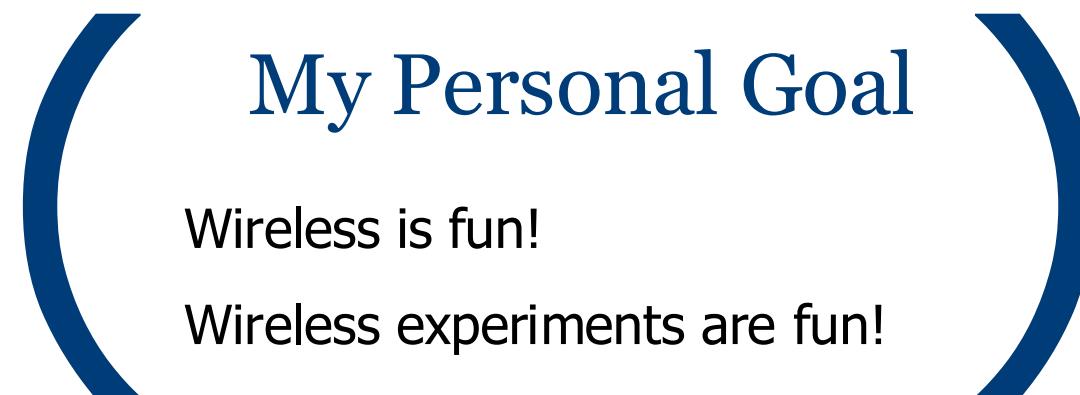


Course Objectives

Perform the main steps of digital wireless transmissions using MATLAB and software-defined radios (SDRs).

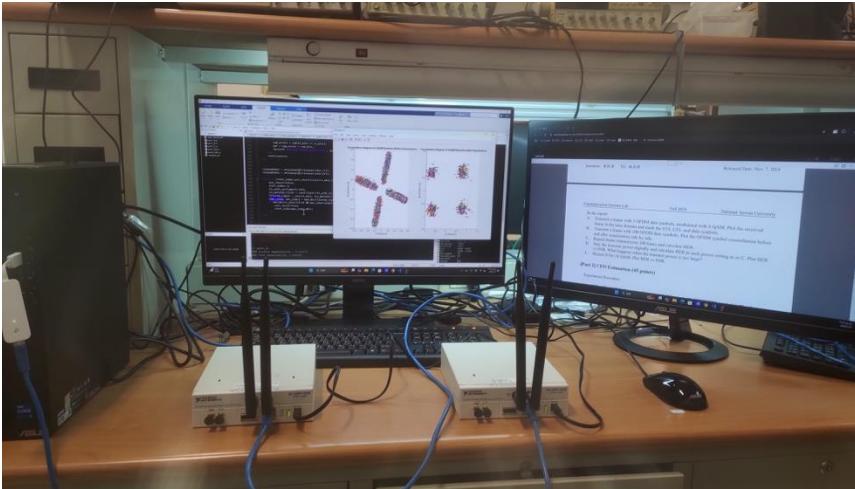
Be aware of the latest application scenarios in communications and critique their experimental methodologies and results.

Apply the experimental skills learned in this course to explore self-selected topics on communications.



Course Highlights

Transmit WiFi-like frame through software-defined radios

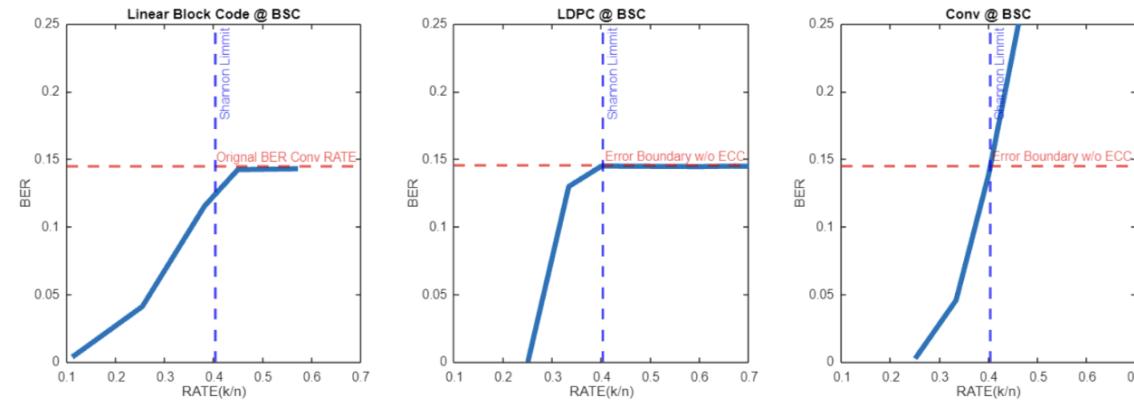


Debate papers on wireless experiments with your classmates

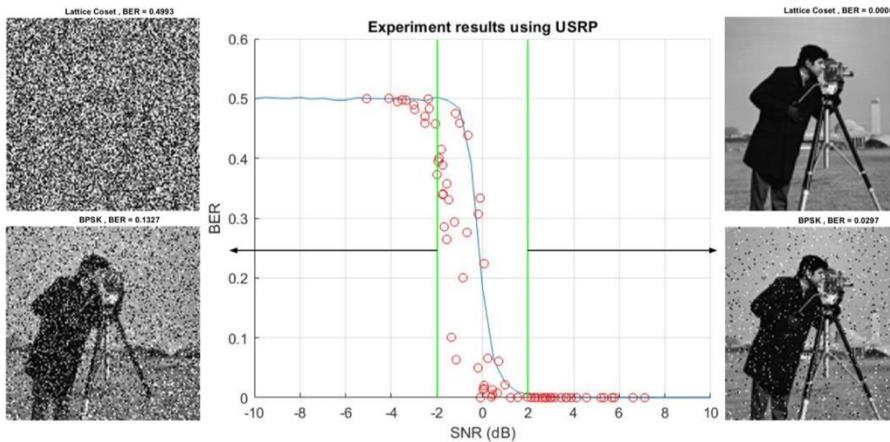


Course Highlights

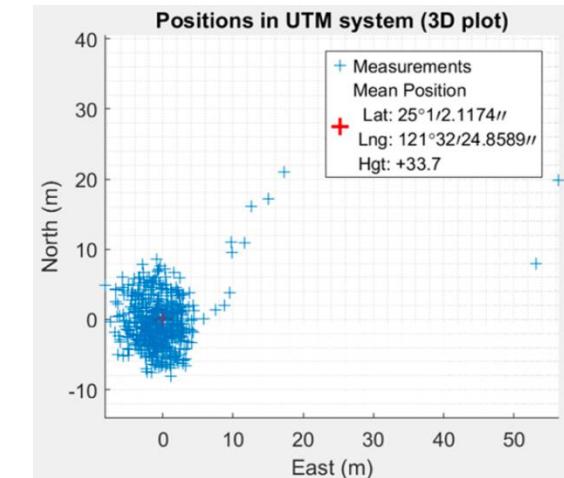
Final Project Demo



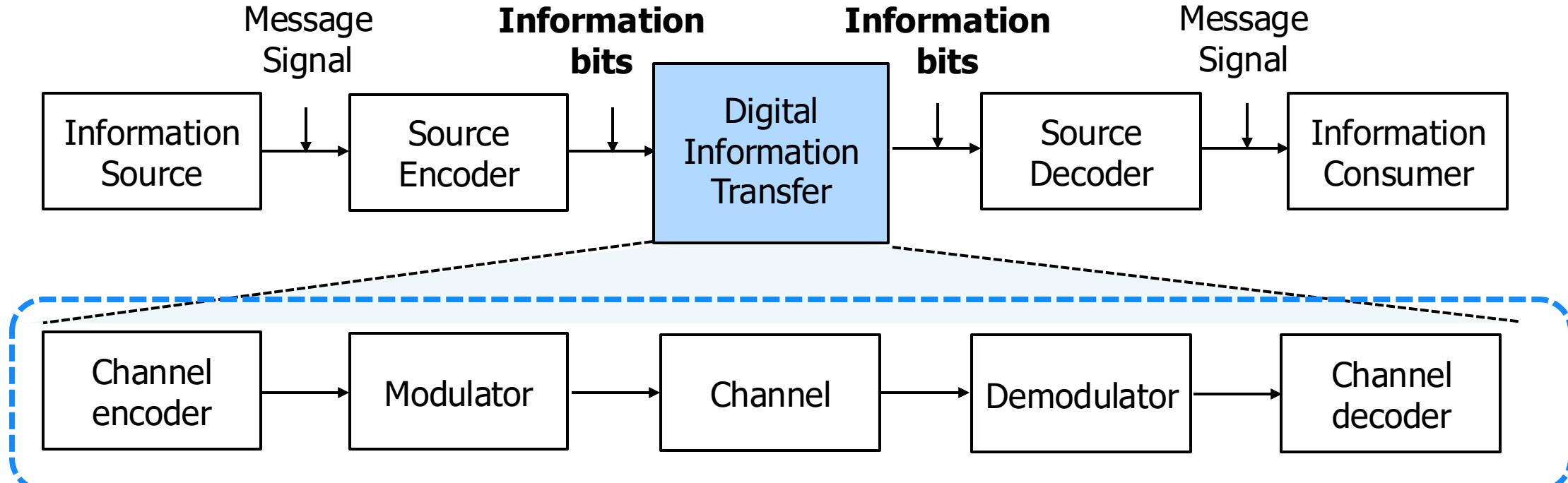
Error correction codes performance characterization



Physical layer security implementation



Positioning using GPS signal

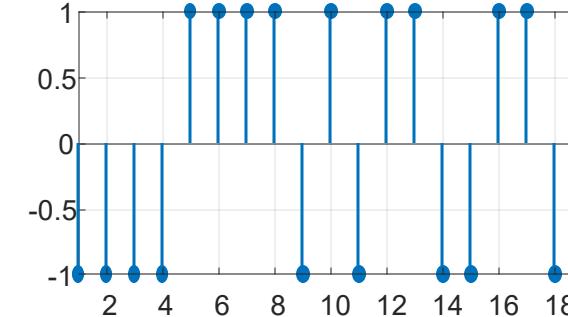


The focus of this class

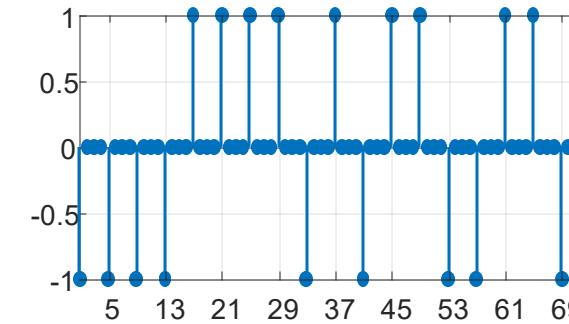
Course Topics

Bits: [1, 1, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1]

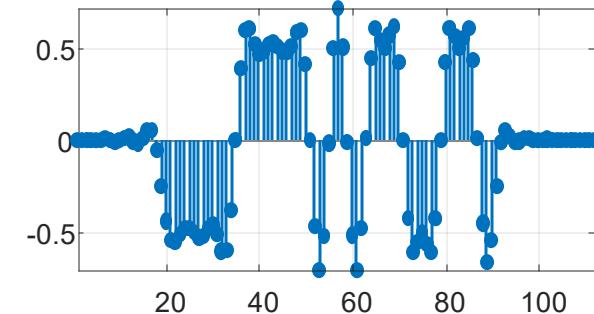
Modulation



Up-sampling

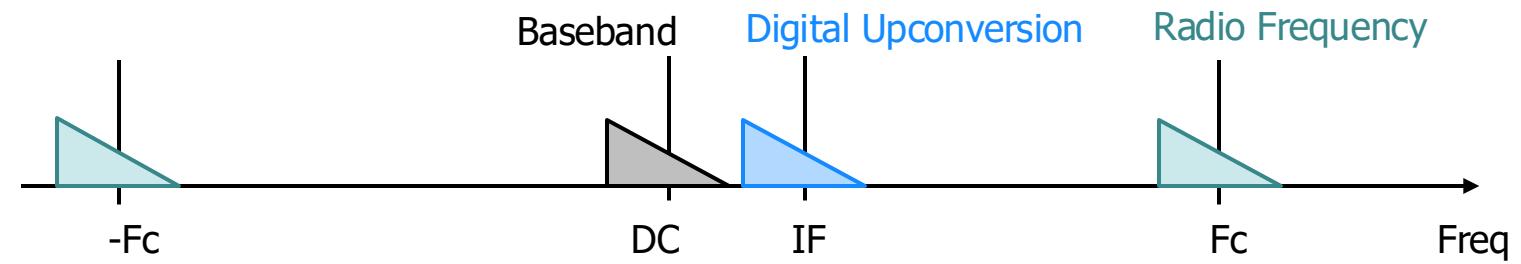


Filtering

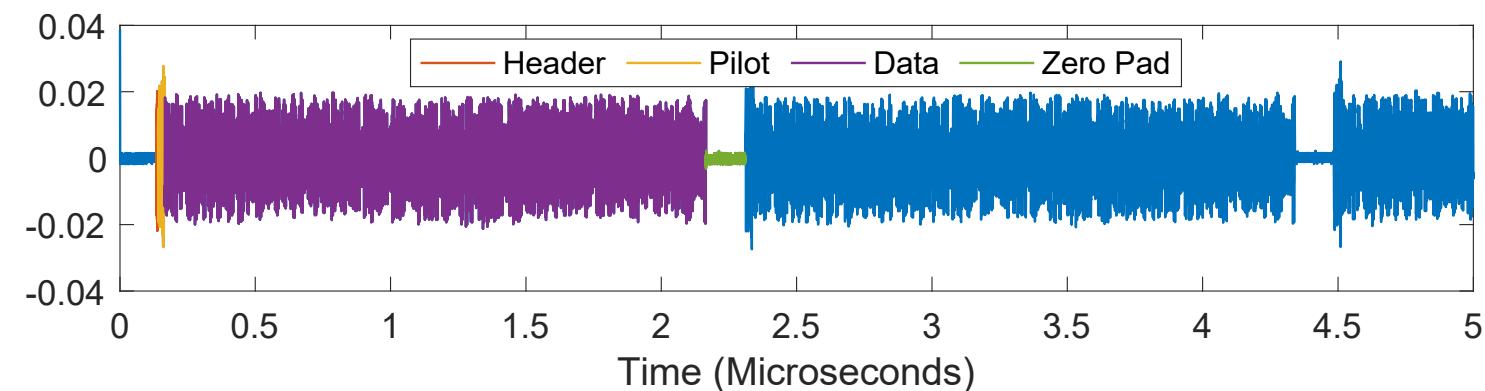


Course Topics

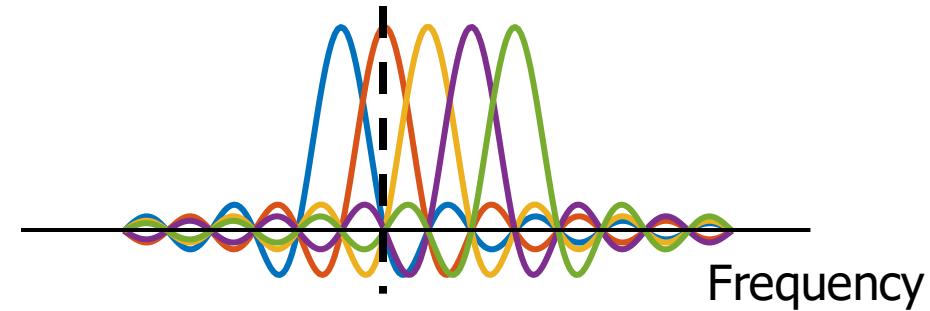
Up/down-conversion



Synchronization,
Channel estimation



OFDM
(Orthogonal Frequency Division Multiplexing)

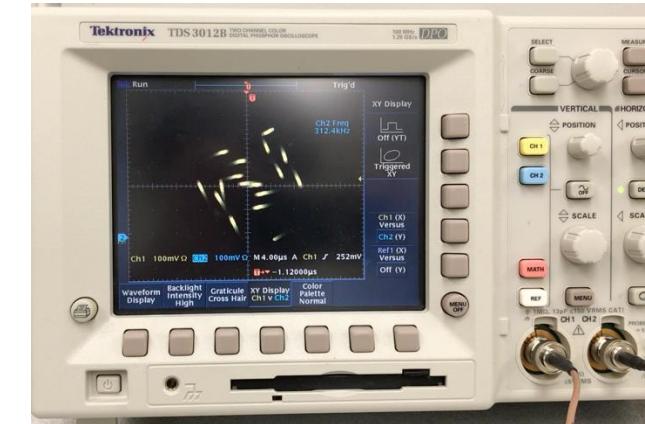


Course Topics

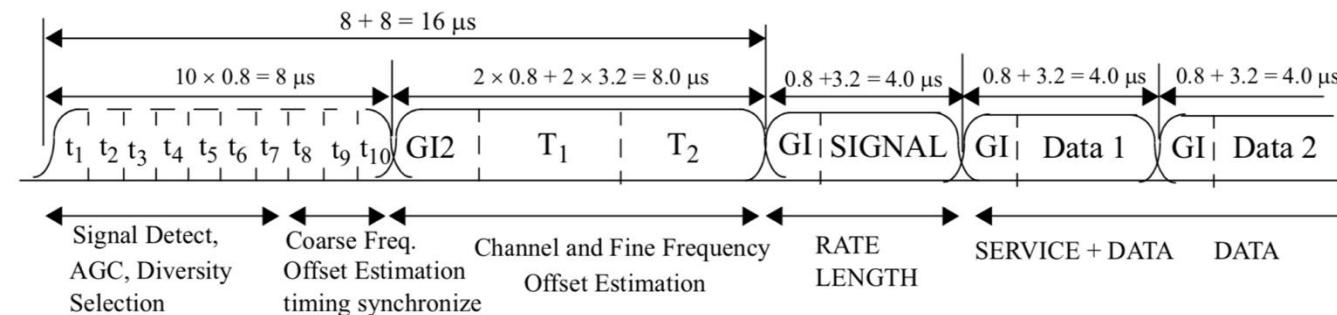
SDR (Software-defined radio)



Hardware impairments
(e.g., Carrier frequency offset)



WiFi frame

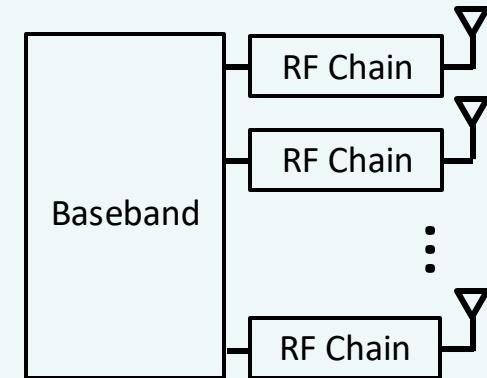


Course Topics

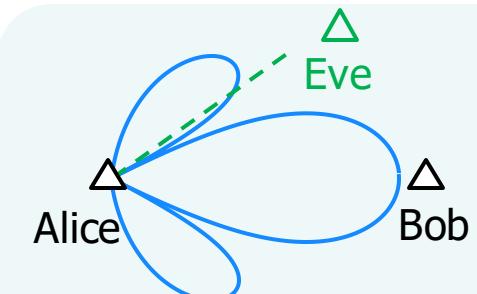
Error-correction code

1 → 0 Error!
111 → 101 → 1 Correct!

Antenna array



Physical layer security



(and more...)

Course Overview: Lab on Comm Systems

I Perform the main steps of
digital wireless comm

II Critique experiments in
wireless papers

	Modulation / Demodulation	Basics	Radar
	Up/down-sampling		Sensing
	Synchronization		Acoustic
	Channel estimation		Satellite
	OFDM		Underwater
12 weeks	:		:
4 weeks			

III Final project

Your Selected Topic

Course Assignments & Workload

I Perform the main steps of digital wireless comm

- | | |
|---|------------------------------|
| 3 | MATLAB individual assignment |
| 2 | USRP team assignment |

12 weeks

II Critique experiments in wireless papers

- | | |
|---|-------------------------|
| 3 | Individual paper review |
| 1 | Team debate |

4 weeks

III Final project

- | | |
|---|---|
| 2 | Project proposal
Demo + final report |
|---|---|

Assignment Schedule

	Assignment Due
Week 1	Paper preference
Week 2	
Week 3	Lab 1
Week 4	Paper 1
Week 5	Lab 2
Week 6	Paper 2
Week 7	Lab 3
Week 8	(Midterm Week)

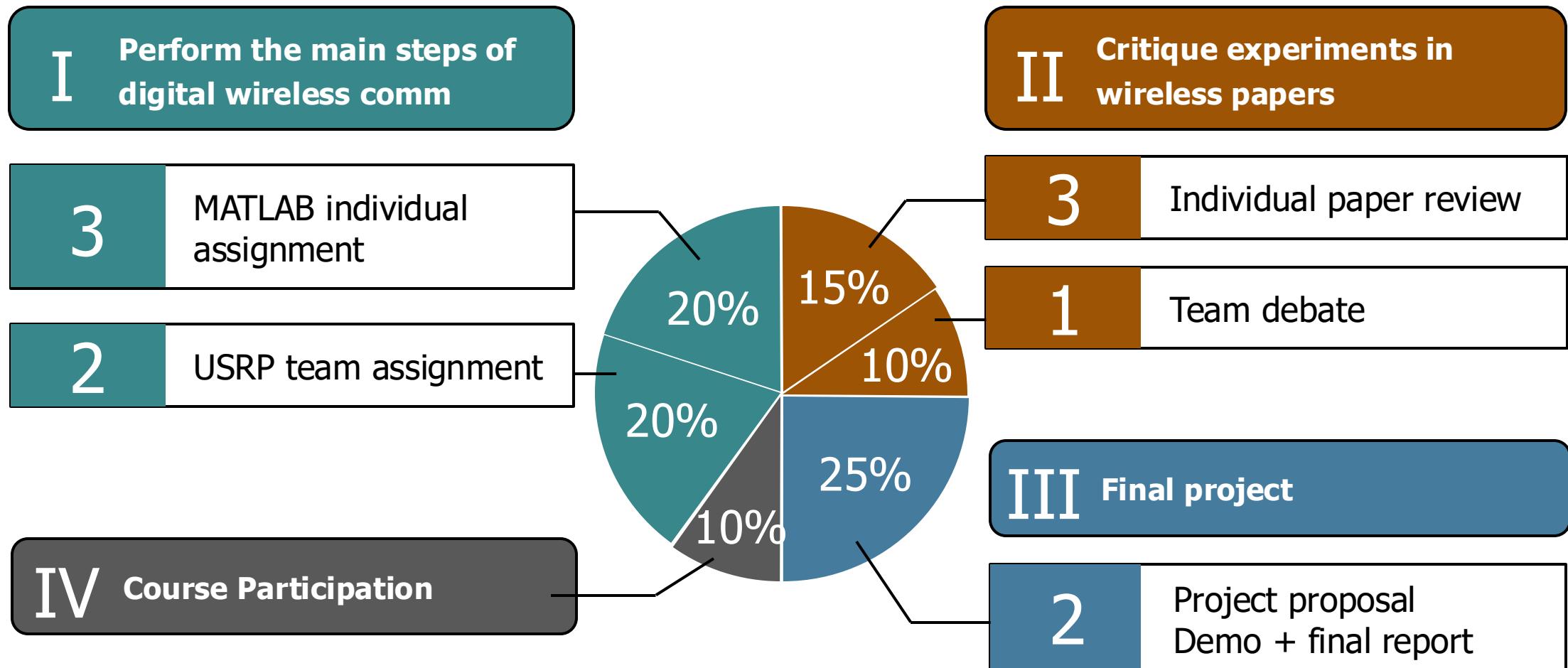
	Assignment Due
Week 9	Paper 3
Week 10	Lab 4
Week 11	Paper 4
Week 12	Lab 5 (with Demo)
Week 13	Final Project Proposal
Week 14	
Week 15	
Week 16	(Final Week)
Week 17	Final Project Demo & Report

You must be able to attend the demo on Week 17

Late Submission Policy

- Assignments are announced at least two weeks before the deadline
- Late submission within one week is allowed, with a 70% score (i.e., 30% late penalty).

Grading Policy



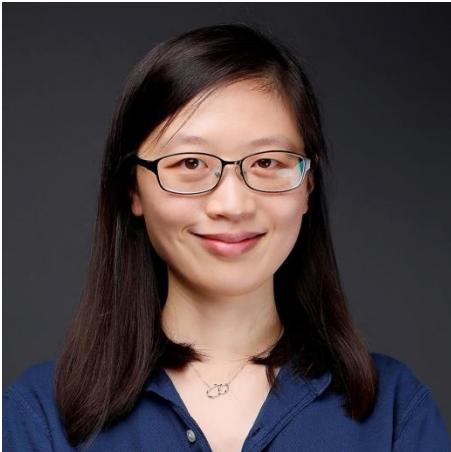
Course Participation (10 pts)

- 5 points for attending all courses
 - You can be absent twice at most and must send me a notice in advance.
 - You must show up if you are on the debate team that week.
 - 1 point off for an unexcused absence.
 - NTU Cool 點名.
Don't worry if you are not on NTU Cool yet. Today is only for testing.
- 5 points for active participation. 1 point each for the following
 - 上課提問, 回答問題, Debate 提問, Provide course feedback, etc.
 - 請同學自行記錄, 期末提交 (NTU Cool 作業 : 課堂發言紀錄)
(Operate by honor system)

Some New Attempts This Semester

- Toward EMI: one week with English lecture
- Course recording for the first two weeks
(This is mainly for one student joining remotely in the first two weeks)

Instructor and TAs



Instructor: 葉佳宜 (Chia-Yi Yeh)

E-mail: ycyyeh@ntu.edu.tw

Office hours:

- Tue: 12:10 - 1 pm (right after class)
- By appointment @ 電二335

Teaching Assistant

華奕昕

b10901031@ntu.edu.tw

Lab assignments
MATLAB, USRP

Teaching Assistant

賴皓煒

d11942018@ntu.edu.tw

Debate grouping & grading
MD331 access management

The LAB: MD 331 (明達331)

- 24-hr video surveillance with access control
- Rules
 - Food and drink are NOT allowed in the lab.
 - No garbage left in the lab - there is no garbage can in the lab.
 - Do not bring unregistered students to the lab.
 - Remember to turn off the lights and the air-conditioner when leaving.
- What you can do in the lab
 - Work on lab assignments or prepare for debates.
 - Please avoid staying late at night for your own safety.
- Lab session time
 - Not every week (perhaps only 2~3 times)
 - Let's decide on a time:
 - First lab session: Intro to MATLAB and MATLAB live script

10	17:30 – 18:20
A	18:25 – 19:15

Paper Review & Debate

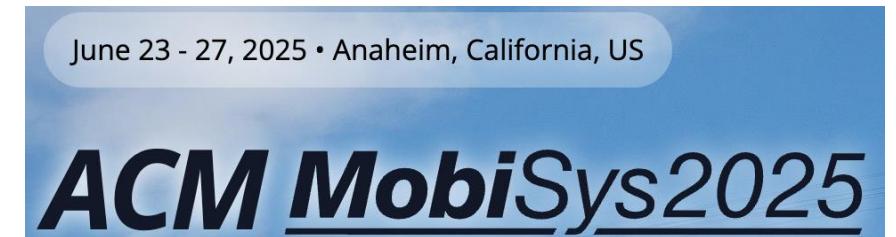
Paper Review & Debate

- Each person: 3 reviews + 1 debate
- Submit your paper preference by Sunday (Sep. 7) 11:59 pm
- TA assigns debate teams based on collected preferences
- Team assignments will be announced next Wed (Sep. 9)
- More details on the review and debate format next week

How papers are selected

From top wireless conferences

- MobiCom
- MobiHoc
- MobiSys
- SenSys
- INFOCOM



IEEE International Conference on Computer Communications
19-22 May 2025 // London, United Kingdom

- Related to course topics
- Propose unique ideas

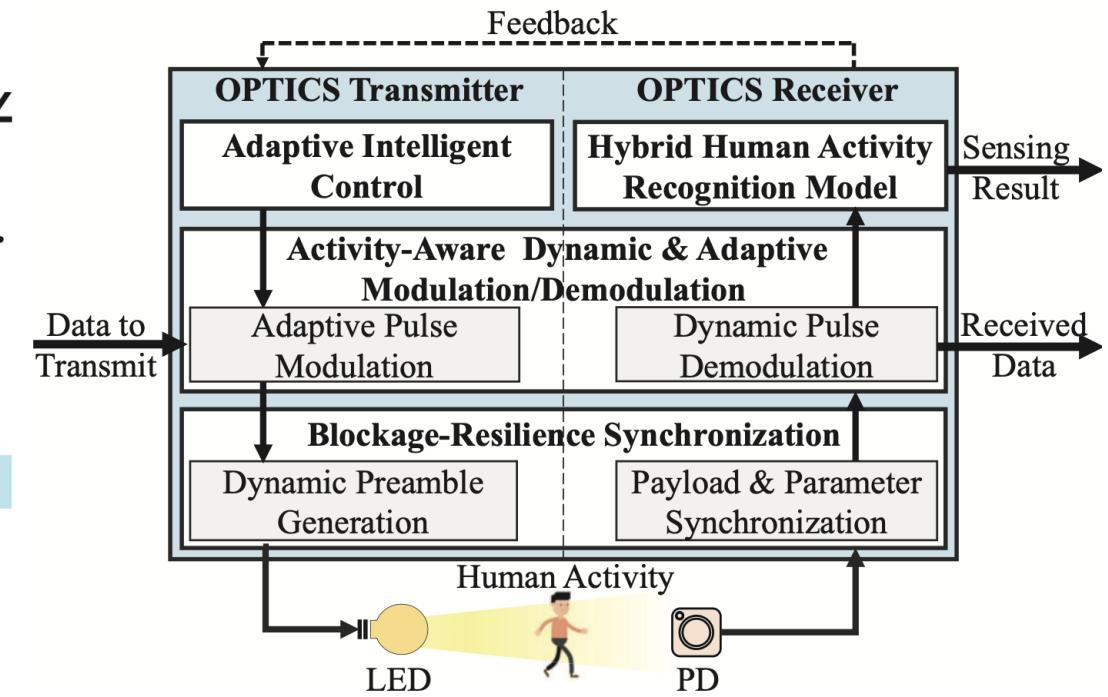
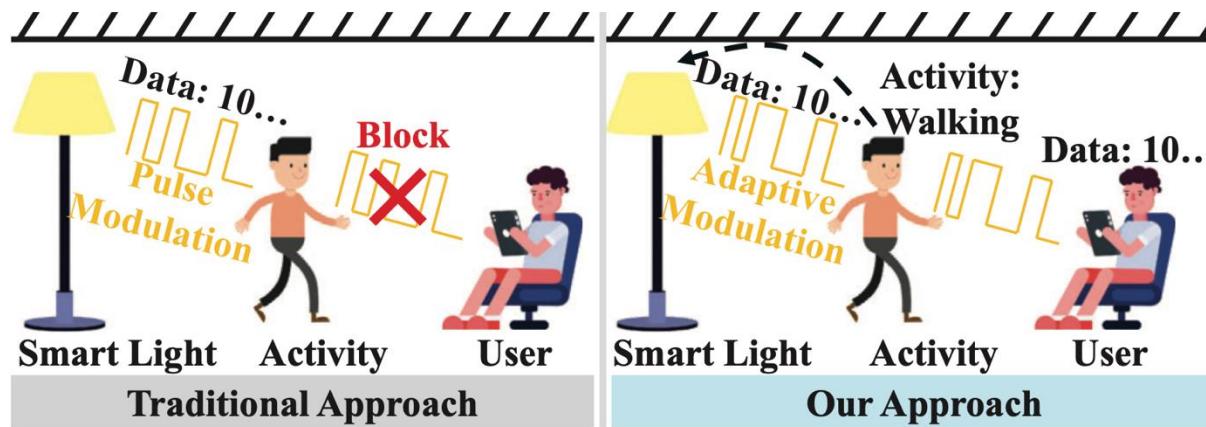


Debate Paper Highlights

1

Week 4
(Sep. 23)

OPTICS: Human Activity-Aware Integrated Optical Wireless Communication and Sensing



- Visible light communication
- Activity-aware adaptive modulation scheme

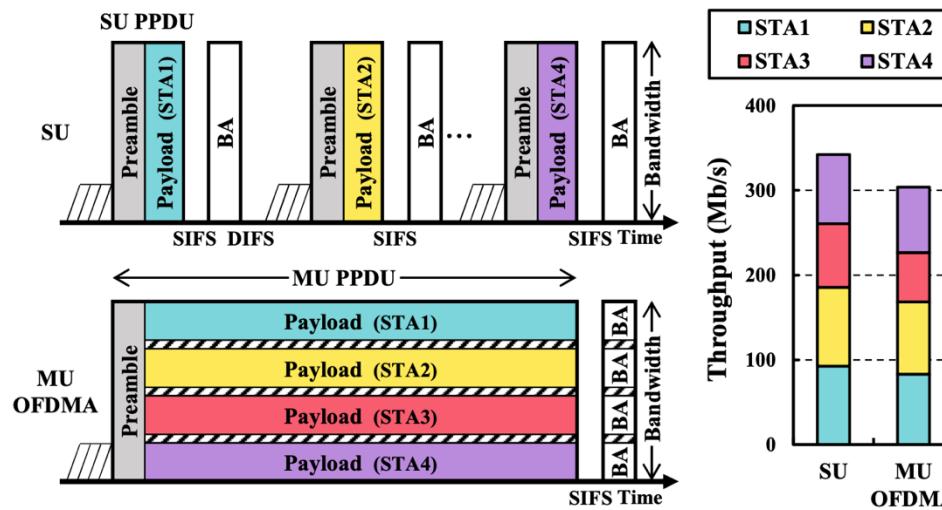
Debate Paper Highlights

2

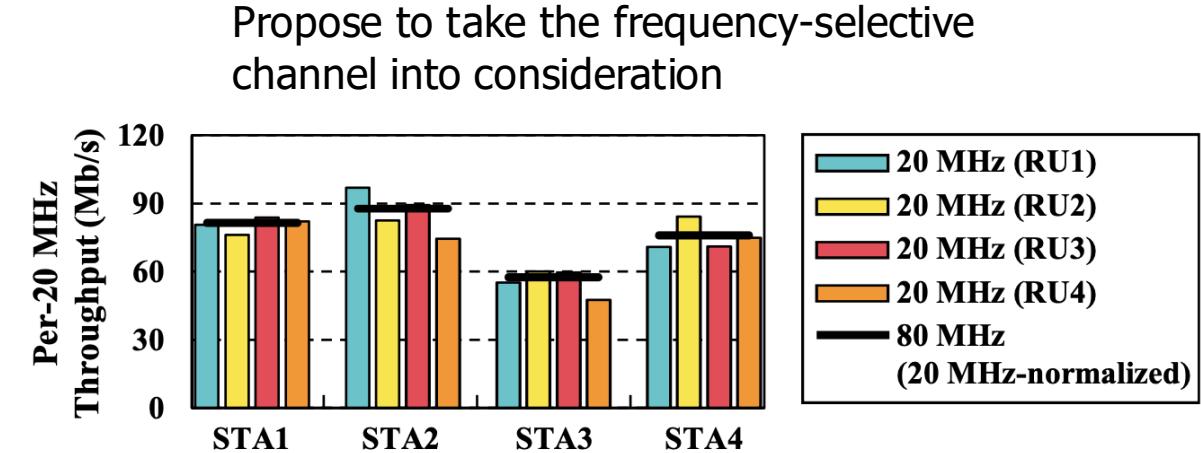
Week 6
(Oct. 7)

Enriching Multi-User OFDMA in Wi-Fi Networks with Frequency-Selective Channel Awareness

Problem with the existing Wi-Fi multi-user scheme



Propose to take the frequency-selective channel into consideration



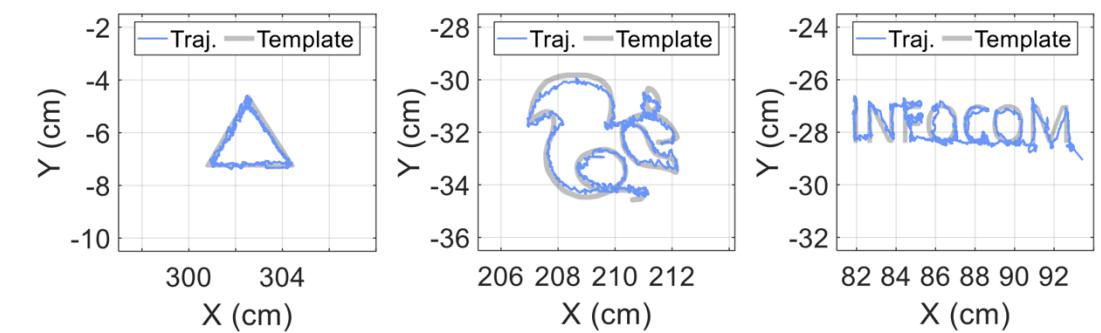
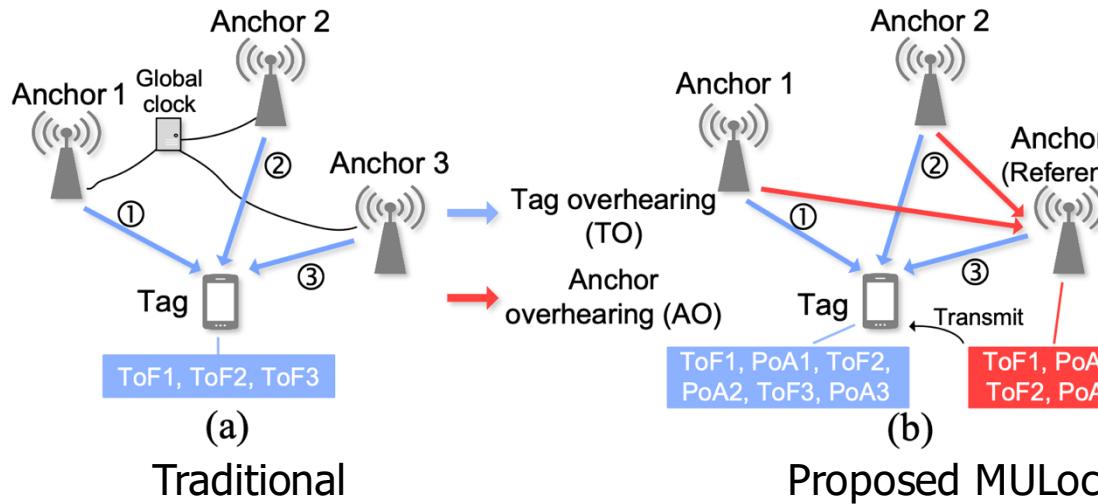
- Resource allocation considering the frequency-selective channel
- Wi-Fi standard compliant solution

Debate Paper Highlights

3

Week 9
(Oct. 28)

MULoc: Towards Millimeter-Accurate Localization for Unlimited UWB Tags via Anchor Overhearing



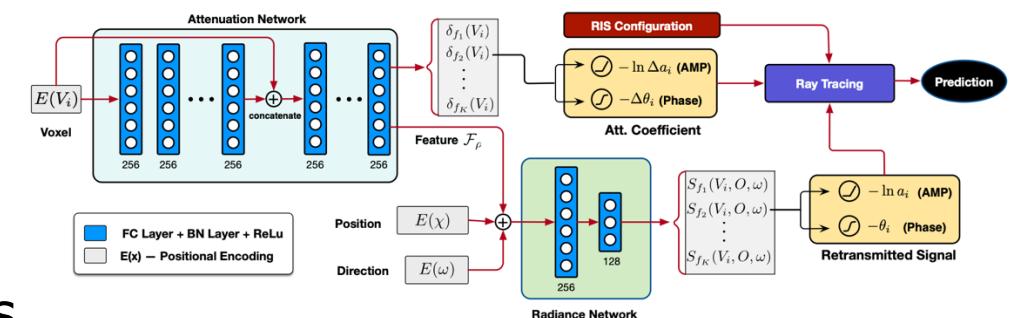
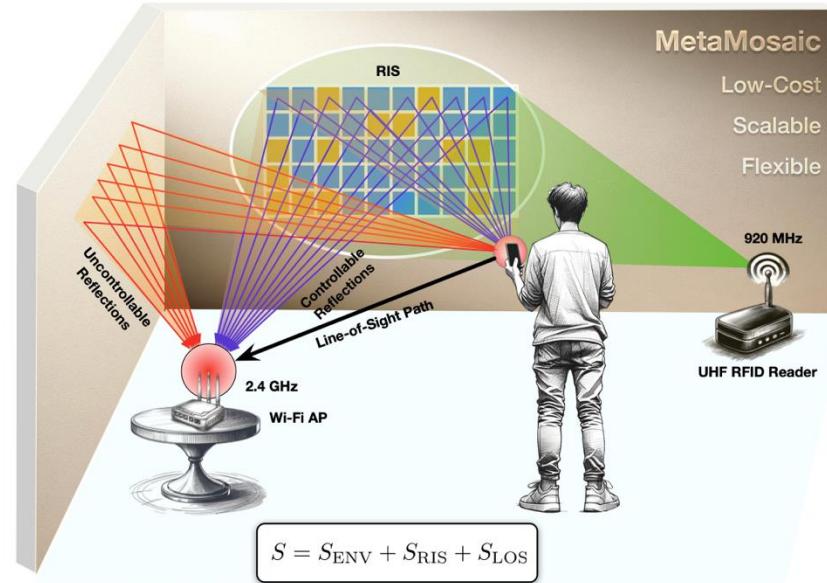
- Signal processing across multiple anchors for localization

Debate Paper Highlights

4

Week 11
(Nov. 11)

Commercial RFIDs as Reconfigurable Intelligent Surfaces



- Hardware design: turning RFIDs into unit cells
- RIS configuration by using the “neural radiance field” (i.e., some ML elements here)

Submit your paper preference
by Sunday (Sep. 7) 11:59 pm

& 記錄課堂發言

Break & 加簽