

# Implementation Course Info Session

2023 (112下/113上)

# 郭柏志

Professor Kuo, Po-Chih

## Topics

Biomedical Signal and Image Analysis

生醫訊號影像分析

## Prerequisite

Basic core courses 修過一些基礎科

## Keywords

Biomedical signal and image processing, Neuroimaging, Machine Learning, AI for medicine

## Contact

- <https://sites.google.com/site/bfantasykuo/>
- [kuopc@cs.nthu.edu.tw](mailto:kuopc@cs.nthu.edu.tw)

# 陳明彰

## Professor Chen, Ming-Chang

### Topics

TBD

### Prerequisite

Basic core courses 修過一些基礎科

### Keywords

High Harmonic Generation, Attosecond Generation and measurement

### Contact

- <http://mx.nthu.edu.tw/~mingchang>
- [mingchang@mx.nthu.edu.tw](mailto:mingchang@mx.nthu.edu.tw)

# 李瑞光

## Professor Lee, Ray-Kuang

### Topics

Machine-Learning Quantum State Tomography

### Contact

- <http://mx.nthu.edu.tw/~rkleee>
- [rkleee@ee.nthu.edu.tw](mailto:rkleee@ee.nthu.edu.tw)

### Prerequisite

1. Quantum Physics or Modern Physics
2. Relevant courses and lab 相關基本課程與實驗課程要求

### Keywords

Quantum Optics, Machine-Learning, Quantum Photonic Chips

# 張鑑元

## Professor Chang, Chien-Yuan

### Topics

TBD

### Prerequisite

- Basic core courses 修過一些基礎科
- Please provide English proficiency test related information. 請附英文檢定資料

### Keywords

Solid-state quantum electronics, quantum control theory, quantum optics and experiment

### Contact

- <https://sites.google.com/view/chienyuanchang/home>
- [cychang@ee.nthu.edu.tw](mailto:cychang@ee.nthu.edu.tw)

# 劉奕汶

Professor Liu, Yi-Wen

## Topics

Ambisonic audio signal processing

## Summary

Implementation of signal processing methods for 3rd-order spherical microphone array, possibly for AR and VR applications

## Expected Output

Familiarization with field recording using the 3rd-order ambisonic array; post processing for creation of spatial effects; rendering to headset or surround output.

## Keywords

Signal processing, music, audio

## Prerequisite

Linear Algebra (must)

Signals and Systems (preferred)

Probability (preferred)

## Contact

- <http://www.ee.nthu.edu.tw/ywliu/>
- [ywliu@ee.nthu.edu.tw](mailto:ywliu@ee.nthu.edu.tw)

# 楊尚樺

## Professor Yang, Shang-Hua

### Topics

- ① Automated THz microscope
- ② High-speed Compressed Sensing THz Camera
- ③ THz Electronic Nose
- ④ 3D Printed THz LEGO
- ⑤ 6G/THz Communication

### Prerequisite/ Contact

- Please talk with the lab students before sending e-mails to make appointment with Prof. Yang. Students are welcome to walk in the lab at Engineering Building III Room 106 and chat with the students in the lab. All contact information is available on the lab website.
- <http://www.ee.nthu.edu.tw/shanghua>
- [shanghua@ee.nthu.edu.tw](mailto:shanghua@ee.nthu.edu.tw)

**Keywords:** Terahertz, Spectroscopy, Computer Vision, 6G Communication, Imaging

# Topic 1: Automated THz microscope

## Summary

- The terahertz wavelength range can simultaneously assist us in achieving "perspective" and "chemical molecule identification." This means that it can be used for remote object perspective through terahertz waves or monitoring chemical and biological reactions, even for non-invasive early cancer lesion diagnosis. This research project will focus on converting collected terahertz signals into three-dimensional spatial and material information in the first semester. The second semester will emphasize image processing and optimization algorithms to achieve sub-millimeter spatial resolution perspective images. This research project can extend to important applications such as non-invasive skin cancer detection, lung cancer detection, burn injury assessment, security screening, and biogenetic engineering. Research project students are required to submit their research results to relevant domestic/international conferences or publicly showcase their research findings.

## Expected Outcome

- Learnable Knowledge and Skills: Terahertz technology, image processing, signal processing, automatic control. Expected Output: Fully automated terahertz perspective microscope.



# Topic 2: High-speed Compressed Sensing THz Camera

楊尚樺  
Professor Yang,  
Shang-Hua

## Summary

- In the first semester of this research project, a single-pixel terahertz camera will be constructed. The camera consists of four main components: terahertz spatial modulator development, 12,500 frames per second (fps) frame control, single-pixel terahertz camera hardware integration, and compressed sensing image reconstruction algorithms suitable for development by a team of 2-4 individuals. The second semester will focus on enhancing the spatial resolution of the terahertz camera for remote real-time perspective of different types of products, such as text in books, package contents, chip information in credit cards, and chip carrier impurity concentrations. Research project students are required to submit their research results to relevant domestic/international conferences or publicly showcase their research findings.

## Expected Outcome

- Learnable Knowledge and Skills: Terahertz technology, material inspection, semiconductor components, signal processing, automatic control. Expected Output: High-speed compressed sensing terahertz camera.

# Topic 3: THz Electronic Nose

## Summary

- ① In the first semester of this research project, the emphasis will be on learning terahertz time-domain spectral analysis systems to establish reliable terahertz spectrum measurement methods. The second semester will focus on applying the established spectral analysis system to real-time monitoring of protein and important physiological factor molecular behaviors (e.g., blood sugar). Research project students are required to submit their research results to relevant domestic/international conferences or publicly showcase their research findings.

## Expected Outcome

- Learnable Knowledge and Skills: Terahertz technology, material inspection, signal processing, automatic control. Expected Output: Terahertz electronic nose.

# Topic 4: 3D Printed THz LEGO

## Summary

- In recent years, terahertz technology has received widespread international attention due to its ability to provide comprehensive identification of chemical agents, drugs, air quality, toxic gases, explosives, and biochemical structures, with significant implications for medical perspective imaging and military detection. However, terahertz systems are mostly found only in laboratories today. This is primarily due to critical issues with the system, such as low terahertz output power, extremely low conversion efficiency, and high cost and complexity. This research project focuses on developing low-cost, high-output 3D printing technology to achieve integrated 3D printed terahertz components and imaging systems. Research project students will integrate existing ultrafast lasers, antennas, 3D printing technology, and imaging technology to design this high-performance terahertz system and measure its optical characteristics, electrical characteristics, spectral characteristics, and terahertz radiation characteristics. Research project students are required to submit their research results to relevant domestic/international conferences or publicly showcase their research findings.

## Expected Outcome

- Learnable Knowledge and Skills: Terahertz technology, semiconductor lasers, ultrafast optics, antenna design, lens design. Expected Output: Low-cost terahertz LEGO system.

# Topic 5: 6G/THz Communication

## Summary

- Due to the increasing demand for wireless networks among modern users, wireless network carrier capacity exceeded 1ZB in 2018. However, the rate of increase in wireless network transmission speed has slowed in recent years and may no longer meet technological demands. This is because the communication speed of today's wireless communication systems is limited by two major factors: the narrow frequency range of the transmitter and the channel spectrum congestion up to 60 GHz. Many research teams have attempted to use the millimeter-wave frequency range to alleviate the high-speed wireless transmission demand, but the available spectrum range is still quite limited, and it cannot solve the congestion problem in transmission channels. Recent research has found that the terahertz frequency range has not yet been regulated, and terahertz carriers can carry a much larger amount of signal. Advancing wireless channels to higher frequency bands can significantly increase wireless transmission rates. Research project students will design an integrated 5G/6G wireless transmission system to achieve ultra-high-speed mass information transmission indoors. Research project students are required to submit their research results to relevant domestic/international conferences or publicly showcase their research findings.

## Expected Outcome

- Learnable Knowledge and Skills: Terahertz technology, semiconductor lasers, signal processing, communication systems, automatic control. Expected Output: 5G/6G integrated wireless communication system.

# 陳國平

## Professor Chen, Kuo-Ping

### Topics

Nanophotonics

### Summary

1. Metasurfaces;
2. Plasmonics;
3. Nanofabrication and 2D materials

### Expected Output

1. Build up the knowledge and experience in nanophotonics and next generation of semiconductor;
2. learning the experiment and simulation in nanostructure fabrication and EM wave modeling

### Keywords

Signal processing, music, audio

### Prerequisite

Basic core courses 修過一些基礎科

### Contact

- <https://sites.google.com/view/kplab/intro>
- [kpchen@ee.nthu.edu.tw](mailto:kpchen@ee.nthu.edu.tw)

# 胡敏君

## Professor Hu, Min-Chun

### Topics

Please discuss with the professor.

### Prerequisite

- Basic core courses 修過一些基礎科
- Accpets students base on the completion of the assignment. 需完成給予的作業，做完才會收。

### Keywords

Multimedia Computing, Computer Vision, Computer Graphic, AR/VR  
多媒體運算、電腦視覺、電腦圖學、擴增實境與虛擬實境

### Contact

- <http://mislab.csie.ncku.edu.tw/>
- [cazimy@gmail.com](mailto:cazimy@gmail.com)

# 王俊堯

## Professor Wang, Chun-Yao

### Topics

Please discuss with the professor.

### Prerequisite

- Basic core courses 修過一些基礎科
- Like writing codes. 喜歡寫程式

### Keywords

Electronics Design Automation, Interconnect Verification for SoC

### Contact

- <http://nthucad.cs.nthu.edu.tw/~wcyao/>
- [wcyao@cs.nthu.edu.tw](mailto:wcyao@cs.nthu.edu.tw)

# Other Availabilities

You may contact other professors in the links below:

- <https://dcs.site.nthu.edu.tw/p/404-1174-9870.php>
- <http://web.ee.nthu.edu.tw/p/412-1175-518.php?Lang=en>

Please politely introduce yourself with personal academic-related information for reference. For example, transcript, courses, or activities you have taken, or resume, etc.

## NOT available list

| Name                   | Not available |
|------------------------|---------------|
| 黃錫瑜<br>Shi-Yu Huang    | Not available |
| 吳財福<br>Tsai-Fu Wu      | Not available |
| 徐正炘<br>Cheng-Hsin Hsu  | Not available |
| 沈之涯<br>Chih-Ya Shen    | Not available |
| 張淵智<br>Yuan-Chih Chang | Not available |
| 洪毓珽<br>Yu-Chueh Hung   | Not available |
| 盧錦隆<br>Chin Lung Lu    | Not available |