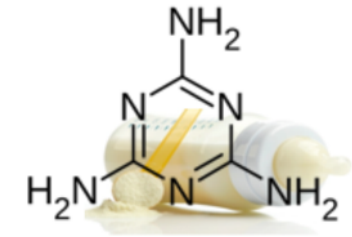


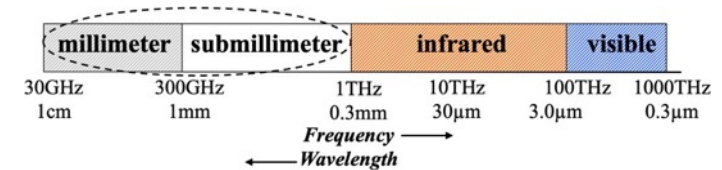
Background :

Harmful substances such as **melamine** in daily foods, milk and animal feeds causes actual environmental and human health problems
 Illegally added to inflate the apparent protein content of food and animal feeds:

- **50%** of dietary supplements are contaminated with melamine
- Found in **baby formula milk** in China, 2008, which was responsible for severe renal problems and kidney stones in infants.



Food safety should be widely monitored and improved



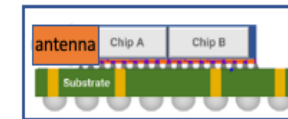
Targets:

a portable and cost-effective **scanner** for real-time detection of contaminants in staple foods and/or animal feeds using non-invasive **mm-Wave sensing** with on-chip **antenna-array system**.

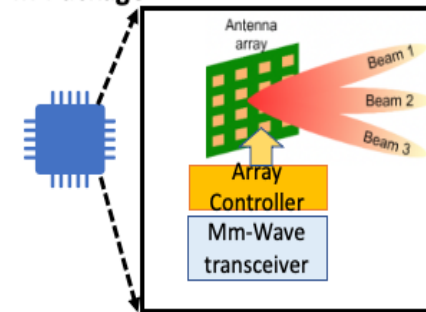
Speaker:

Nguyen Ngoc Mai-Khanh
 System Design Lab (d.lab)
 The University of Tokyo, Japan

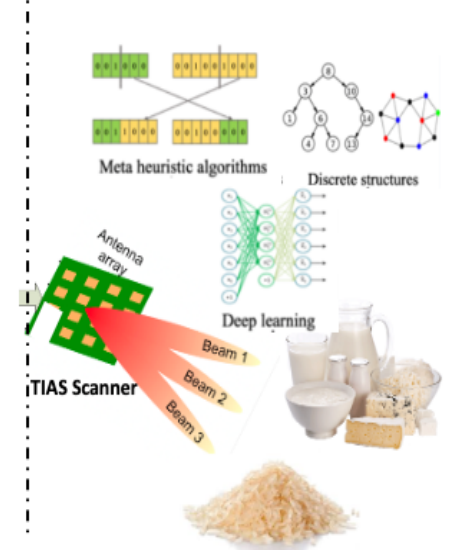
System-in-Package Tier



SiP TIAS Scanner with Antenna-in-Package



Sensing Application Tier



Project Title: 2.5D Technology-based Integrated Antenna Array mm-Wave System For Non-Invasive Food Safety Scanner (TIAS)

Project Members :

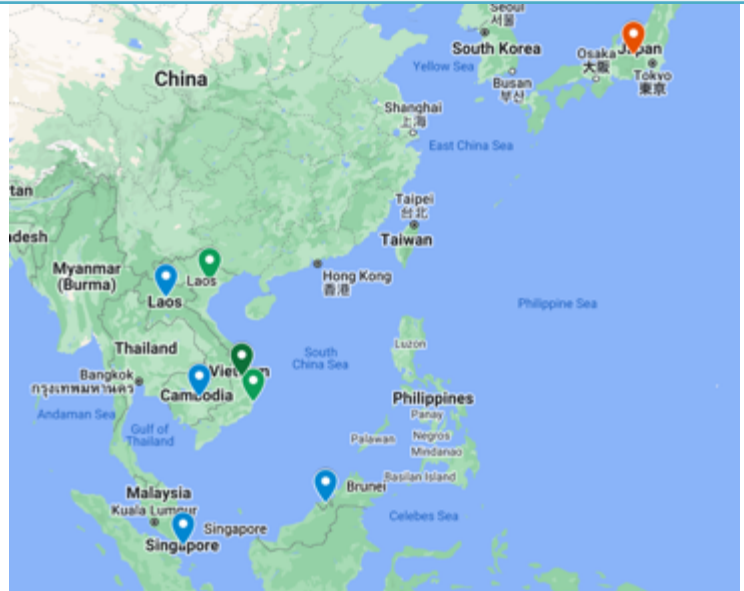
Name /Position/Institution	Name /Position/Institution
Nguyen Ngoc Mai-Khanh (Project Leader)/Assist. Prof./ The University of Tokyo, Japan	Padapxay Sayakhot /Deputy Director General/IICT, Laos
Tran Thi My-Hanh /Vice-Director/Department Research Affiars, Nha-Trang University, Vietnam	Aromhack Saysanasongkham /Deputy Director/IICT, Laos
Pooja Shivanand Breh /Assist. Prof./Universiti Brunei Darussalam/Brunei Darussalam	Bich-Yen Nguyen /Senior Fellow/Soitec, Singapore
Gong Xiao /Assist. Prof./National University of Singapore, Singapore	Chea Soheat /Researcher/Cambodia Academy Of Digital Technology (CADT), Cambodia
Vo Nguyen Quoc-Bao /Assoc. Prof., Dean/PTIT, Vietnam	Tetsuya Kawanishi /Prof./Waseda University, Japan

Project Duration :

2 years

Project Budget:

80,000USD



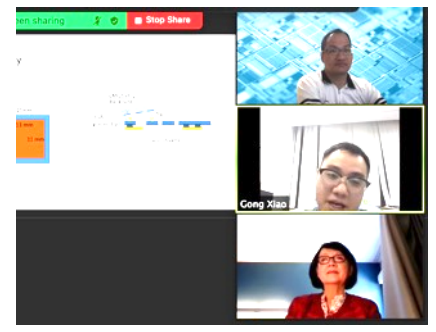
PTIT: Posts and Telecommunications Institute of Technology; IICT: Institute of Information and Communication Technology

Project Activities: TIAS Meetings

Kick-off meeting, May 2021, online



Group#1 meetings

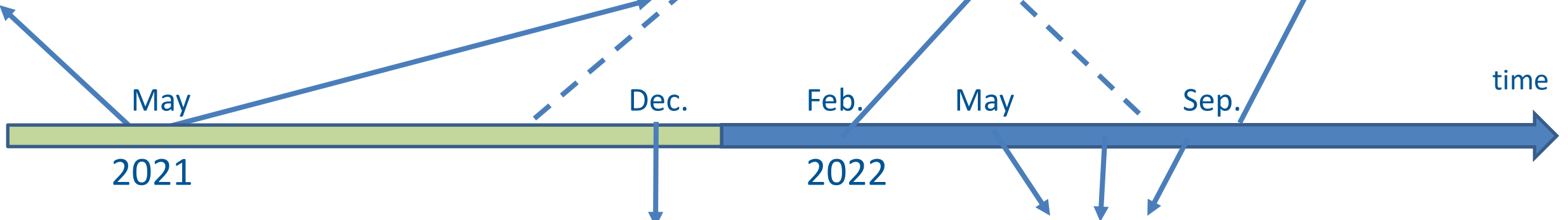


Antenna chip fabrication
~6 times

Group#2 meetings



Chemical sample
Antenna design
Measurement



Collaboration with others:
U.S and Belgium

Field test/experiments:
NTU, Vietnam and NICT, Japan

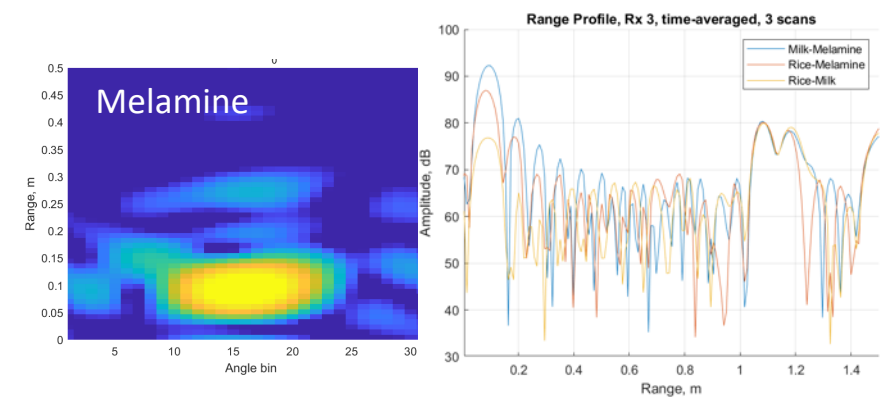
1. Field Test @ Vietnam:

- **Time:** April 21, 2022, **Place:** NhaTrang Univ. (NTU), Vietnam
- **Content:**
 - Chemical and data analysis
 - Sample preparation plan
- **Members:** NTU, Vietnam; Soitec, Singapore; UTokyo, Japan



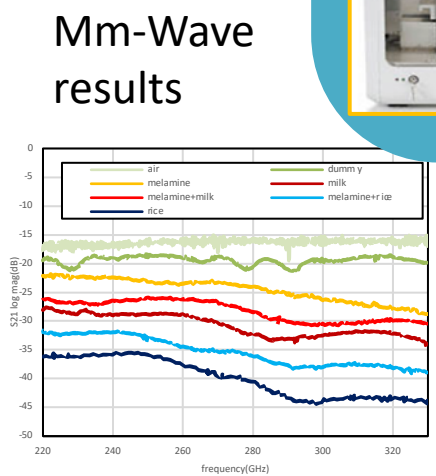
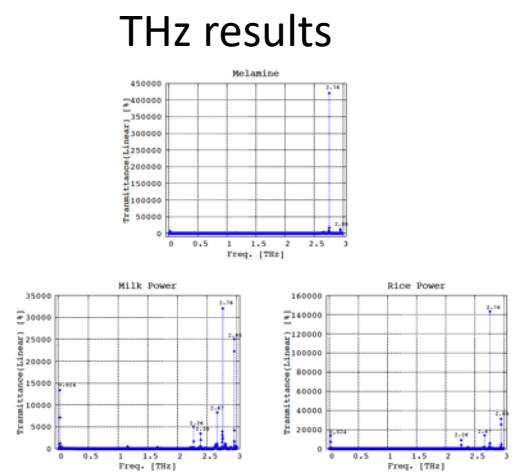
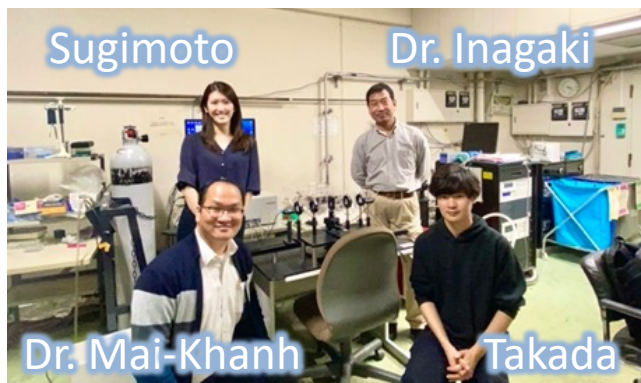
2. Intl. Collaboration Expansion

- UC Davis (U.S): 77GHz radar measurement
- UCLouvain (Belgium): chip design & fab.



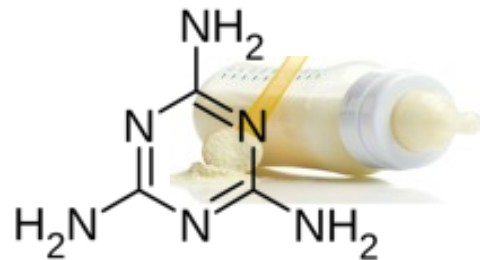
R&D results: Field Testing at NICT, Japan

- **Time:** Jun., Aug. 2022
- **Place:** UTokyo and NICT, Japan
- **Content:**
 - Sample preparation
 - THz/Mm-Wave measurements:
 - 220-330GHz; 330-500GHz
 - 0.1 – 3THz
- **Members:**
Waseda Univ, UTokyo, & NICT



Societal Impact:

- Broader impacts on different angles including advanced research, practice, and education
- **Advance the research** of food safety by integrating the latest portable semiconductor technologies such as antenna, and the advanced 2.5D integration technology
- Open vast opportunities to build fast, cheap, compact and energy-efficient mmW for developing countries
- For a look ahead, the project aims to build an Artificial Intelligence and Internet-of-Things (**AIoT**) **library** for mm-Wave-based sensing data as well as a **database** for consumer users with a **traceability** to e-society.

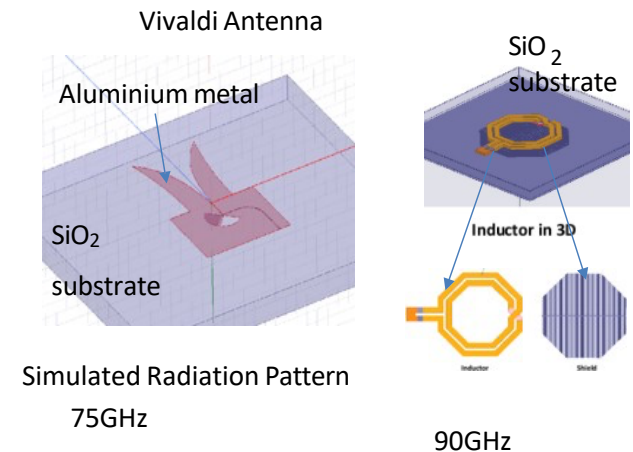


1. Scientific and technological:
 - Successfully designed an on-glass Vivaldi antenna for the purpose of sensing
 - Melamine sample preparation

2. Application development & experiment
 - Measurement in 10 —500GHz and THz ranges
 - On-glass fabrication process: antenna design & implementation

3. Field test:
 - Vietnam & Japan

4. Intl' Collaboration
 - UC Davis (U.S) and UCLouvain (Belgium)



- **Define the mm-wave specification for detecting harmful substances:**
- **Build a heterogeneous integrated mm-Wave sensing system:**
 - Setting up a *2.5D modelling platform* for implementing the proposed mm-wave system
 - Design on-chip *antenna array* and then integrate it with the transceiver
- **System Implementation, Calibration & Validation**
- Develop a prototyping system being used in the food safety sector currently.
- Data collecting and creating a *big database* of harmful food substances.

