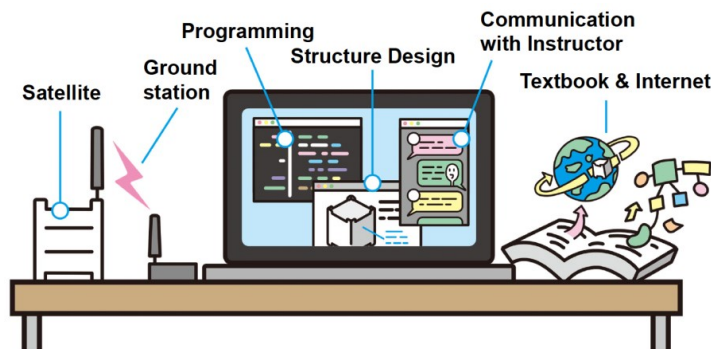
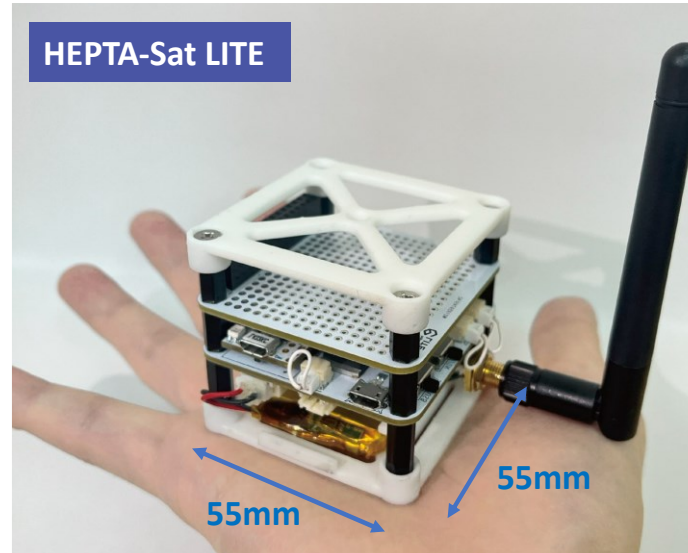
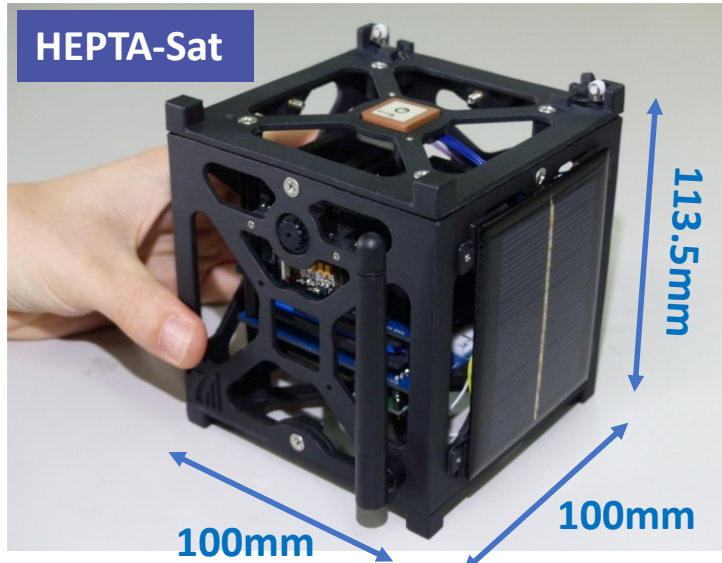


Overview of HEPTA-SAT and HEPTA-SAT LITE: Practical Training for Space Engineering

Nagisa Sone (Nihon University, UNISEC)



Overview of HEPTA-SAT and HEPTA-SAT LITE: Practical Training for Space Engineering

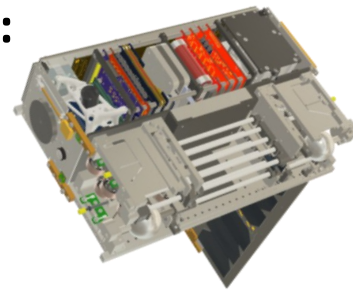
Nagisa Sone (Nihon University, UNISEC)



1st-year of Master Course Student

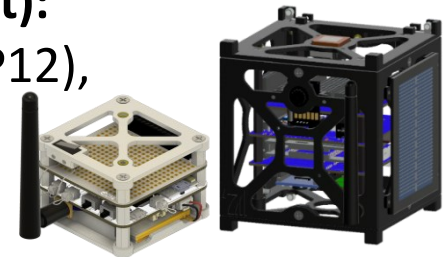
Main Responsibilities in Satellite Development:

- Project Management
- COM, ADCS
- Space Activity Law, Frequency Coordination



HEPTA-SAT Training (As Teaching Assistant):

- 2023: Taiwan, South Africa, Japan (CLTP12),
- 2024: Vietnam, Japan (CLTP13)



Research Theme:

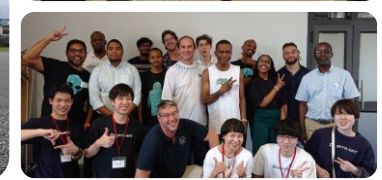
- Clarify relationship between the ionosphere and earthquakes.

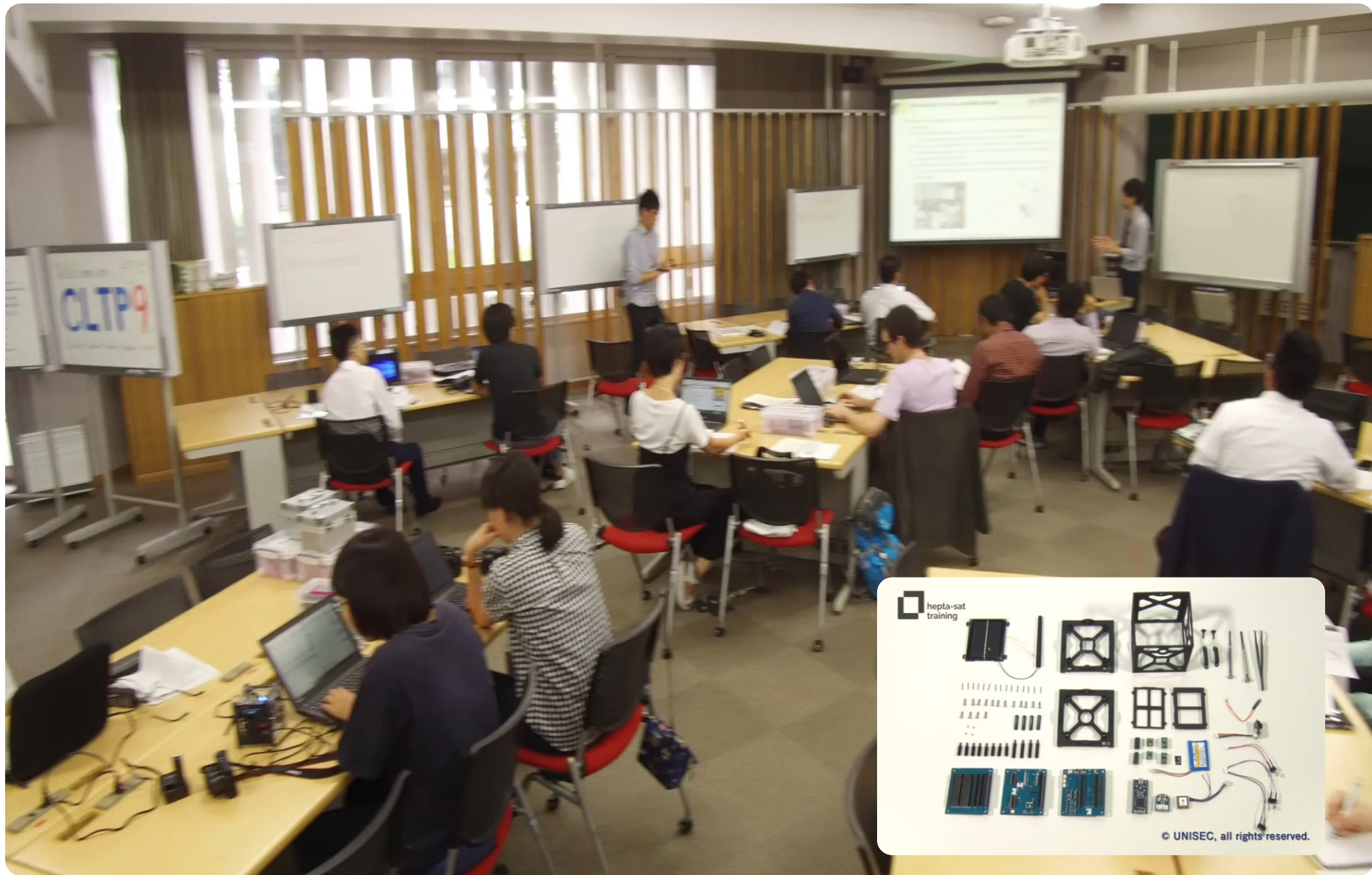
Overview of HEPTA-SAT Training to Date

- ❖ The HEPTA-SAT training course is practical hands-on learning of the “CubeSat” system, which is widely used in universities and companies around the world, to learn the basics of “Space Systems Design” through actual products.



- Workshops at International Space University (France, Australia)
- JICA's Overseas Human Resources Dispatch Program
- Training for space agencies (JAXA, Kenya, Oman, etc.)
- University Lectures (UAE, Taiwan, Kyoto University, etc.)
- UN side event workshop (South Africa)
- Development of training programs for astronaut candidates (JAXA, JAMSS)
- Lectures for junior high and high school students (Science Museum)





Increasing Demand for CubeSat Utilization

- CubeSats and small satellites can be developed at **low cost** and within a **short period**, increasing demand in **education, research, and commercial applications**.

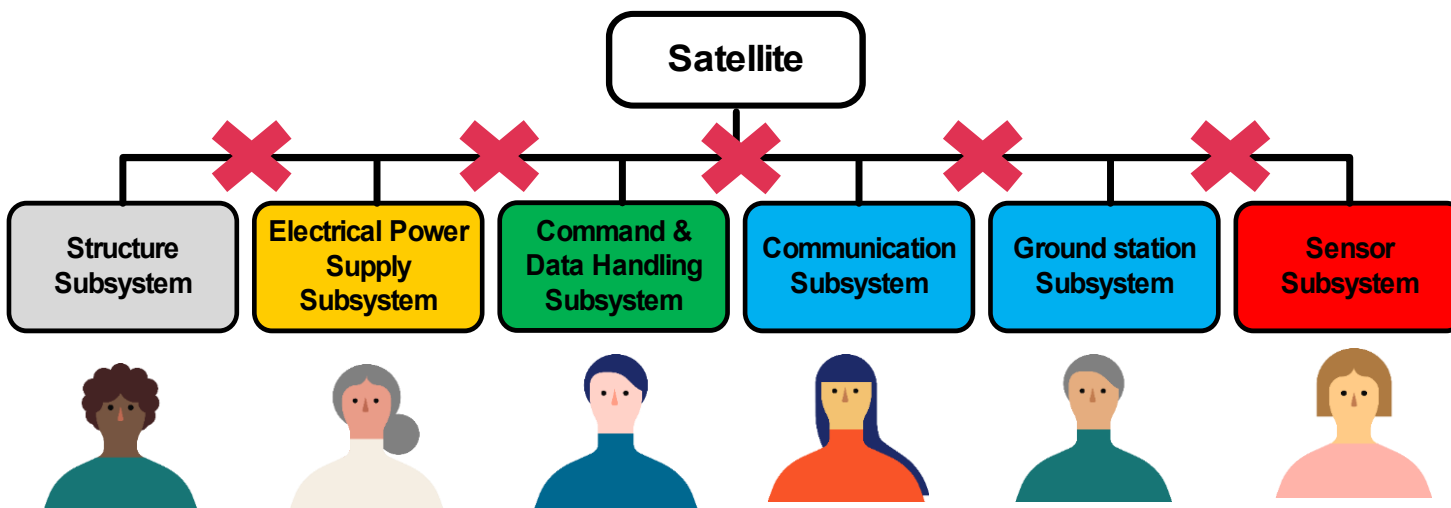
We are developing an actual satellite and creating an educational program based on it.



Examples of UNISEC Japan satellites from 2003 to 2019 (R&D, Commercial)

- ❏ The level of missions is growing and the complexity of the system is increasing.
- ❏ There are few opportunity to learn for **systematically** and **practically** understanding the **entire satellite system**.

Even if we belong to a specific team and learn parts of it, can't optimize the whole system without understanding the entire satellite system.

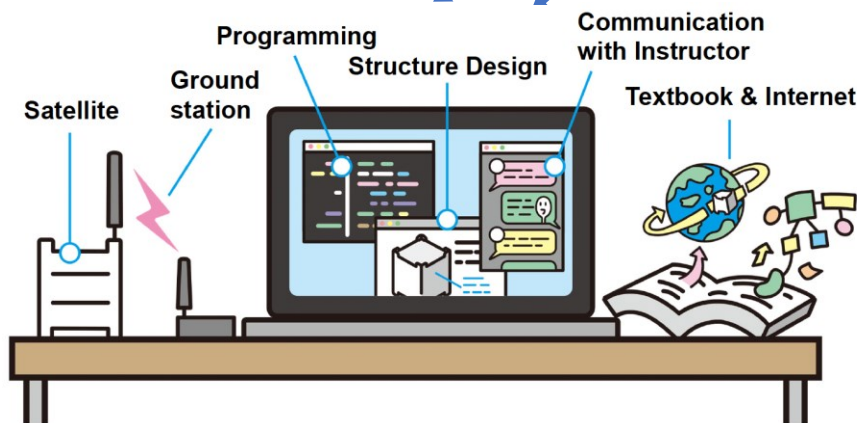
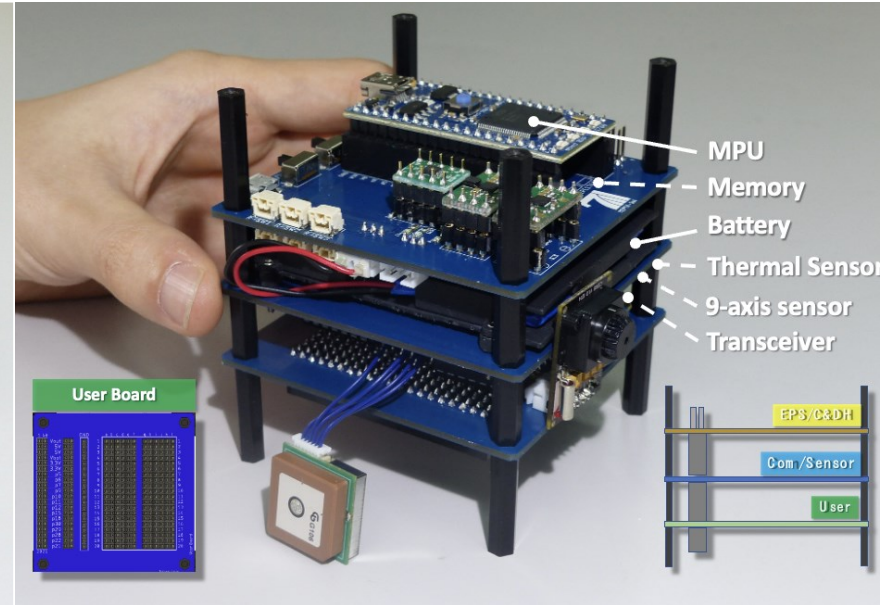
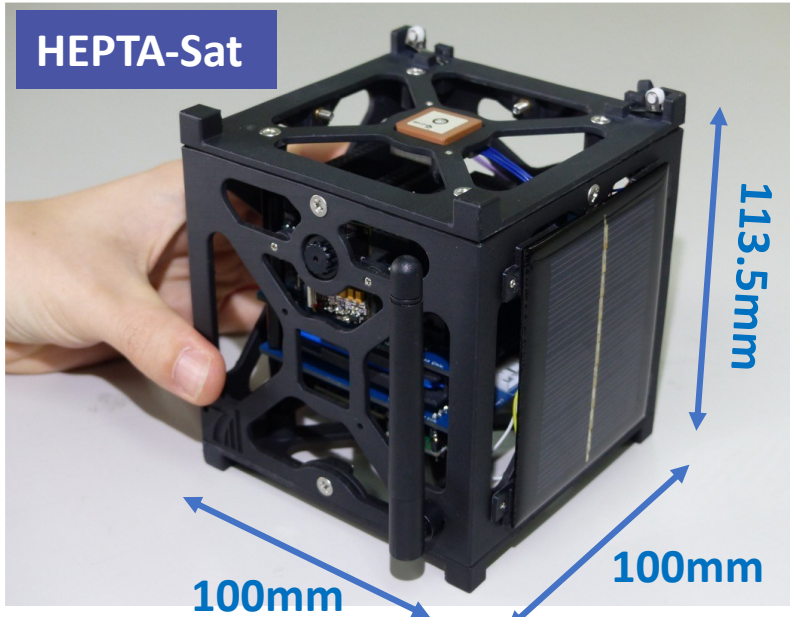


- ❏ Satellite development technology is advancing day by day.
- ❏ Educational platform is needed to **continuously** gather the latest satellite development knowledge.

To solve the problems, HEPTA-SAT Training provides **kits** , **corresponding textbooks** and the **OJT style workshop**.

What is HEPTA-Sat and HEPTA-Sat LITE?

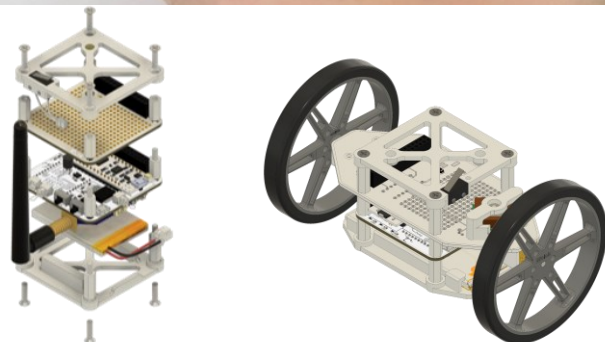
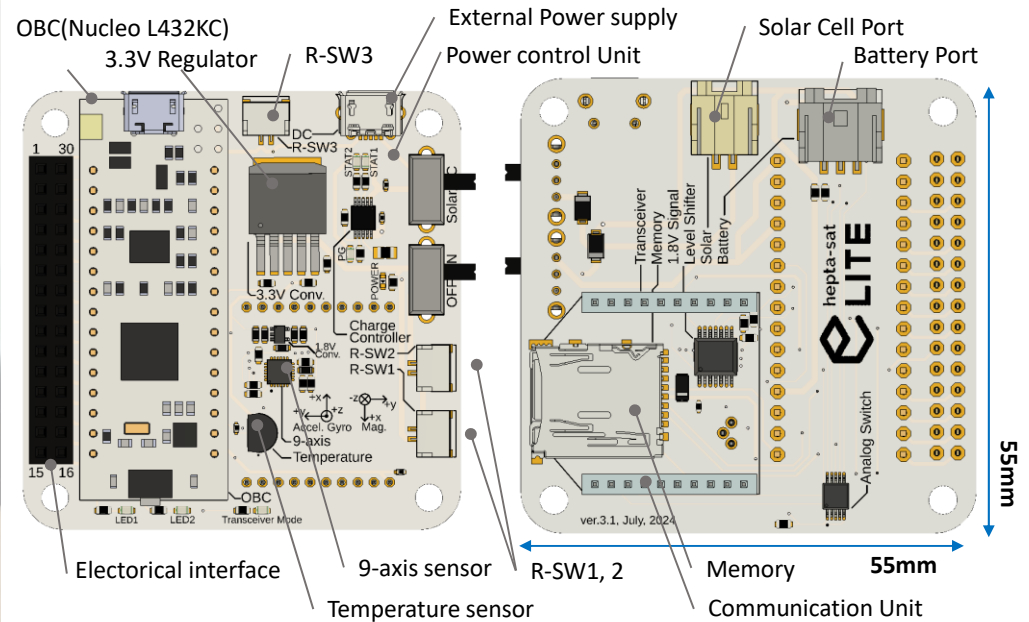
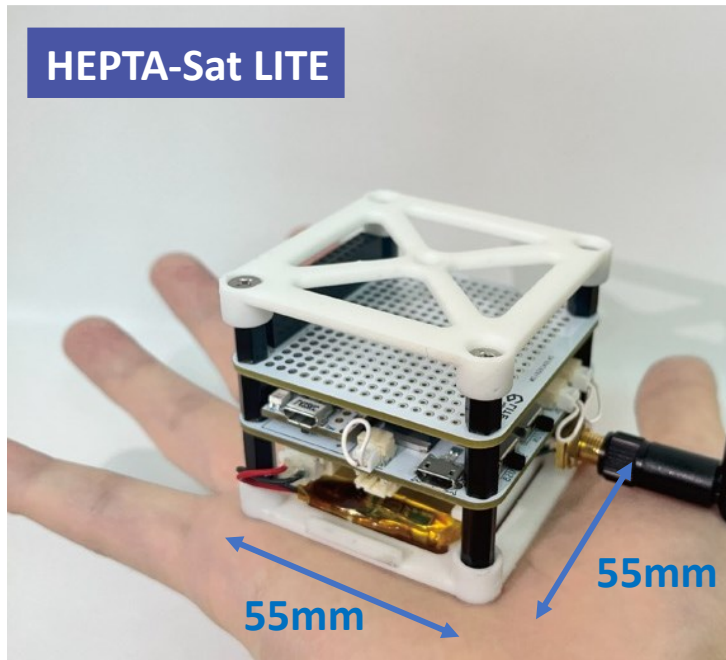
- HEPTA-Sat is a CubeSat education kit that contains a satellite bus system, including a microcomputer, battery, transceiver, sensor devices, and structure.



Easy access to space for newcomers, requiring only an Internet environment and a laptop computer.

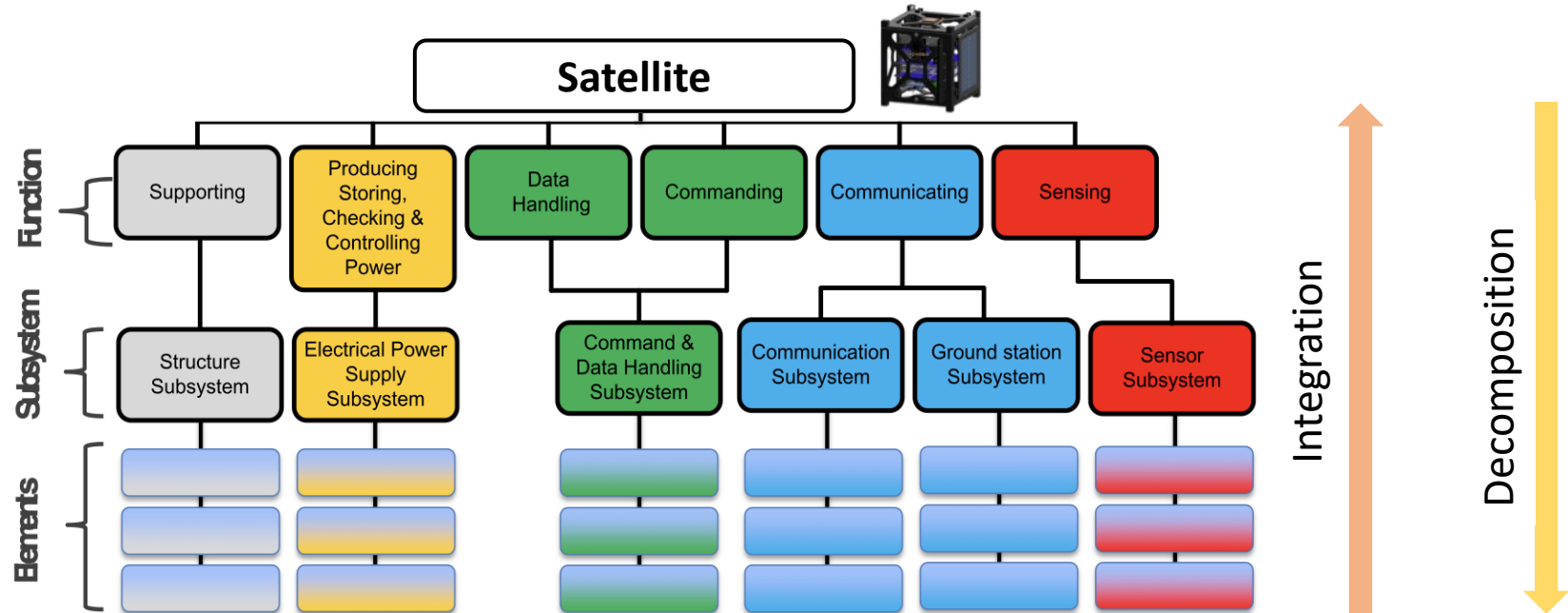
What is HEPTA-Sat and HEPTA-Sat LITE?

- ❖ The HEPTA-Sat LITE is a new training kit that simplifies HEPTA-Sat into a single chip, only 55mm x 55mm palm-sized board. offering an equivalent curriculum in less time.



- Easier to use because of its smaller size and lower cost.
- Most sensors and other functions are already included on a single board, making it easy to use for other applications.

- Experience how a system is composed of elements and sub-elements.
- Understand the relationship between the whole system and the elements.

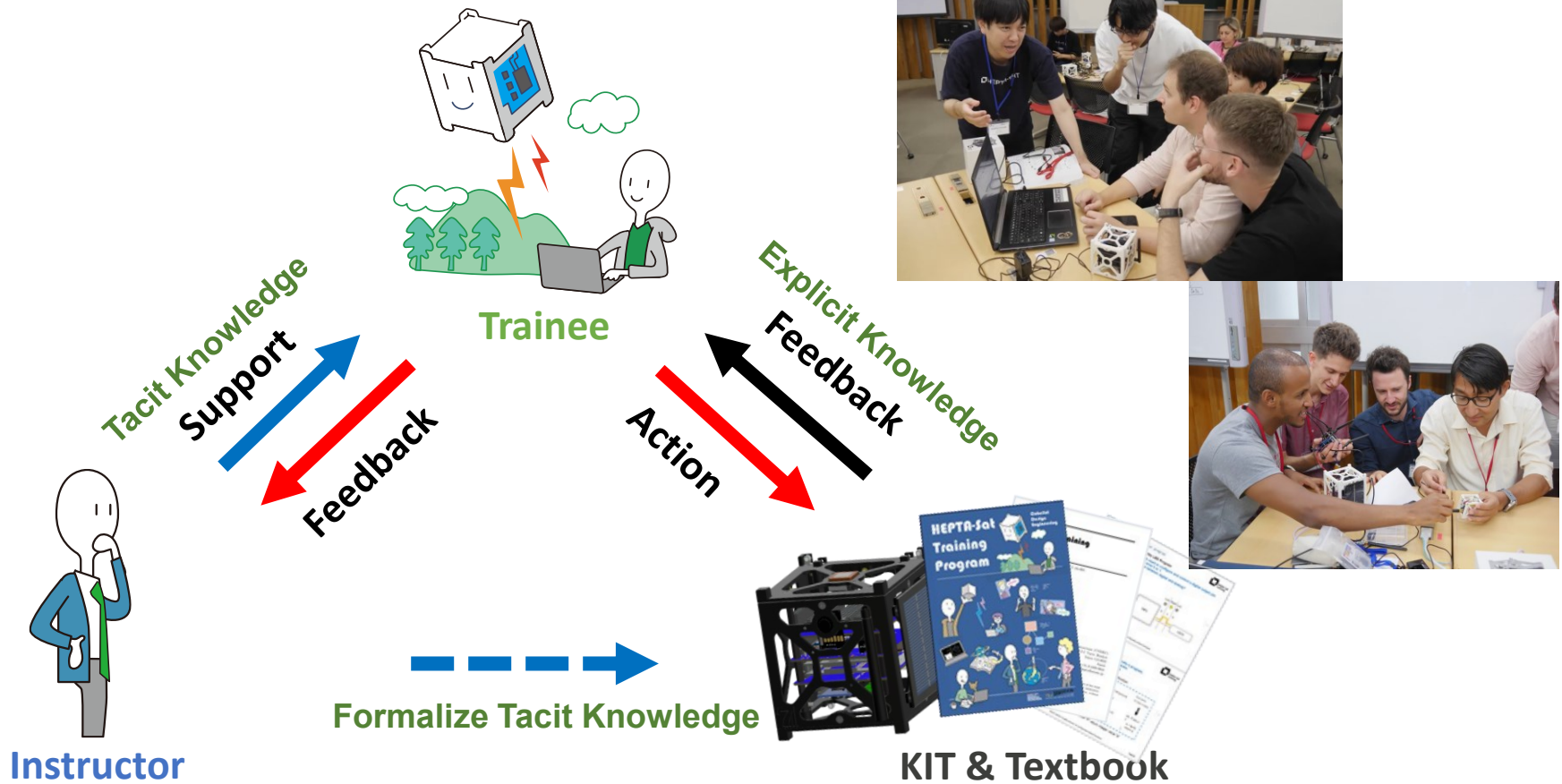


Decomposition & Integration

- Understand the logic at the element level
- Step-by-step assembly of elements **to understand the entire system.**

The behavior of the system changes by the **elements** and the **connections between elements**. The HEPTA-SAT provides learning what the system is **step-by-step in a practical.**

- ❖ To pass on satellite technology and knowledge from the Instructor with experience in satellite development to the participants.



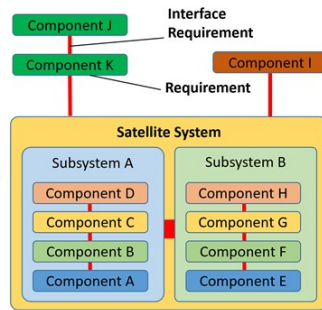
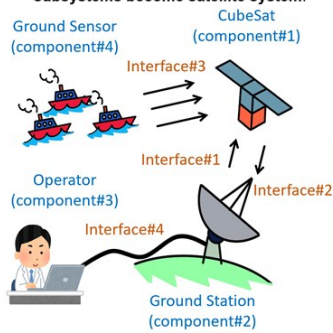
- 📦 The kit and textbook are strongly linked, following a scenario-based structure.
- 📦 Learning that aligns with the flow of theory, design, and assembly.
- 📦 The text book bridges theory and practice.



Systems Engineering



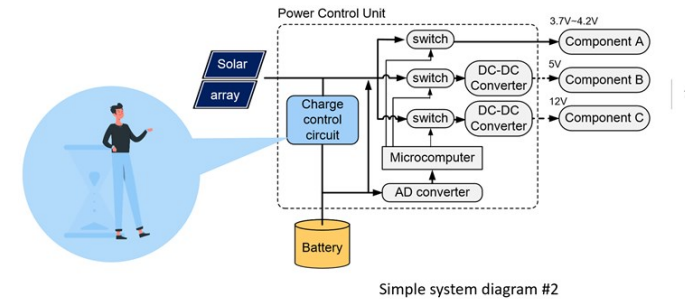
- 🔍 In this course, you will learn about a 1U CubeSat hands-on using the HEPTA-Sat kit. At the beginning of the lecture, students learn how to handle components, and as the lecture progresses, students experience how components become subsystems and subsystems become satellite system.



Architecture



- 🔍 Rechargeable batteries in general need to be charged at an appropriate charging current. In this sense, a management function using a charge control circuit (charge control IC such as an ON/OFF switch) is necessary.



*Charge current is controlled in response to the level of remaining power of the rechargeable battery.

Software



Lab#4 2.15 F Using GPS receiver

- 🔍 Now, let's get the data from the GPS receiver and display it on the PC.

Exercise 4.8

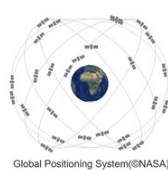
- 🔍 Let's downloaded the following program from the "heptasat_program library".

Lab4-08_detect_gps_rawdata

- 🔍 Implement the program and run the GPS receiver!

```

1 #include "mbed.h"
2 #include "HEPTA_EPS.h"
3 #include "HEPTA_CDH.h"
4 #include "HEPTA_SENSOR.h"
5
6 RawSerial pcd(U5B7X,U5B8X,9600);
7 HEPTA_EPS eps(p16,p26);
8 HEPTA_CDH cdh(p5,p6,p7,p8,"sd");
9 HEPTA_SENSOR sensor(p17);
10
11 p28,p27,0x0,0x18,
12 p13,p14,p25,p24);
13
14 int main()
15 {
16     sensor-gps_setting();
17     pc-print("GPS Raw Data Mode\n");
18     while(1) pc-putc(sensor.getc());
19 }
    
```



Global Positioning System(©NASA)

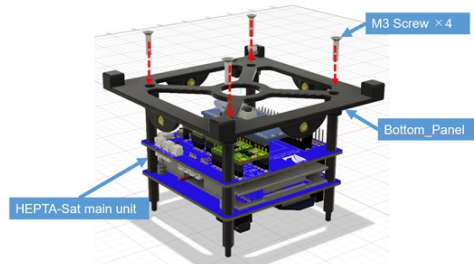
Hands-on



Integration and Test of the HEPTA-Sat structure

Exercise 6.1

- 🔍 Fix HEPTA-Sat main unit and Bottom Panel completely
- ✖ Please do not tighten the screw so tight!

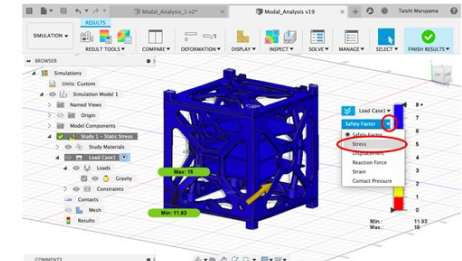


Analysis • Evaluation



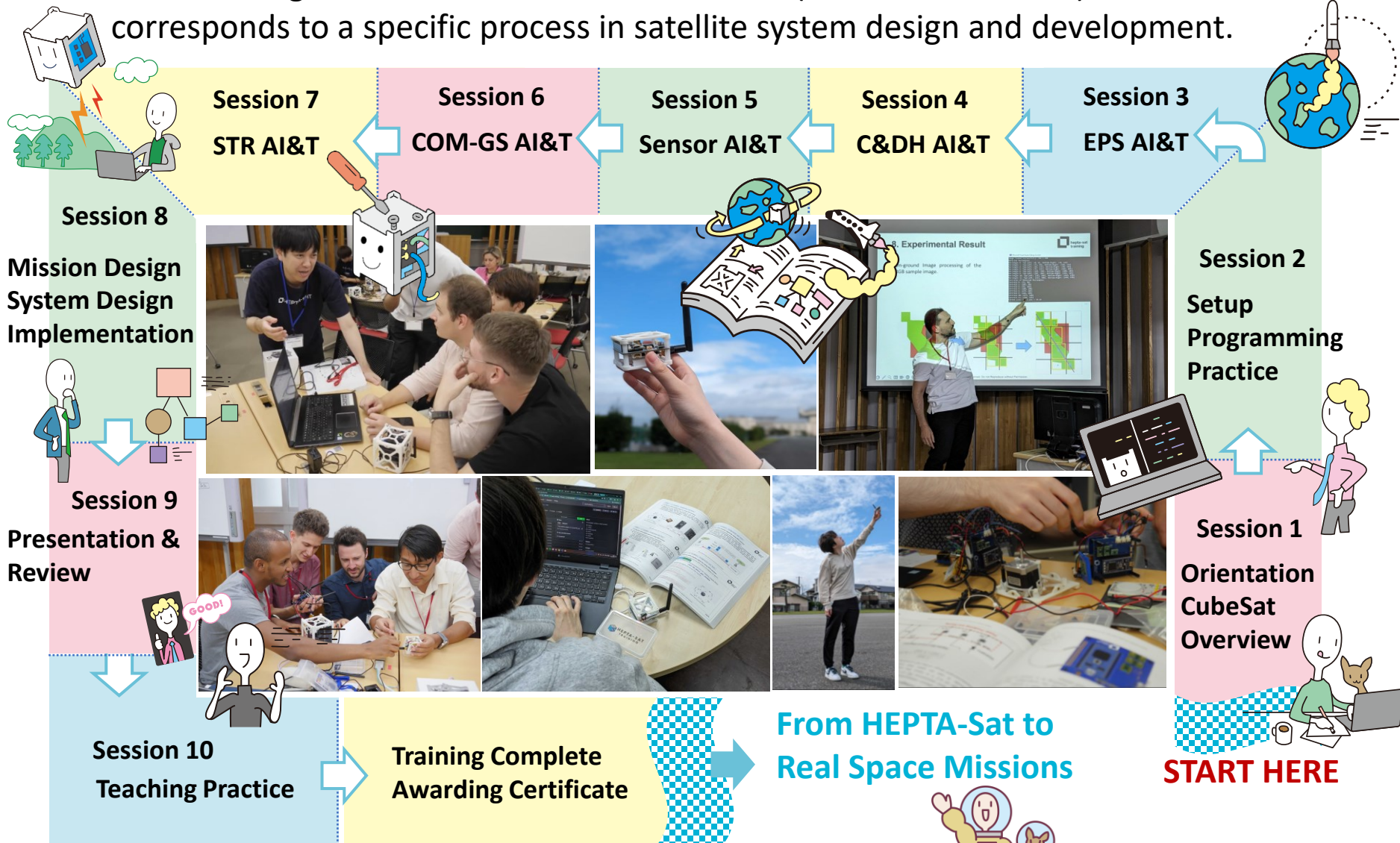
Exercise 6.9

- 🔍 From now on, the flow is exactly the same as Modal Analysis.
- 🔍 Generate a mesh and start the analysis.
- 🔍 When the result is obtained, the maximum stress is displayed.



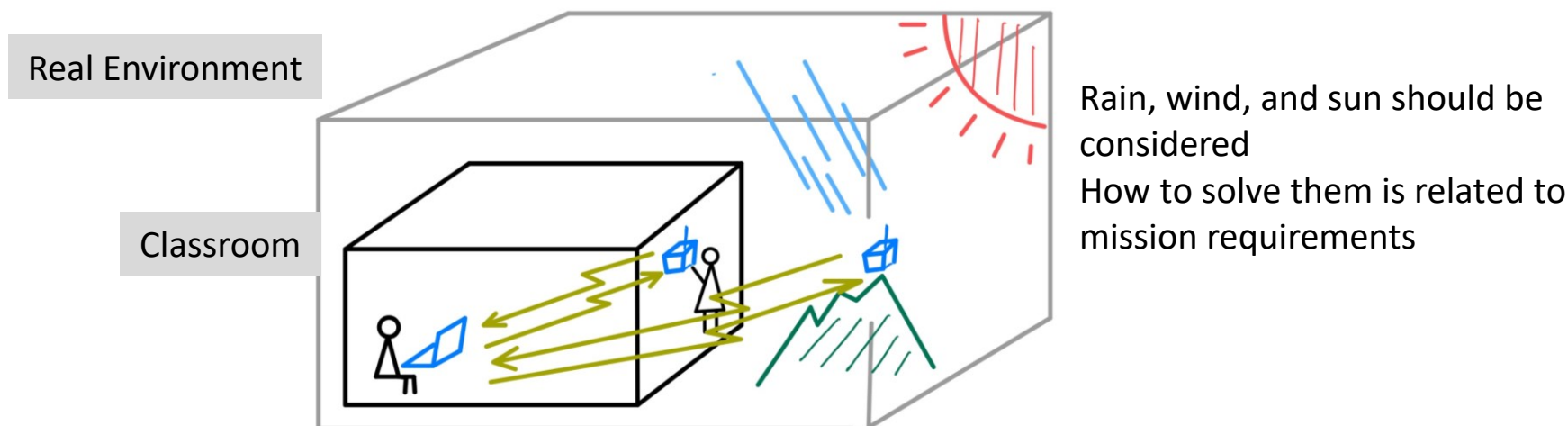
Curriculum Overview and Steps

📦 This training is consisted of 10 sessions (Lab#1 to Lab#10). Each session corresponds to a specific process in satellite system design and development.



Achieve Systematic, Realistic, and Practical Education That Includes Operations.

- ❖ Basically, the HEPTA-SAT training is limited to the classroom, but I would like to test in more tough conditions.
- ❖ This creates many thermal, structural, and other requirements for the system to work.



The Integration of Engineering Education and Science Education.

- ❖ From The experience of developing PRELUDE, which performs scientific observations, I think the importance of studying both engineering and science to conduct globally optimize the satellite system.

CubeSat Leader Training Program(CLTP)

“CubeSat Leader Training Program 2024, utilizing HEPTA-Sat”

The CubeSat Leader Training Program 2024 aims to equip participants with the skills and knowledge necessary to teach CubeSat development in their own countries in the future.

The two-weeks Space Education Program in Japan

1. Learn about satellites for one week, and design original mission by using HEPTA-SAT.
2. Buy the electronic elements for the mission implementation.
3. Participants teach classes as HEPTA-SAT teacher to Japanese space industry.

Deeper understanding and networking



We are looking for participants of HEPTA-SAT 1day training on Saturday and CLTP14 in 2025!
Please let us know if you are interested!

Please contact us

hepta@unisec.jp