Capacity Building in Space Technology Development
The United Nations/Japan
Long-term Fellowship Programme

Mengu Cho

Laboratory of Spacecraft Environment Interaction Engineering

Kyushu Institute of Technology, Kitakyushu, Japan

September 24, 2016

25th UN/IAF Workshop on Space Technology for Socio-Economic Benefits

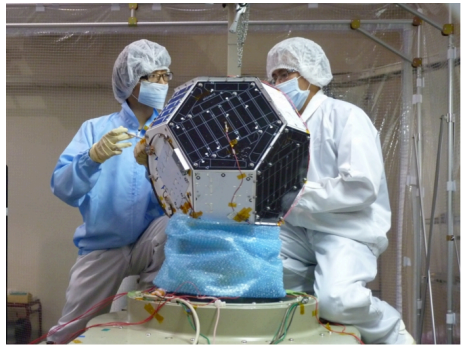
Guadalajara, Mexico

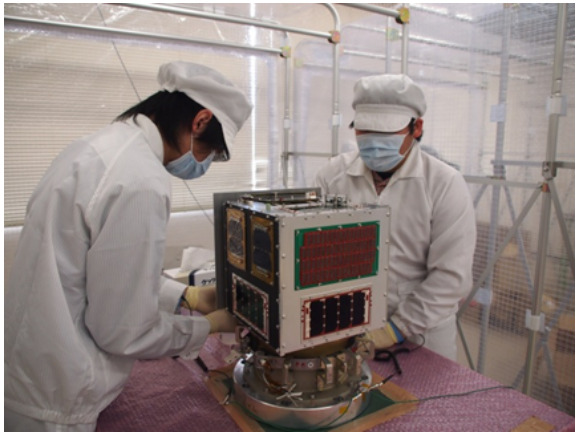
Kyushu Institute of Technology

- A national university founded in 1909
  - 4,200 Undergraduate students
  - 1,300 Graduate students
  - 360 Faculty members
  - Engineering, Computer science, Life-science
- Located in the Kitakyushu region
  - Population of more than 1million

Space Engineering Research and Educations at Kyutech

- Space Engineering Education at Tobata Campus since 1993
  - Undergraduate (30 students/class) and graduate levels
  - Department of Space Systems Engineering from April 2018
- Member of International Astronautical Federation (IAF) since 2011



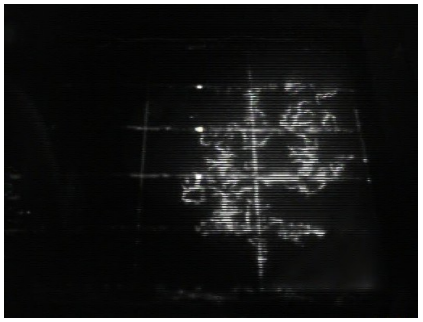


Kyushu Institute of Technology

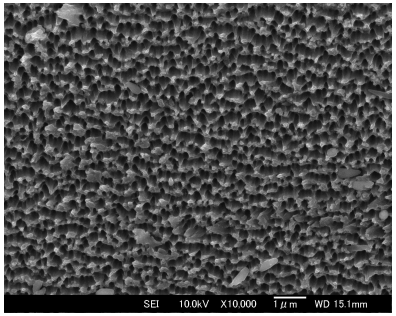
Laboratory of Spacecraft Environment Interaction Engineering (LaSEINE)

- Inauguration: December 2004
- 12 academic + 3 administrative staffs
- Annual research budget: 1 ~ 2 MUS$
- 1400m^2 laboratory space
- Partners
  - Space agency
  - Space industries
  - Local small industries
  - International institutions

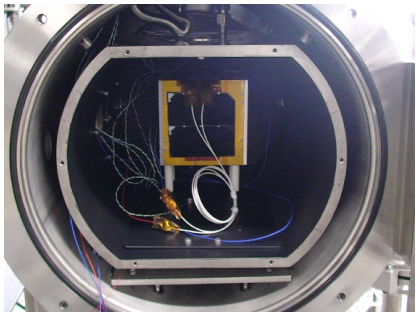
Spacecraft charging



Debris



Material degradation

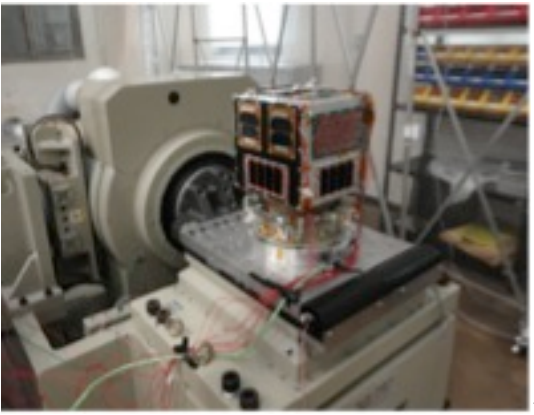


Nanosatellite environment test

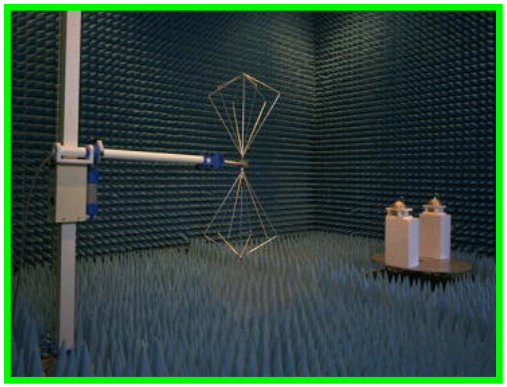
Center for Nanosatellite Testing

Established in 2010

Provides all the test service except radiation up to 50cmx50cmx50cm and 50kg



Vibration

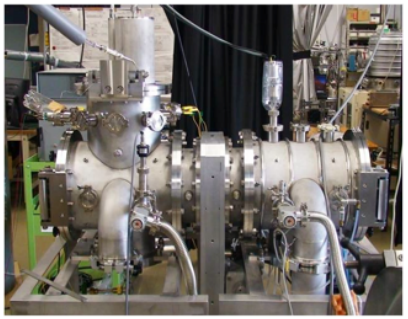


EMC & Antenna pattern

Pressure & Leak

Thermal vacuum

Assembly & Integration



Vacuum thermal shock

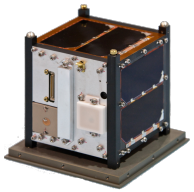
Thermal cycle

Shock

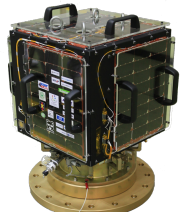
Outgas (ASTM E595)

α&ε measurement

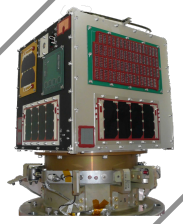
List of satellites tested



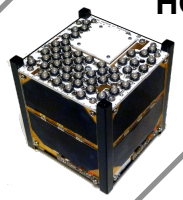
KSAT
launched in 2010



UNITEC-1



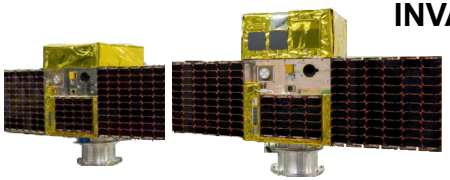
HORYU-II



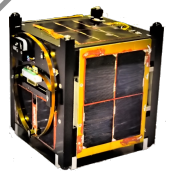
FITSAT-1

launched in 2012

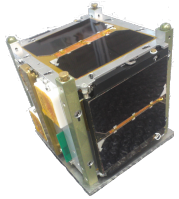
QSAT-EOS



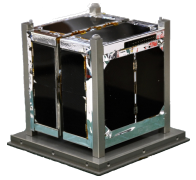
Hodoyoshi3,4



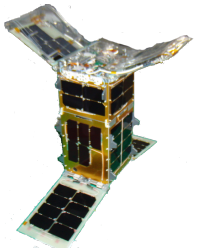
OPUSAT



KSAT-2

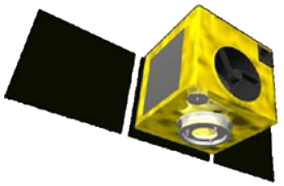


INVADER

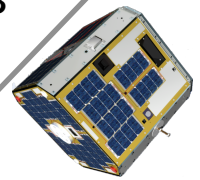


STARS-II

Teikyo-sat3



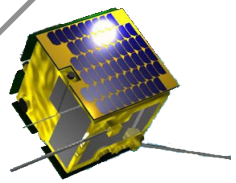
ChubuSat-3



Nano-JASMINE

DIWATA-1

Hodoyoshi2
(RISESAT)



ChubuSat

RISING-2

UNIFORM-1

Velox-II

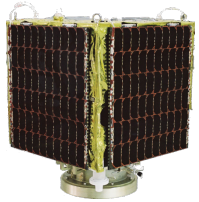
CE-SAT-I

launched in 2015

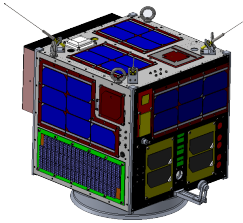
しんえん２

ARTSAT2

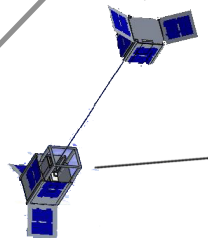
launched in 2014



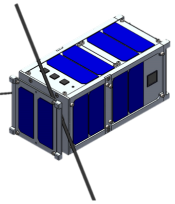
PROCYON



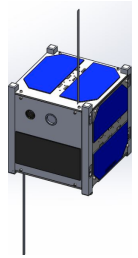
HORYU-IV



STARS-C



Aoba-VeloxIII



BIRDS

To be launched.

Two-thirds of less-than-50kg Japanese satellites

United Nations/Japan Long-term Fellowship Programme

- Presentation of UN Basic Space Technology Initiative (BSTI) at 27th International Symposium on Space Technology and Sciences, Tsukuba, Japan in 2009
- **Mission**
  - To enhance access to space application tools for sustainable development through building capacity in basic space technology
- Call for collaboration in long-term fellowship program to support students studying abroad and gaining experience through *on-the-job training (OJT)*
  - Reading books or attending lectures can not make a satellite
  - Experience the complete cycle of designing, building and testing
- Based on the research and education infrastructure, Kyutech answered the call.

United Nations/Japan Long-term Fellowship Programme

- Fellowship to students from non-space-faring countries
  - 2 or 3 years
  - Tuition and living costs
  - On-the-job training on satellite development, especially infrastructure
- Started as “Doctorate in Nano-satellite Technologies (DNST)” in 2011
  - 2 doctoral students accepted every year
  - Funded entirely by Kyutech
- Became “Post-graduate study on Nano-Satellite Technologies (PNST)” in 2013
  - 6 students (2 Master, 4 Doctor)
  - Funded by Japanese government fellowship

United Nations/Japan Long-term Fellowship Programme

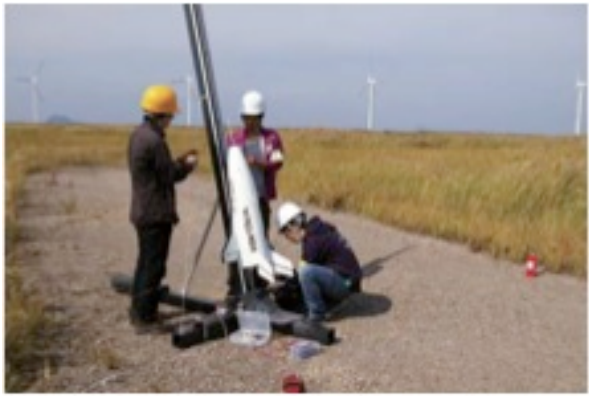
Year	Number of countries	Registered	Application package received	Accepted
2011	18	36	36	2
2012	25	39	39	2
2013	28	83	83	5
2014	55	509	69	6
2015	44	156	45	6
2016	52	386	71	4
2017		500+		

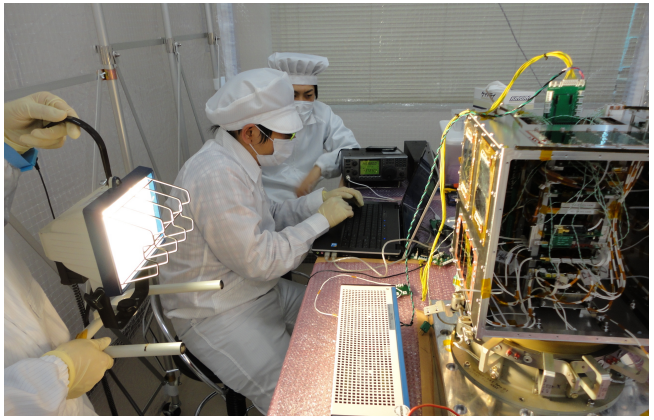
The selection process has been very competitive

In 2013, Space Engineering International Course started

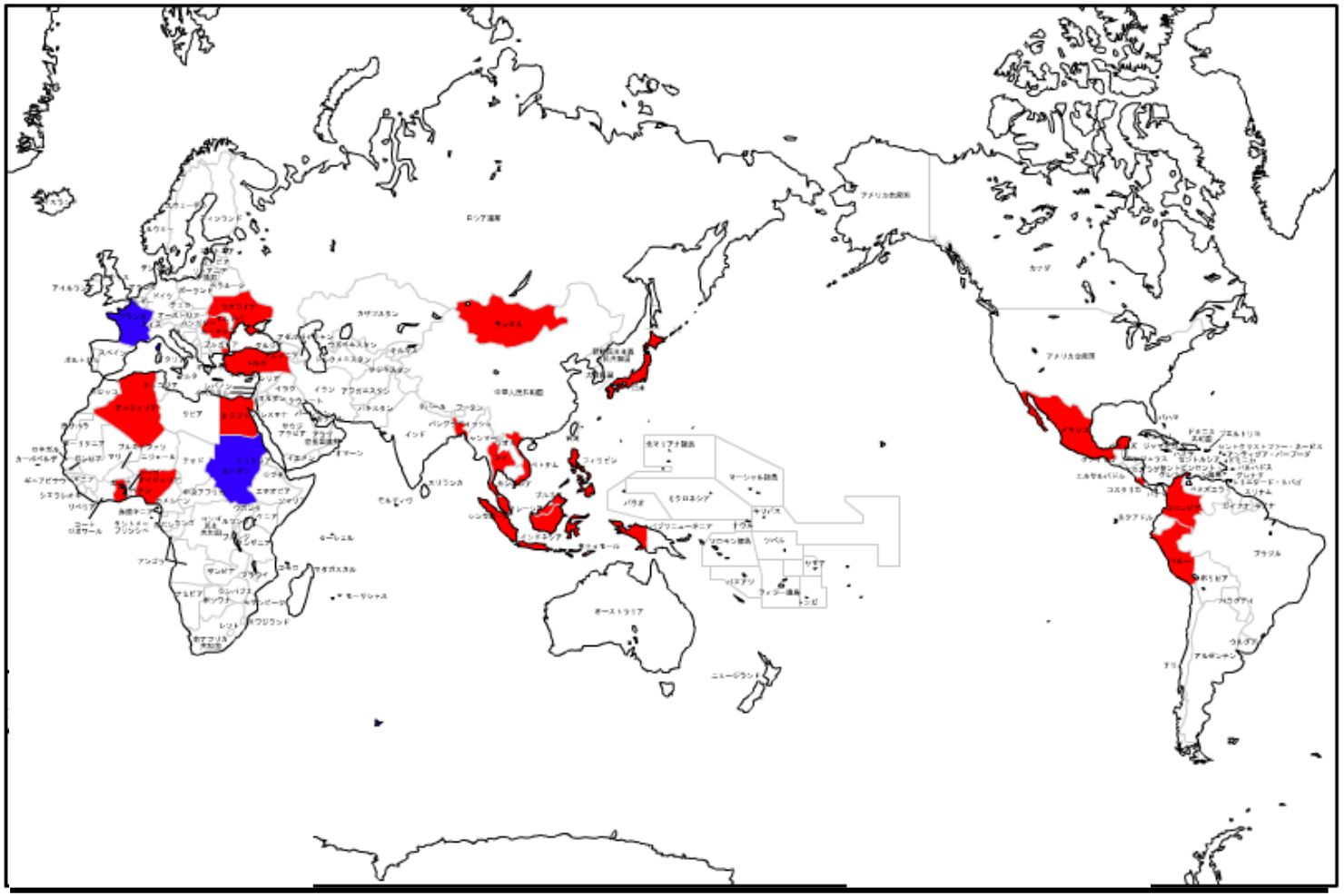
Space Engineering International Course (SEIC)

- Started in April 2013 at Graduate School of Engineering, Kyutech
- Research toward a Master or Doctoral degree
- On-the-job training such as space environment testing workshop
- Project Based Learning (PBL) through a space project
- Lectures in English
  - Space Systems Engineering, Satellite Engineering, Space Environment, Environment Testing, Power System, Structure and Material, Dynamics, Propulsion, Plasma, Semi-conductor, and more





SEIC Student Composition

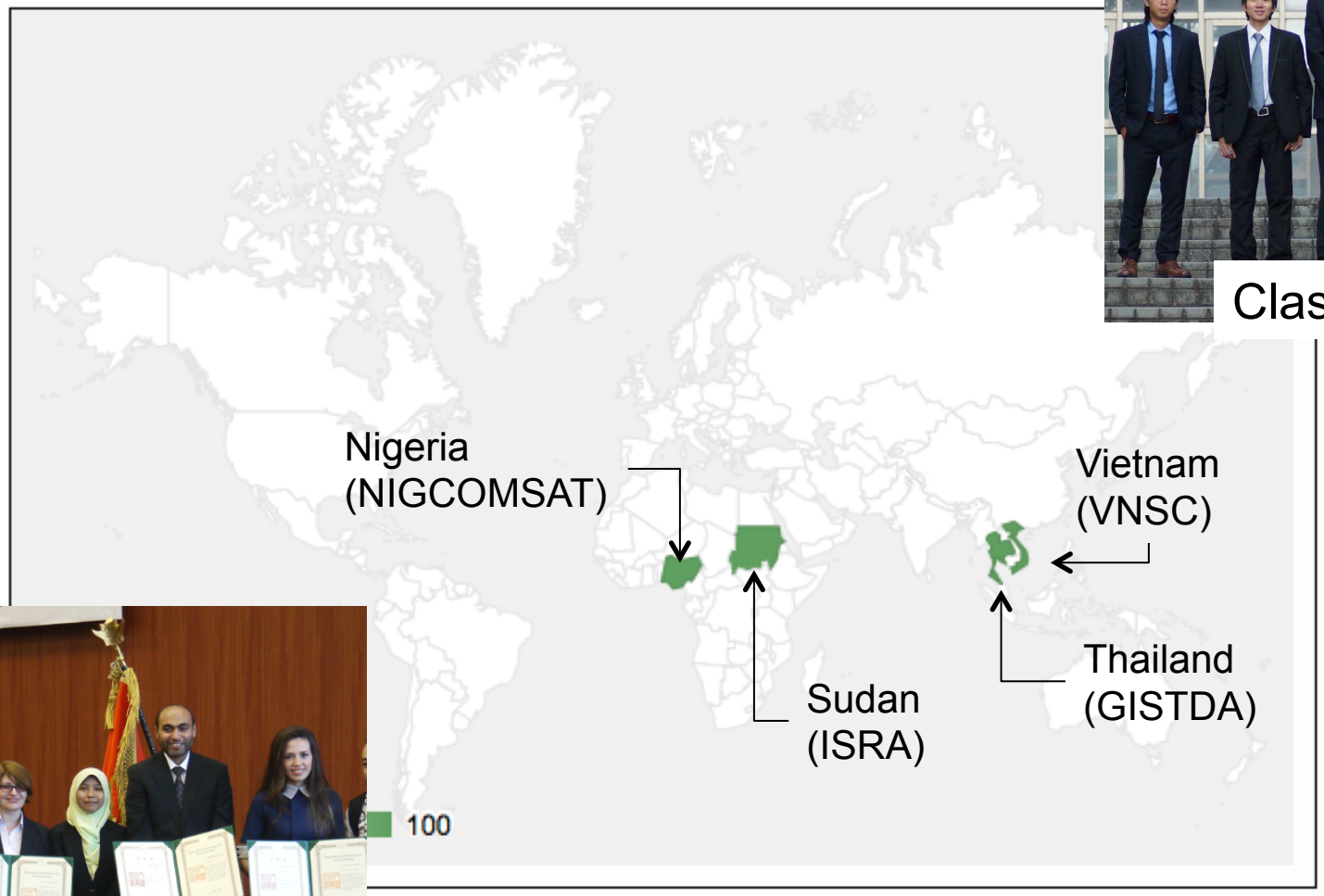


Graduated Current (as of February 2016)

As of February 2016, 20 countries (16 Japanese, 34 foreign students)

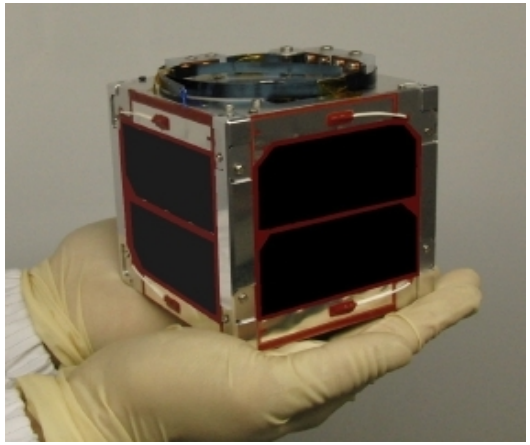
SEIC alumni

Class of 2015

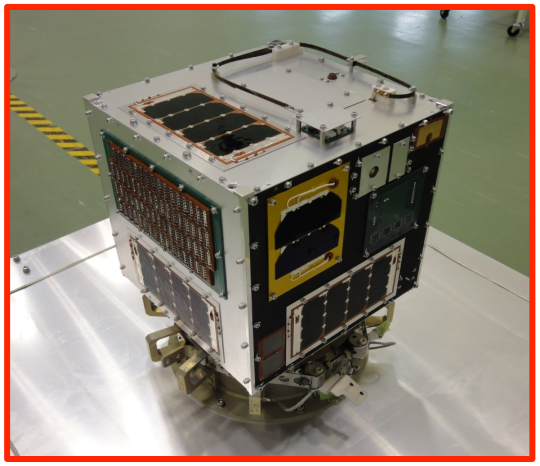


Class of 2016

Kyutech Satellites

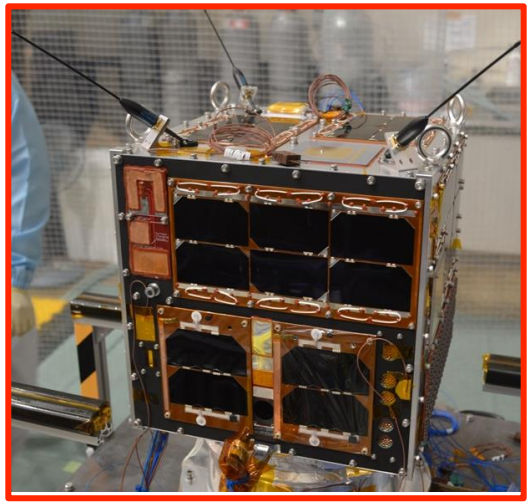


HORYU-1 (1U)
2006-2010
Not launched

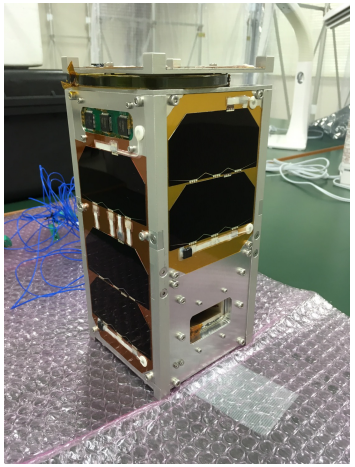


HORYU-II (30cmx30cmx30cm)
2010-2012
Launched on May 18, 2012

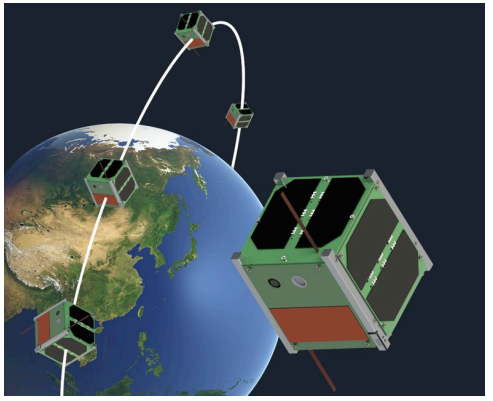
Shinen-2
2013-2014
Launched on December 3, 2014



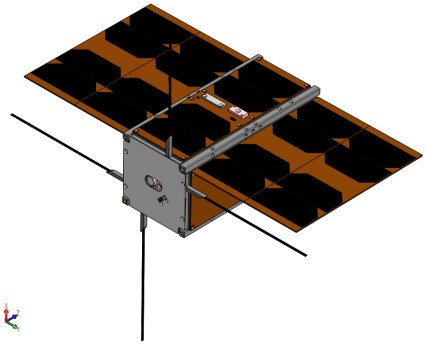
HORYU-IV
2013-2016
Launched on Feb. 17, 2016



AOBA VELOX-III
2014-
To be launched in 2016



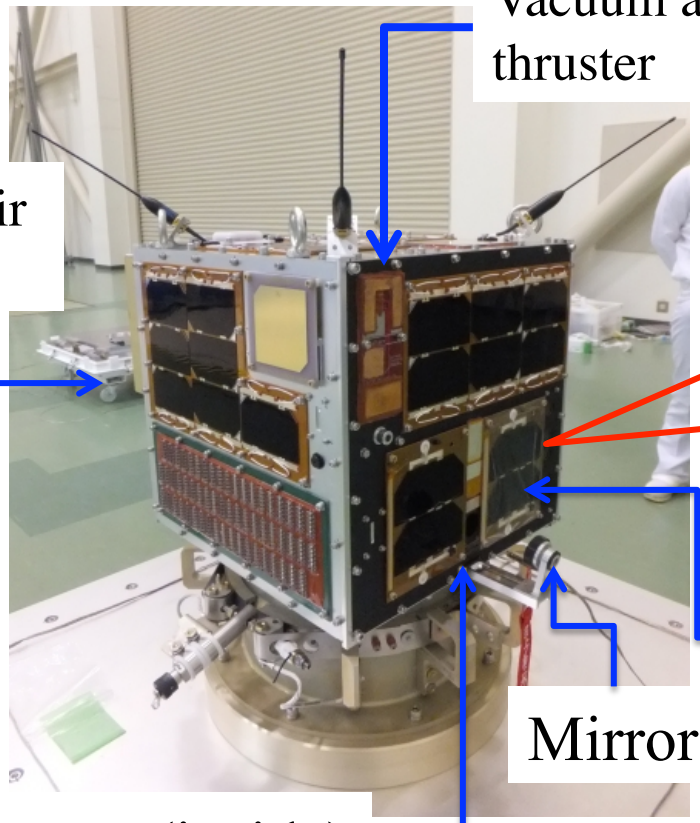
BIRDS constellation
2015-
To be launched in 2017

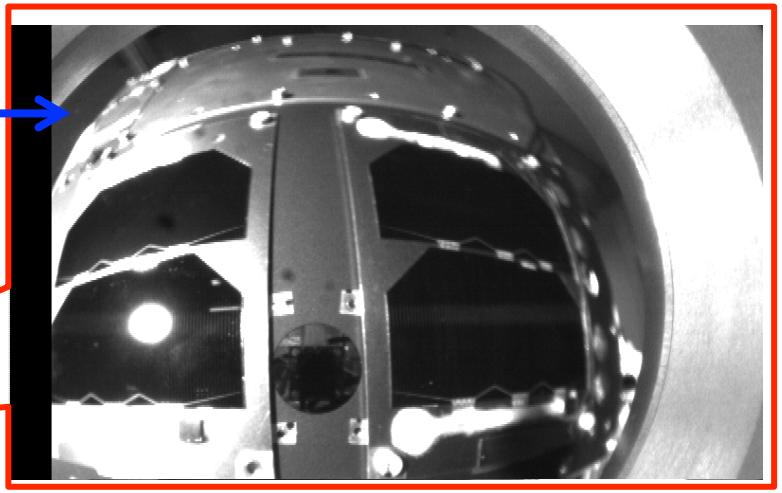


AOBA VELOX IV
2016-
To be launched in 2018

Kyutech Satellite Projects

AEGIS (Arc Event Generator and Investigation Satellite), HORYU-IV





Technology demonstration and experiments

Acquisition of current waveform and image of arcs on high voltage solar array

Launched on February 17, 2016

HORYU-IV team

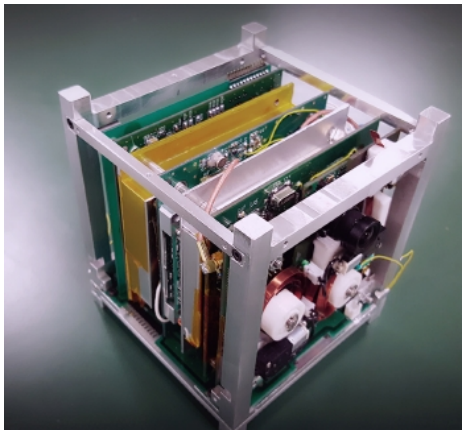
44 members from 18 countries

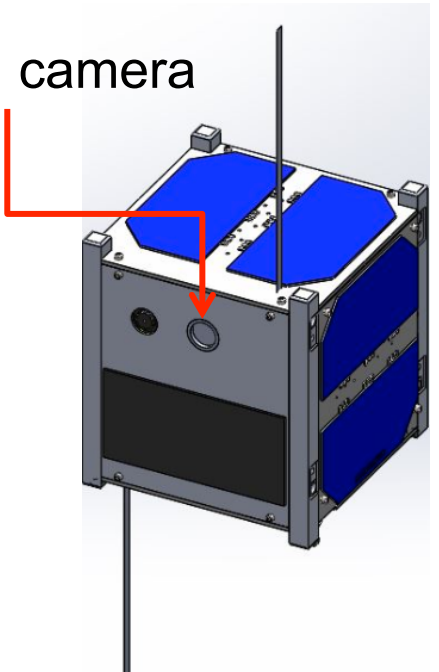
BIRDS project (2015~)

By successfully building and operating the first satellite of nation, make the first step toward indigenous and sustainable space program at each country

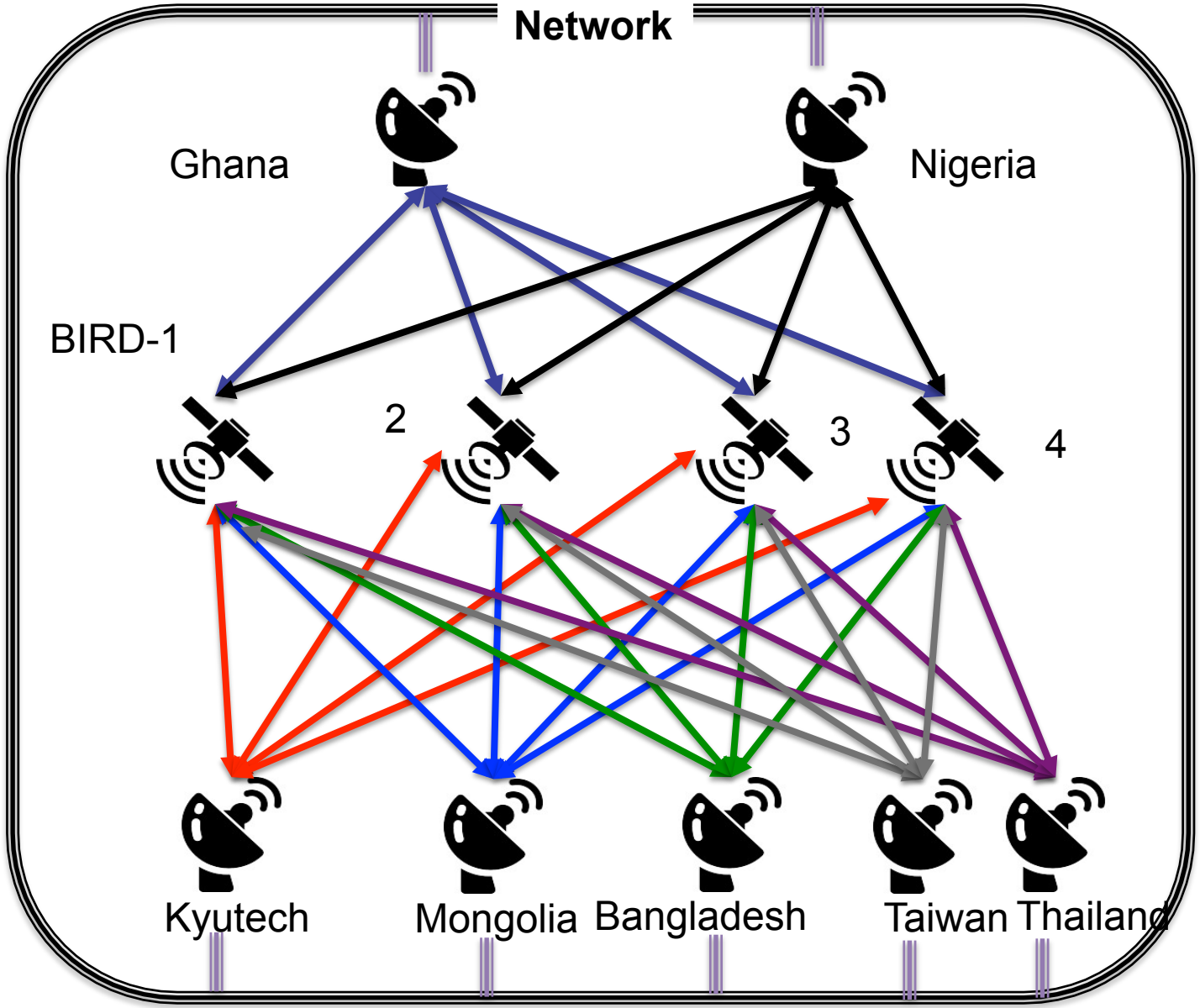
- 1U CubeSat constellation of 4 satellites by **Bangladesh*, Ghana***, Japan, **Mongolia***
- Made by students at Kyutech
- To be released from ISS in 2017
- Earth observation, Outreach, Space environment measurement

**** First satellite for the country***

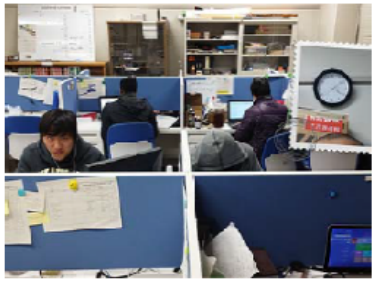
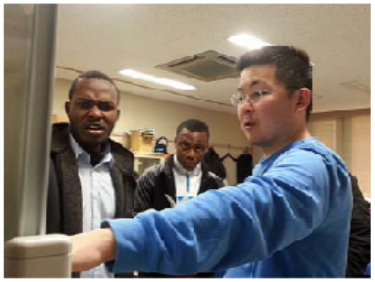




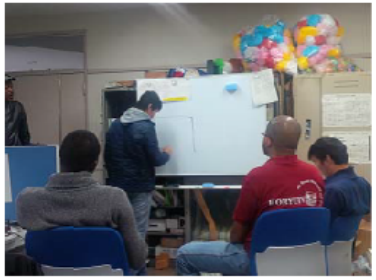
Network operation



These are the multi-nation engineering students of the BIRDS Project ….

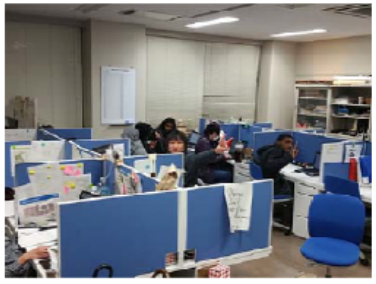












Educational aspects

- A short-tem goal
  - Build and operate satellites
    - Give the students confidence they can do it
- Long-term goal
  - Students initiate their own space program in home countries
  - The full mission success
    - The former students successfully build and operate the second satellite in their home countries
- Let students learn the entire processes of a satellite program from beginning to end
  - Witness each decision process and make decisions by themselves
- Fit the project within the degree timeline. 2 years longest
  - Selected 1U CubeSat and ISS launch as a platform

Capacity building aspect

- BIRDS program aims at fostering university space programs in non-space faring countries
- Often a national space program suffers disruption because of political and economical disturbance
- University space program is immune to the external disturbances.
- The university space program cannot grow forever.
  - Need to hand over the national space program to the government or companies
- To start with the minimum budget, a university is an ideal place.
  - CubeSat chosen as a training platform.
  - Affordable enough at university budget level
- Even after handing over the big projects to the outside body, the university still can continue its own space research and education

Cross-border network

- The BIRDS project intends to foster the cross-border inter-university network
- Human network
  - Human bonds created during intensive two-year training
  - Lead to joint space missions
- Ground station network
  - The backbone of the inter-university network
  - Enable constellation operation
    - Space research using a small satellite constellation lead to scientific outputs
- Assist the infant space programs survive the hard time

P N S T Fellowship

What we look for:

- *Passion* to be engaged in space technology (determined through original essay at the first stage, and through Skype interview at the second stage)
- Good English skills
- Must be under age 35
- Must be from a non-space-faring nation
- Strong background in engineering – any field is OK

Application for October 2017 admission is now open

Google "PNST UNOOSA"

Application deadline is January 22, 2017

Kyutech's desire

- Want to recruit excellent students from all over the world
- Want to provide a multicultural learning environment to Japanese students
- Want to strengthen Space Engineering research

But above all,

- Want to contribute to humanity by helping more countries entering the space sector that promotes the peaceful use of outer space

Thank you

UNOOSA Officer (Dr. W. Balogh) with Kyutech PNST students on 25 January 2016.
Location: Kyutech.