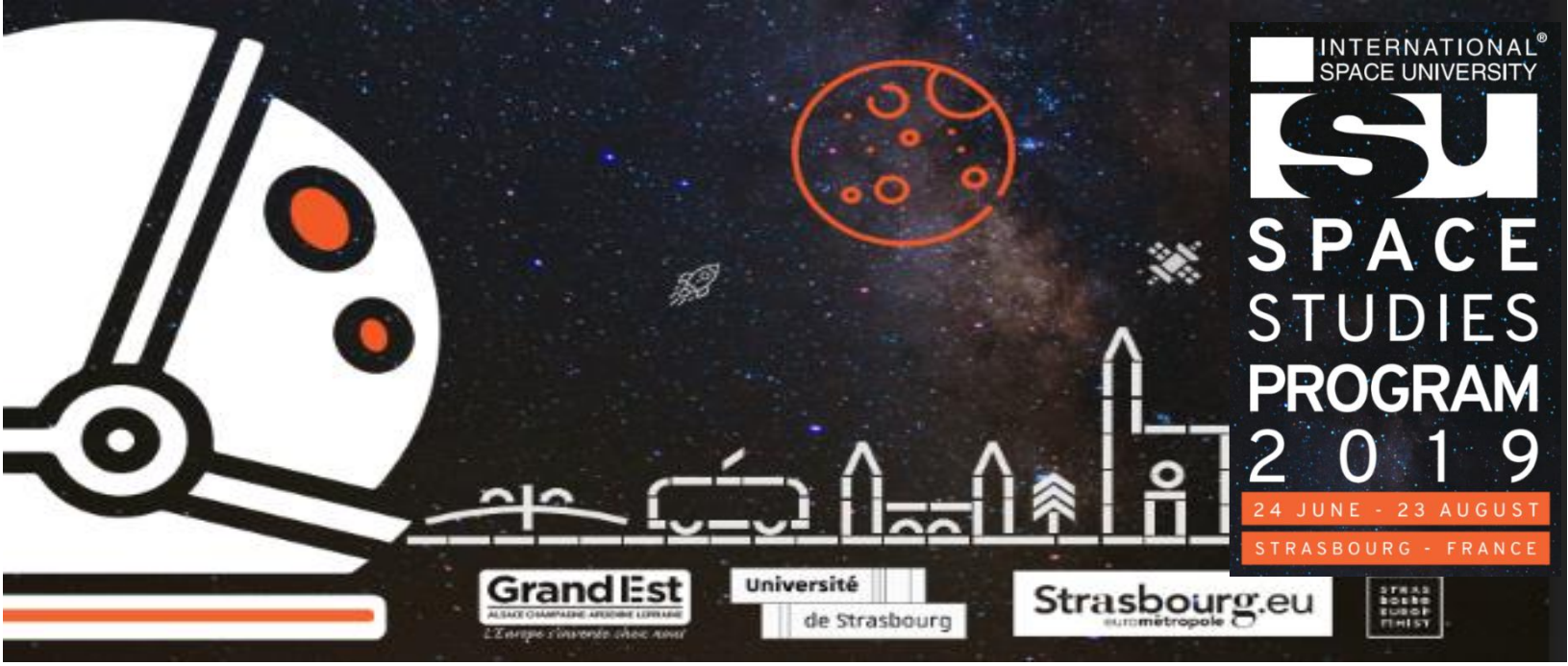

International Space University
Space Studies Program 2019 Report

June 24 – August 23, 2019

Strasbourg, France

Prepared by:

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Tohoku University Graduate School of Engineering

Aerospace Engineering

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1. Introduction

The International Space University conducted the Space Studies Program 2019 (SSP19) last June 24 to August 23, 2019 in its main campus in Strasbourg, France. As a part of the International Space University Dispatch Program of the Institute of Fluid Science, I, Julie Ann Banatao, attended the said program and this document contains my report on all the knowledge I gained and the experiences that I will always cherish in the years to come.

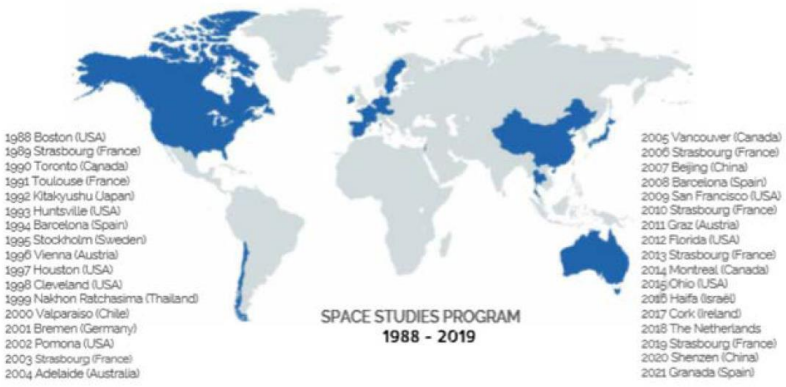
1.1. International Space University

The International Space University (ISU) was founded in 1987 by Peter H. Diamandis, Todd B. Hawley and Robert D. Richards with the vision to study, explore and develop space for the benefit of humanity. ISU provides a distinctive brand of space education that space agencies, the private sector and research institutions around the world look after. True to its founding principles, ISU's education focus on the three "I"s — International, Interdisciplinary, and Intercultural.

Over the past 31 years, ISU has graduated more than 4,800 students from over 100 countries and has hosted over 300 faculty experts. Programs offered by ISU include a one to two-year Masters Program (MSS), the annual Space Studies Program (SSP), Southern Hemisphere Program (SHSSP), and on-demand Short Space Courses.

1.2. Space Studies Program

The Space Studies Program (SSP) is the university's longstanding, pioneering program. It is an intense two-month graduate-level professional development program conducted since 1988. The curriculum includes both technical and non-technical space-related fields: physical sciences, engineering, policy, law, business, management, humanities, life sciences, and space applications. Given the broad range of the topics covered in the program, it is a unique educational experience for postgraduate students and professionals of all disciplines.



Countries that Served as SSP Hosts

SSP is conducted annually, and it is conducted in different host institutions each year. Moving to a new city and country makes it more exciting and dynamic, and gives access to new resources and expertise to the program.

2. Outline of Space Studies Program 2019

2.1. Venue

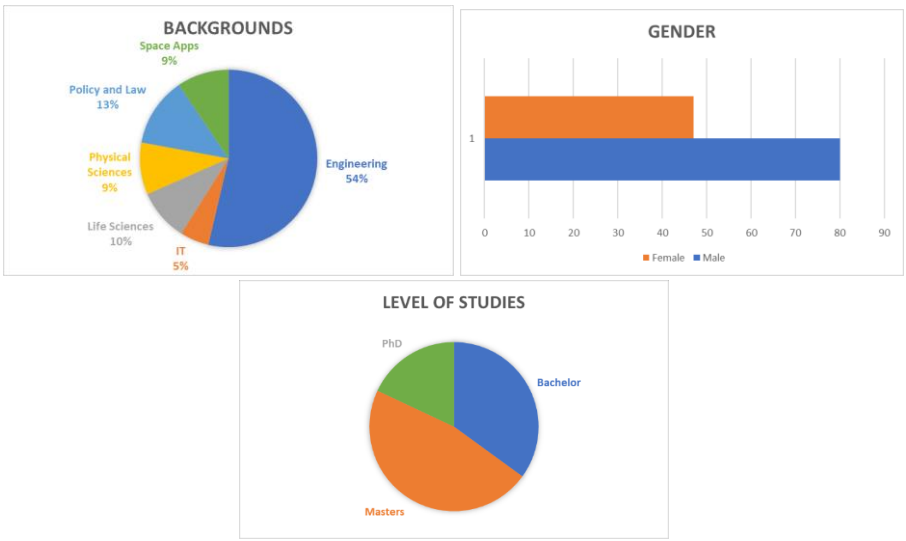
ISU Central Campus in Strasbourg France

The year 2019 marks the 50th Anniversary of Apollo 11's landing on the Moon, and the International Space University was proud to bring its Space Studies Program, 30 years later, back to Strasbourg, France. The program was conducted in ISU's Central Campus in collaboration with the Eurometropolis of Strasbourg, Grand Est Region and the University of Strasbourg.

Famous Landmarks in Strasbourg: Colorful Houses and the Strasbourg Cathedral

As expected with cities in Europe, Strasbourg boasted of impeccable architecture and a very homey ambiance. Aside from the intense experience in the activities of SSP, having a world heritage city center within a ten-minute train ride definitely added to the experience

2.2. Participants



The class of SSP19 was the most diverse group that I have ever been a part of. We were composed of 127 participants coming from 37 different countries. The gender ratio was 40% female and 60% male. As for the level of studies, 18% had a PhD or equivalent (Juris Doctor or medical doctor), 47% had a Masters degree, and 35% has a Bachelor's degree. The age of the participants ranged from 21 to 57.

This level of diversity added a twist to every activity as opinions and perspective comes in all forms and every idea is deliberated with fairly different approaches.

2.3. Faculty and Staff

Some of the Faculty and Staff with Buzz Aldrin

SSP19 invited close to 200 experts and professionals from around the world to share their knowledge with the participants. This year's distinguished lecturers have included Dr. Mohammed Nasser Al

Ahbabi, Director General of the Emirates Space Agency; former member of the NASA Advisory Council, John Logsdon; author Ramon Vullings; NASA's Mars Study Capability team Lead, John Connolly; entrepreneur Storm Boswick; Assistant professor of the Institute of Space and Astronautical Science of JAXA Ryudo Tsukizaki; Breakthrough Prize Foundation's Pete Worden; and Prof. Mikhail Marov, former chief scientist for Soviet Venera spacecraft studies of Venus, ESA's Director General Jan Woerner, DLR's Chair of the Board Pascale Ehrenfreund, NASA's Chief Scientist Jim Green and astronauts Buzz Aldrin, Jean-François Clervoy, Paolo Nespoli and Reinhold Ewald.

The SSP19 staff was composed of individuals from around the world, some of them were part of ISU, and others participated in previous programs or had an interest in space-related fields. The organization, logistics and academic tasks were carried with the expected quality thanks to the professional and responsible work of the staff, ensuring the success of the program once again.

2.4. Logistics and Other Details

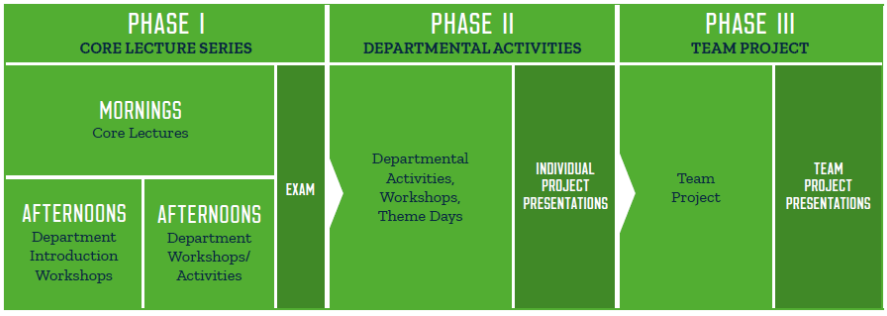
The tuition fee amounting to €18,500 paid to ISU covers all fees and activities related to the program. It also covers living expenses that include accommodation and food.

We were housed in a dormitory but there were some issues with logistics as some of the previous occupants did not move out on time and some SSP19 participants was therefore forced to check-in into less than ideal rooms with no kitchen, and a building that's currently undergoing renovation. I am very thankful that I was somewhat spared of this ordeal but felt bad for all the other participants that had to make do of the situation and adjust accordingly.

3. Curriculum

The curriculum of SSP is specifically targeted to post-graduate students or young professionals hoping to learn more about space.

3.1. Overview



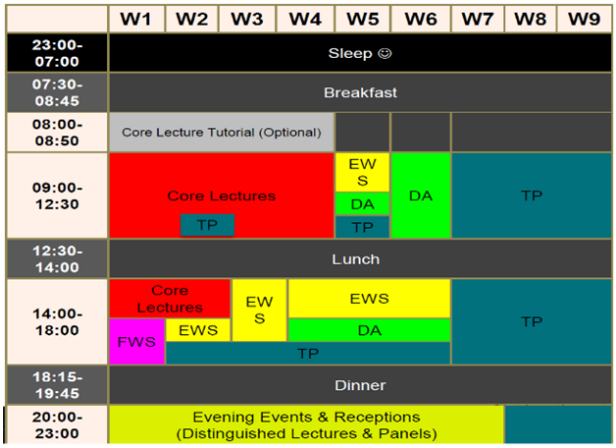
SSP19 Curriculum

The SSP19 is composed of three phases namely:

- Phase I: Core Lecture Series
- Phase II: Departmental Activities
- Phase III: Team Project

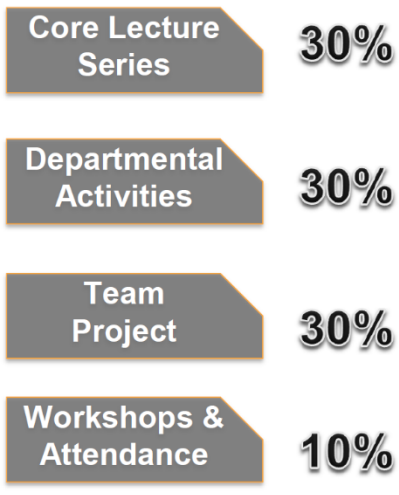
Dividing the program into three phases allowed the participants to ease into the process then eventually apply all the knowledge acquired in a Team Project in Phase III.

Aside from all the lectures, departmental activities, workshops, and team project, a lot more activities are interspersed into the schedule which makes a typical day to be very tiring but a lot of fun. Most days would start at 8 AM for breakfast and end at 11 PM after a distinguished lecture or a social gathering.



Looking back, I can say that these 9 weeks has been a rollercoaster ride. There have been days especially after a late-night compulsory gathering that we would discuss how tired we all were during the 15-minute walk back to the dorm. However, we would also motivate each other up and say that these nine weeks will be over before we know it, and the best that we can do is set aside all the fatigue and make the best out of it. Having amazing people during this nine-week journey whom I can share all the laughters and excitement made my participation in the program memorable.

3.2. Evaluation Method



The SSP evaluation is composed of four elements.

In order to receive a Certificate of Completion for the Program, participants must be able to get at least a 50% in each of the first three elements.

For the Core Lecture Series, grades are based on two examinations, a midterm exam and a final exam.

For the Departmental Activities, grades are based on a department project.

For the Team Project (TP), grades are based on feedback from groupmates and TP chair, and final presentation grade.

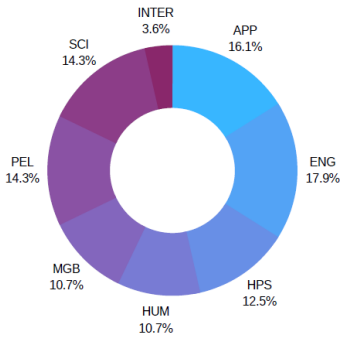
For the Workshops, attendance and participation is graded.

4. Core Lectures

The Core Lecture Series is the first phase of the SSP curriculum. It is composed of 56 lectures from the seven disciplines: Space Applications (APP), Space Engineering (ENG), Human Performance in Space (HPS), Humanities (HUM), Management and Business (MGB), Policy, Law and Economics (PEL), and Space Sciences (SCI).

The lecture series is designed to create a basic framework of knowledge in all aspects of space and prepare the participants for a holistic understanding of space in general.

4.1. Lecture Contents



The lectures are intended for non-experts in the different fields and is made as an excellent crash course on everything related to space. For four weeks, I learned so much about space, and from experts in the field no less. I learned about space missions from NASA's Chief Scientist, Space Law from people actually involved in the United Nations Committee on the Peaceful Uses of Outer Space (UN COUPUOS), learned how to be an astronaut from an actual astronaut, and Space Medicine from an actual Flight Surgeon.

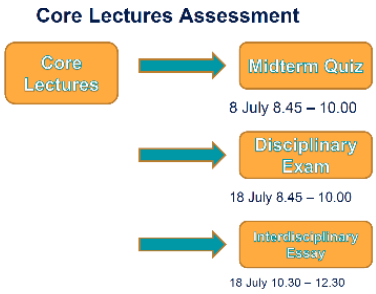
Here's a list of all the 56 lectures with the corresponding departments and instructors:

Date	Class Code	Class Title	Department	Instructor
Week 1				
June 25, 2019	CLS-01	Origins of the Space Age	HUM	Kerrie Dougherty
	CLS-02	Legal Underpinnings of Space Activities	PEL	Tanja Masson-Zwaan
	CLS-03	Orbital Mechanics	ENG	Christopher Welch
June 26, 2019	CLS-04	Space Law and the New Space Economy	PEL	Tanja Masson-Zwaan
	CLS-05	Cultural Rationales for Space Activities	HUM	Kerrie Dougherty
	CLS-06	Introduction to Space Applications	APP	Taiwo Tejumola
	CLS-07	Management of Space Projects	MGP	Christian Sallaberger
June 27, 2019	CLS-08	The Electromagnetic Spectrum	SCI	Hugh Hill
	CLS-09	Introduction to Remote Sensing	APP	Su-Yin Tan
	CLS-10	Business Structures and Planning	PEL	Christian Sallaberger
	CLS-11	Policy Rationales for Space Activities	MGB	John Logsdon
	CLS-12	Orbits and Applications	INTER	Christopher Welch

June 28, 2019	CLS-13	Major Space Nations	PEL	Paul Wohrer
	CLS-14	Space and the Arts	HUM	Kerrie Dougherty
	CLS-15	Communicating Space	HUM	Juan de Dalmau
Week 2				
July 1, 2019	CLS-16	The Solar System	SCI	James Green
	CLS-17	Human Performance in Space	HPS	Volker Damann
	CLS-18	Economic Rationales and Costing of Space Programs	PEL	Walter Peeters
	CLS-19	Being an Astronaut	INTER	Jean-François Clervoy
July 2, 2019	CLS-20	The Space Environment	SCI	James Green
	CLS-21	Human Adaptation and Countermeasures	HPS	Volker Damann
	CLS-22	Space Habitats (LEO, Moon, and Mars)	SCI	Barbara Imhof
	CLS-23	Microgravity	SCI	James Green
July 3, 2019	CLS-24	Current and Future Space Remote Sensing	APP	Su-Yin Tan
	CLS-25	Space Sustainability and Orbital Debris	APP	Ruediger Jehn
	CLS-26	Spacecraft Configuration and Testing	ENG	Christopher Welch
July 4, 2019	CLS-27	Financial Issues and Techniques of Space Projects	MGB	Walter Peeters
	CLS-28	Commercial Space Launch Business	MGB	Silvio Sandrone
	CLS-29	A Future with Innovation	MGB	Omar Hatamleh
July 5, 2019	CLS-30	International Dimensions of Space Exploration	PELL	François Spiero
	CLS-31	Satellite Image Processing and Data Integration	APP	Jerome Maxant
	CLS-32	NewSpace: The Emerging Commercial Space Industry	MGB	Gary Martin
Week 3				
July 8, 2019	CLS-33	Space Psychology	HPS	Volker Damann
	CLS-34	Astrobiology	SCI	Pascale Ehrenfreund
	CLS-35	Spacecraft Subsystems: G&C, Thermal Control, TCC&DH	ENG	Angie Bukley
July 9, 2019	CLS-36	The Cardio-Vascular System in Space	HPS	Gilles Clément
	CLS-37	Space Robotics	ENG	Kazuya Yoshida
	CLS-38	Satellite Telecommunications	APP	Daniel Glover
July 10, 2019	CLS-39	Neuroscience in Space	HPS	Gilles Clément
	CLS-40	Spacecraft Subsystems: Structures, Propulsion, and Power	ENG	Angie Bukley
	CLS-41	Navigation, Positioning and Timing	APP	Daniel Glover
	CLS-42	Stars and Galaxies	SCI	Benoit Famaey

July 11, 2019	CLS-43	Rocket Science, Thrusters and Launchers	ENG	Angie Bukley
	CLS-44	Life Support Systems	HPS	Gilles Clément
July 12, 2019	CLS-45	Commercial Satellite Communications Industry	APP	Joseph Pelton
	CLS-46	Current and Future Trends in Global Navigation Satellite Systems	APP	Su-Yin Tan
	CLS-47	Space Medicine	HPS	Gilles Clément
Week 4				
July 15, 2019	CLS-48	Space Systems Engineering	ENG	John Connolly
	CLS-49	Emerging Space Players	PEL	Christopher Johnson
	CLS-50	Anthropology and Space	HUM	Kathryn Denning
July 16, 2019	CLS-51	Military Space	ENG	Ofer Lapid
	CLS-52	Cubesats and Nanosats	ENG	James Mason
	CLS-53	Space Operations	PEL	Ginger Kerrick
July 17, 2019	CLS-54	Space Mission Design	ENG	John Connolly
	CLS-55	Space Futures	HUM	William Kramer
	CLS-56	Cosmology: Origin and Fate of the Universe	SCI	Mikhail Marov
July 18, 2019	Core Lecture Exam			

4.2. Examination



We are required to take the midterm exam and disciplinary exam to prove that we had understood the basics of all the lectures.

The Interdisciplinary Essay tests if we can use all of this knowledge to solve a certain topic.

We were given 3 topics to choose from and I chose if government receives a message from aliens confirming their existence, should they disclose it to the public and what are the repercussions in all aspects (HUM, SCI, ENG, MGB, etc).

5. Department

5.1. Overview

Living to the interdisciplinary mantra of the ISU, there are a total of 105 departmental activities within all the seven departments: Space Applications (APP), Space Engineering (ENG), Human Performance in Space (HPS), Humanities (HUM), Management and Business (MGB), Policy, Law and Economics (PEL), and Space Sciences (SCI).

During the orientation in the beginning of the program, we are briefed on all the departments and their corresponding activities. After which, we were asked to choose our top three preferred departments, and was encouraged to pic a department different from our background. The idea is to emphasize the importance to try new things and broaden the participants' background. This way, we get to appreciate the other aspects of science that we don't get to do in our actual careers.

As a student in Aerospace Engineering, I have background in Space Engineering, and since helped build an earth observation satellite, I am also knowledgeable in Space Applications. To explore different areas, I chose HPS and MGB as my two and ENG as the backup. The academic staff assigned me to the HPS department.

5.2. Human Performance in Space (HPS) Department

The HPS Department is focused on the human aspects of spaceflight and what factors in the space environment impact astronauts. These includes the biological, psychological, human factors, and engineering aspects.

We had 15 departmental activities to enable the department members to experience and evaluate challenges related to human spaceflight activities for both short-term, and long-duration and long-distance missions. These topics are especially interesting since we have been hearing of planned missions to Mars and eventually establishing a colony there.

Another factor that made me choose HPS is that I dream of becoming an astronaut. Being in the department gave me insight on the factors that affect astronauts and the dangers that comes with the job such as bone loss and muscle atrophy. The lectures also touched on how the astronauts in the International Space Station counteract these effects by exercising and how they do it in a zero-gravity environment.

Here's a list of all the activities in the HPS Department:

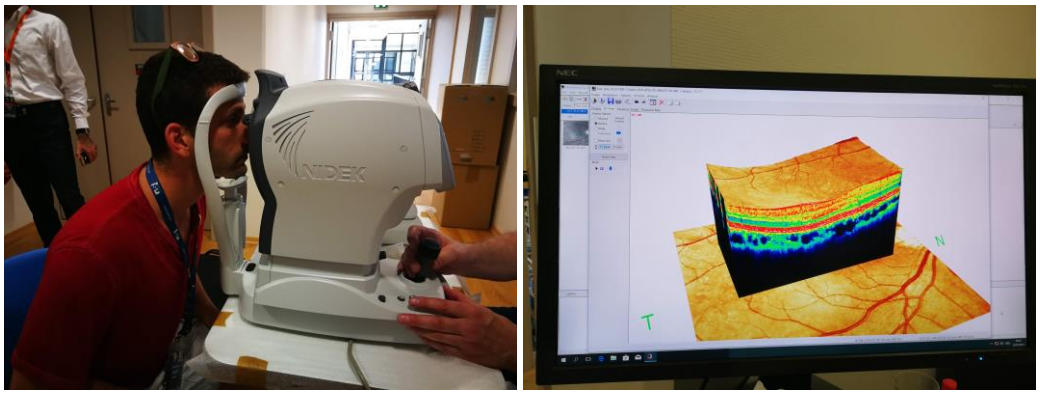
Date	Class Code	Class Title	Instructor
July 15, 2019	DA-HPS-1	Applied Anatomy & Physiology (Ultrasound Workshop)	Sergi Vaquer Araujo
July 16, 2019	DA-HPS-2	Introduction to HPS Research Projects	Volker Damann, Kwasi Nkansah
July 19, 2019	DA-HPS-3	Spirits of Space Medicine	Volker Damann
July 22, 2019	DA-HPS-4	Bioethics and the Human Experience in Outer Space	William Kramer
July 23, 2019	DA-HPS-5	EAC Professional Visit	Romain Charles
	DA-HPS-6		
July 25, 2019	DA-HPS-7	Human Systems Integration in Human Space Flight	Jackelynne Silva-Martinez
	DA-HPS-8	Eye Examination Workshop	Claudia Stern
July 29, 2019	DA-HPS-9	Crew Medical Officer Training	Sergi Vaquer Araujo
	DA-HPS-10		
	DA-HPS-11	Biological Life Support Systems	Jens Hauslage
August 1, 2019	DA-HPS-12	Design Thinking for a Virtual Health Assistant	Linda Dao
August 1, 2019	DA-HPS-13	Behavior-Oriented Assessment of Interactive Capabilities in Astronaut Candidates	Yvonne Pecena
August 1, 2019	DA-HPS-14	Space Expedition Medical Facility	Volker Damann, Clementine Colin
August 1, 2019	DA-HPS-15	Research Project Presentations	Volker Damann

I had lots of with the department activities especially as our Department Chair, Dr. Volker Damann and one of the lecturers, Dr. Sergi Vaquer Araujo are actual ESA Flight surgeons and have overseen astronaut activities from the selection process, to the actual flight, and checking the astronauts as soon as they come back to earth. One of the interesting facts that I have heard from them is that most astronauts puke after the launch to space. Astronauts undergo intense training to prepare for the intense forces that their bodies undergo through, however, most feedback is that nothing can simulate how weightlessness feels and the they feel disoriented, thus the puking.

Another cool story is how the flight surgeons plan the logistics when astronauts are coming back to earth after a mission from the International Space Station. As the astronauts have been in space for a couple of months, the human body will have a hard time adapting to the earth's gravity again. This is mostly because muscles have atrophied due to the lack of need to exert too much effort without gravity. The heart muscle suffers the most and has less pumping power to supply the brain with blood. Most astronauts can't even walk straight weeks after landing and have to be escorted while walking. There used to be a time where astronauts are immediately brought to a press conference after landing but after one astronaut kept on fainting while doing their speech, the protocol has changed and the flight surgeons

check the astronauts first and they only give a go signal when they have ensured that the astronauts have adjusted to the earth's surface and will not faint.

I liked the workshops as they had us test some medical equipment to have a better understanding of the human physiology. We had a workshop where we got to use ultrasounds to check different parts of the body. We then simulated what happens to the blood flow when we go to space by going upside down and saw that the arteries and veins contract or becomes bigger depending if the heart is exerting more effort or not in supplying blood to the brain.



Eye Examination Workshop

We also got to do an eye examination workshop as having blurry vision is one of the main complaints of astronauts is blurry vision upon returning to earth. Studies are still being conducted but researchers suspect that the cause may be due to the difference in intercranial pressure due to the shift in fluid from the legs to the brain arising from the lack of gravity.

One of the cool equipment that we got to use is a 3D eye scanner where it maps the layers of the eyes and you let you see it in color. This way, we get to see if there are any defects. This equipment is also used on the astronauts before and after flight, and the results are checked to map differences and contribute to the research regarding the effects of spaceflight on the human body.

European Astronaut Center Professional Visit

Another highlight of the HPS department is the professional visit to the European Astronaut Center (EAC) of ESA located in Cologne, Germany. It is the center for astronaut training, operations, and space medicine of ESA and is home to ESA's astronaut corps. It equips Europeans to fly to the International Space Station and houses the astronaut training facilities such as the 10-meter deep pool and other simulation equipment.

This trip was definitely exciting since we are told that we may be able to see actual astronauts. It wasn't in the schedule but we were actually able to have an impromptu meet and greet with ESA astronaut Alexander Gerst. He told us about his journey from getting selected as an ESA astronaut to the motivations that he had to keep on going during training, and how it feels to be in space. For people like me whose lifelong dream is to see earth from space with my own eyes, his words were inspiring. He also shared what his life has been after coming back to earth and how he is contributing to the training of other astronauts in training.

The professional visit to EAC included a tour of all their facilities and we got to see 1:1 models of the ISS modules. I have been to JAXA Tsukuba Center so I have seen the Kibo Module there in display and I was very impressed. Seeing all the other modules in one room was even more impressive as I get to pretend as if I'm walking on the ISS just like the astronauts. During training, the astronauts use the modules to familiarize themselves with the ISS and get to simulate the tasks done on a daily basis. There was also a slight simulator for docking from a Soyuz capsule to the ISS and we got to try the controls that the actual astronauts use. From this part of the tour, I learned that the captain of the flight should always be a Russian since the Soyuz is from Russia and all flight cotrols and all the buttons in the aircraft is also marked in the Russian language. This is the reason why all astronauts going to the ISS are also required to learn, understand, and speak Russian.

EAC also houses one of the operations centers for the ISS and we got to see how the schedules of each astronaut currently in the ISS are planned, and then communicated to them. Unfortunately, the astronauts are on holiday (yes, they also have holidays) so we were not able to talk with them, but we get to see the ISS from the monitors and the activity logs that are currently being monitored.

Another workshop that we did is the design thinking for a space medical assistant. Considering all the factors that affect humans during space flight, we decided that the best way to address medical issues with limited resources is to have a remote medical assistant, and send real-time details to the flight surgeons on earth. Our group composed of three people came up with a prototype shown in the picture with fancy feature such as in-depth scanning, and a huge database of space-related sickness that it can do first-aid on. Much like Baymax in the movie Big Hero 6, it can detect sickness and give immediate medical attention and advice when needed.

We also had a professional visit to one of the hospitals in Strasbourg that specializes in hand surgery. The idea of the workshop is to make us familiar with the different medical equipment that may be needed if we ever succeed in creating a space colony, and the logistics involved in setting up the medical support for such an undertaking. We were even allowed inside the operating room of the hospital and got to see up close an ongoing hand surgery. It was an amazing experience for me as I have never been inside an operating room before.

5.3. Individual Project

As the final requirement to pass the HPS project, we were assigned to small groups and were given options on the topic that we need to research on. The requirement is to write a paper and give a ten-minute creative presentation about the topic.

I was assigned to a group of three and we worked on the topic: *Human Genome Testing for Astronauts Selection: Medical Aspects and Promising Predictors for Medical Pathologies*. The Abstract of our paper can be on the left.

Human Genome Testing for Astronaut Selection: Medical Aspects and Promising Predictors for Medical Pathologies

Julie Ann Banatao[1], Bowen Han[1], Dina Saad Fayez Jaber[1]

[1]International Space University, Strasbourg, France

Abstract: At some point in the future, there will be no doubts that we will travel to Mars or beyond, which apparently brings some challenges we need to address. From the evolution point of view, natural selection ensured only advantageous genes survived and was passed on. To address all potential challenges easier and to ensure the best performance will be given by the whole crew, should we select astronaut according to their genome?

We will investigate first what challenges we will have to encounter during the long-term space travel and figure out which part of the human body will experience changes, then figure out what function will be potentially changed. Finally, we will rely on some current data of human genomes to figure out which gene is responsible for those functions, we will then investigate which gene is better and more advantageous.

Finally, we need to also consider the probability that the best candidate in theory will appear in practice or whether there will be any factors during the space travel trigger some other genes which might bring disadvantages to an individual.

In the paper, we discussed about the hazards to astronauts such as radiation, isolation and confinement, miscrogravity, and hostile environment. Astronaut training is done to prepare for all these hazards but we discuss the possibility that human genome testing be included in astronaut selection to mitigate these hazards. We are aware of the moral implications of this kind of screening process, but we focus on the medical aspects on the paper.

In recent years, the idea of humans becoming an interplanetary species has been gaining traction, both from government and commercial entities alike. Conceptual designs of Mars cities for example are already available. However, before these kinds of mission become a reality, a lot of challenges needs to be addressed first. One of these is the effects of a long-term space flight to the human body. From existing studies, these effects may include development of cancer due to long term radiation exposure, bone and muscle loss due to microgravity, depression due to limited social contact and living in a

confined space, etc. The selection process and training for astronauts considers these risks and prepares the candidates for such risks.

One idea to mitigate these risks is the use of human genome testing as a criteria for the selection of astronauts for long term space flight. From [1], Genetic testing is defined as the analysis of human DNA, RNA, chromosomes, or proteins used in detecting abnormalities related to an inherited disorder. Aside from diagnosing a disease, genetic tests are also currently used to identify increased risks of health problems, to choose treatments, or to assess responses to treatment.

Following the recent discoveries, we now understand more and more about gene, to the extent that we could determine whether the existence of a gene would raise the risk of certain diseases. As more sophisticated genome sequencing and analysis methods are developed, comprehensive insight in the genetic makeup of cancer cells and genes that help in preventing cancer mutation are discovered.

In more recent years, advances in the understanding of cancer biology have led to the discovery of a number of anti-cancer genes. These cancer-associated genes can either promote cancer cell survival or can induce cancer cell death when ectopically overexpressed.

It is intuitive that it is advantageous to have astronauts that would be less susceptible to cancer, especially due to the long-term exposure to radiation which may cause mutations in the human DNA. Having the anti-cancer genes can be argued as one criteria in the selection of astronauts.

In conclusion, it is helpful to predict which individual will have a higher risk to develop breast cancer via genetic screening, we still need to consider a lot more issues. It is also worth noting that all the test subjects are living and working on earth, therefore, it is very difficult to predict what would happen in space, where there are microgravity effects and more radiation.

Having anti-cancer genes present in astronaut candidates can be an advantage during the selection process. However, more studies are needed to check if these will essentially translate to more cancer-resistant astronauts after long term exposure to radiation in outer space.

Furthermore, genetic screening for cardiovascular diseases can prove to be essential when it comes to astronaut selection. The presymptomatic diagnosis can moreover help in attaining a deep understanding of cardiovascular disease pathogenesis and make genotype-based therapy possible.

Whether to introduce genetic screening during the astronaut selection or which genetic indicators to lead to disqualification directly should be investigated further. It is crucial to take into account the effects of microgravity, especially if the selection is for long duration space flights.

5.4. Activities with Other Departments

5.4.1. Mini-Rocket Launch

The miniature rocket launch is an activity by the Engineering Department and is supervised by former SSP director and NASA Chied Exploration Scientist, John Connolly.


Launch Preparations and Me Having fun with the Mini-Rocket

For the launch, we gathered in a park near the French-German border to launch five rockets in total that were designed in built by the members of the ENG department. As a payload, they put Alsatian wine glasses in the rocket, and after it is deployed, a parachute is deployed to guide the payload safely back to earth. It was my first time to attend a miniature rocket launching event and it was amazing to see how they were able to build the rockets using cartons as the body and painted it themselves to mimic actual rocket bodies.

5.4.2. Robot Competition

The robot competition is a culmination of a two-day workshop on building robots using Lego Mindstorms. It is headed by no other than the head of my laboratory in Tohoku University, Professor Kazuya Yoshida. Unfortunately, I was not chosen to be part of this workshop but I got to see how my fellow participants who have no experience in building robots got to build working robots, and scoop marbles from a predetermined area.

6. Team Project

6.1. Overview

Covers of the Executive Summaries of the Four Team Projects

The Team Projects (TP) are an integral part of ISU. The Team Projects aim to solve a real-world problem using the knowledge acquired so far by the participants during the first two phases of the program. For SSP19, the participants are divided into four Team Projects. These four are:

- Fast Transit to Mars
- Enhancing Industrial Space competitiveness: Global Trends and Local Positioning
- Space for Urban Planning
- Next Generation Space Systems: Swarms

We were asked to list our top three preferences and provide the reason behind why we want to be assigned to those said Team Projects. I picked Fast Transit to Mars as my first choice since it aims to find a futuristic technology that is the most promising to cut the current seven-month trip to Mars with the rocket technology that we have, to the shortest time possible, a few days if possible.

I chose the Swarms project as my second choice since it is a futuristic take on satellites. I am currently working on autonomous operation of satellites for my PhD Thesis so it is related to my field of expertise. I was also hoping that I would acquire more insight from doing the project which can be applied to my own research at Tohoku University.

My third choice was Space for Urban Planning as I was positive some of the space applications that will be used for urban planning is earth observation. The microsatellite that we built in the Space Robotics Laboratory and is currently flying in space is an earth observation microsatellite. Another project that I can contribute to since it overlaps with my field of expertise.

Although I got assigned to my third choice which is Space for Urban Planning, I got to enjoy it so much. Looking back, I am actually glad that I was assigned to this TP as we had the best final presentation out of all the four.

6.2. Space for Urban Planning

TP Space for Urban Planning Team

I wrote the Participant Preface for our hundred-page final report and I believe it sums-up perfectly how I felt after completing the project. Our preface read something like this:

Modern society has seen the rise of vast improvements in science and technology that has made the day to day life of mankind very different from decades ago. One of these changes is that more and more people are flocking to urban areas in the hope of better opportunities for jobs. These creates a problem as big cities are facing problems such as rapid population growth, traffic congestion, uneven spatial distribution of public facilities, while small cities are facing population outflow, and even security problems. One solution to this is urban planning as it addresses how the city can cope with the influx of people. As the problems in the big cities come up, urban planning is becoming a research hotspot and focus, attracting the attention of many scholars and urban planners.

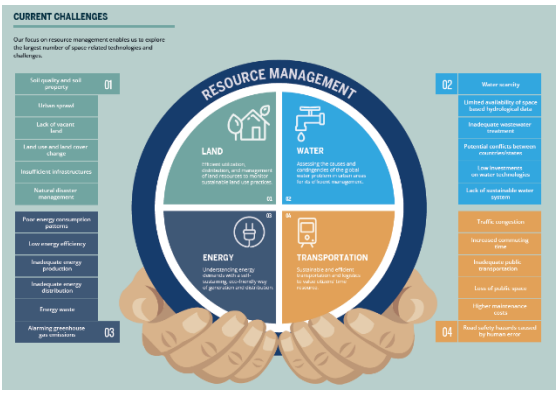
For the Summer Space Program 2019, ISU decided to make the urban planning the topic for one of its Team Projects. The Urban Planning Team is composed of 30 individuals coming from 16 different countries. True to ISU's 3Is principle of being international, intercultural and interdisciplinary, the team is composed of lawyers, pilots, scientists and engineers coming from different cultures. Although our profession and nationality vary from one another, we are bound by the same goal which is bridging the gap between space technology and the common good of people here on Earth.

This project stemmed from the Sustainable Development Goals that were set by the United Nations by 2030. Given the fact that around 60 percent of the world's population will be living in urban areas and moving forward from the assumption that these Sustainable Goals will be met by 2030, we set out to create a plan for urban cities focusing on how space technologies can be the solutions for the problems encountered in urban cities. These include managing the limited resources such as land, water, energy, and time, then relate these to the socioeconomic effects, and ultimately make a recommendation for urban planners.

In the past two months that we are here in SSP19, we have appreciated the different aspects of space spanning from the science and technology needed to launch missions to space, the business and economy side, the laws that needs to be addressed, and most especially how it will impact humanity.

This project is the culmination of all this learning as we attempt to piece all these aspects together and come up with a comprehensive analysis and feasible recommendations.

Finally, we present this project in the hopes that the recommendations can be implemented by actual urban planners in the future. We are optimistic that cities of the future can be as sustainable, accessible and progressive as what we imagine them to be.



The last three weeks of SSP19 were dedicated to the creation of all the deliverables of the TP. These include a 48-page Preliminary Research and Gap Analysis Review (PRaGAR) to check all previously related literature and identify the gaps between existing technology and what we want to achieve; a Project Plan for all the activities that we plan to do during the full three weeks that we have and the milestones that we need to achieve, an Executive Summary which shows our TP in a creative way, a 100-page Final Report to document all our motivations and results, and an hour long final presentation.

As the final result, we were able to identify what we think are the most important problems that arise due to the lack of urban planning as more and more people migrate to urban areas. We focused on resource management and divided these into four main categories: Land Use, Water, Energy and Transportation. The Resource Management will then impact Socioeconomic Factors and from this interaction, necessary urban planning decisions needed to be implemented. I got assigned to the Water Team, and I worked on the technologies derived from space that may alleviate water shortage in urban areas. This includes the water purifying and recycling technology current being used in the ISS. Another space technology that we identified that is viable for use is the large area observation capacity of satellites. This way, bodies of water can be monitored effectively, thus making drought or flood predictions more accurate.

7. Workshops

SSP19 offered a total of fifty different workshops in eight different timeslots. This meant that we can only attend eight workshops where we get assigned. I was able to get most of my first choices but unfortunately not everything due to the huge demand to some of the more interesting workshops.

Ground Truth Surveying of Satellite Images in Strasbourg

The workshop that I enjoyed the most is the Ground Truth Field Trip where we got to compare satellite data with ground truth data. It was particularly memorable since it was 40 degrees Celsius outside and we were walking around the city at random spots to check the satellite data accuracy versus the actual buildings and trees all over the city. What made it more enjoyable is the company of the other participants plus the picturesque city architecture. We made sure to treat ourselves the famous ice cream and gelato afterwards to get some relief from the heat.

Satellite Simulation Workshop

Another workshop that I enjoyed is the workshop where we got to model satellites and simulate vibration testing of the satellites. Although this is not new for me, it was fun to teach some of my co-participants who have never experience before how to model and simulate satellites.

8. Other Events

The other events signify the activities of SSP19 that are not graded but significantly made the experience so much more exciting. Although it also made the schedule a little too tiring, it added so much more value to the experience.

8.1. Welcome Brunch and Strasbourg Boat Tour


During the second day of the program, we had a welcome brunch at the Strasbourg City Hall. Here, the officials of the City of Strasbourg welcomed us to the city. We also got to meet all the SSP19 Staff and Teaching Assistants for the first time. It was interesting to know that most of them are ISU Alumni and they just decided to share their summer with all of us at SSP19.

After the Opening brunch, we got to tour the city onboard a boat. As expected of a World Heritage Site, the city was full of magnificent architecture. As I am not used to these kinds of buildings, I was awe-struck how they preserve the beauty of their buildings even though most these are already very old buildings.

8.2. SSP19 Opening Ceremony


Opening Ceremony at European Parliament

The European Parliament is located in Strasbourg. This is where the Opening Ceremony of SSP19 was held. Being inside the Parliament building was an experience on its own. We were asked to wear either traditional or formal clothes. I opted to wear a Filipiniana, the traditional wear of Filipinas. I was a little shy at first since it was a bright colored dress and is eye-catching, but after I got a few appreciative comments from my co-participants, I was actually glad that I decided to wear it. It gave a chance to showcase our clothing, and comments on the dress was made as good conversation starters.

8.3. Distinguished Lectures


We had the honor to have various distinguished lectures. These include the Director General of the the UAE Space Agency talking about their planned mission to Mars, a talk by Buzz Aldrin about how we should be having manned mission to Mars already, and the head of ESA talking about is in store for ESA in the coming years.

8.4. TEDX ISU

We had our very own TEDX in ISU which focused on exploration. The talks were varied ranging from conquering Mt. Everest, to interstellar missions innovative ideas for space, and architecture designs for a planned Mars colony.

8.5. Rube-Golberg Machine


Partcipants Busy Building a Rube-Golberg Machine

A Rube Goldberg machine, named after American cartoonist Rube Goldberg, is a machine intentionally designed to perform a simple task in an indirect and overly complicated way. Building a Rube-Golberg machine was one of the tasks that we had to do during the first two weeks of SSP. Here, our teamwork was tested to the limit. The task was to build a machine that will pass a small metal ball from one stage to another among twelve teams, and the most creative team wins.

8.6. Astronaut Panel


It is not everyday that a person gets to meet an astronaut in real life. However, in ISU, I got to meet three astronauts during the Astronaut Panel which also included the second man on the moon, Buzz Aldrin. I even got to take a picture with two of them, Jean-François Clervoy and Paolo Nespoli.

8.7. Site Visits

Pictures from the CERN Visit

CERN is the European Organization for Nuclear Research and is home to the world's largest and most complex scientific instruments. The most famous of which is the Large Hadron Collider (LHC). It is most famous for the institution where the Higgs-Boson particle was discovered last 2012. As a kid who was interested in the sciences, I have only heard of CERN from the stories and I had always though of it as one of the coolest places to work at aside from NASA. When I heard that the TP Fast Transit to Mars was having a field trip there, I was so jealous that other TPs don't get to go too.

Fortunately, we were able to arrange it ourselves and got to visit CERN. Although we were not able to go to the actual LHC tunnel as they are currently doing maintenance during our visit, we got to

experience the next best thing which is to visit the factory where they manufacture the actual segments of the LHC. Here they explained the different engineering mechanisms that are in place to make the LHC work.

We also visited ESA European Space Operations Center (ESOC). This is the center of the operations of the active ESA satellites including various weather satellites and earth observation satellites. As I am operating Philippines' own satellite, this was very interesting for me. The explanation of how the Galileo constellation works, the global navigation satellite system of the European Union, was the highlight of the trip. The engineers operating the said satellites explained the challenges that they encounter and how important these satellites are. We were also able to visit the operations room where they monitor possible collisions in space. It was fun to see the real-time probabilities in the huge monitors of possible collisions. We were informed that if there are semi-high probabilities, they coordinate with the people in-charge of maneuvering said satellites to plan the maneuvers and avoid the said collisions.

8.8. Dance Lessons

Aside from the usual mind exercises that we get to do in lectures and writing papers, we also get to tdo physical exercises via dance lessons. Although I am not good in dancing, I joined these dance classes and had one of the most fun nights during the program dancing.

We got to do the Latin dances such as Cha-cha, Samba, Salsa, etc. It was mostly dancing with a partner so I got to know some of the male participants through this activity. It was mostly fun too as most of us has never experienced being in a dance class and we got to share the experience of getting confused when some of the steps are first introduced and experience the joy when we get to execute a routine perfectly for the first time after a few hours of practicing.

8.9. Culture Night

Owning to the fact that the participants come from different countries, Culture Nights are one of the highlights of SSP. Here, the cultures of the different countries are shared by the participants coming from their respective countries. These includes the tourist attractions, the food, people, and all the other interesting details about their cultures.

As for me, I was the only representative from both the Philippines and Japan so I got to have a presentation about both countries. I shared about the amazing culture of Japan especially the food and the people. The one-of the kind Toto toilets also got a mention and the famous anime characters and manga.

8.10. ISU's Got Talent

We had a night dedicated to showcasing the talents of the different participants. As for me, I got to join a group who sang Let It Go from the movie Frozen but we sang it in 25 different languages. Practicing with all 25 people for 1 song was a challenge on its own as we had to gather all 25 people while everyone was busy with our respective TP deliverables. Although we didn't win, I was so happy for the Dance Team who won group prize.

8.11. Space Masquerade and Alumni Dinner

Every year in SSP, an Alumni dinner is hosted for all the alumni that wants to visit and get together. This coincides with a costume party and for this year, the theme is Space Masquerade.

We got to see different costumes from Star Wars, Star Trek, and even people dressed as satellites or the solar system.

8.12. Closing Ceremony

After nine weeks, we sadly got to the end of the program. We received our Certificate of Completion and got to have our very own ISU plan, exclusive memorabilia only for ISU alumni.

9. Conclusion

Attending SSP19 is one of the most exhilarating and memorable experiences that I have. It was an intense nine weeks and I would never have imagined that that experience was possible if I haven't done it firsthand.

After everything is said and done, and now that I'm back in Tohoku University to continue my PhD degree, I would forever cherish all the memories. I have learned a lot from all our expert lecturers and the workshops that we did. But the most precious takeaway is the network of people that I now have access too. ISU has 4,800 alumni all over the world who are carving their own paths in the space industry.

For everyone interested to learn more about space, I highly recommend attending any of the future Space Studies Program in the coming years.