



ANNUAL REPORT



**Academic Year
2019-2020**

International Space University

The International Space University, founded in 1987 in Massachusetts, US, and now headquartered in Strasbourg, France, is the world's premier international space education institution. It is supported by major space agencies and aerospace organizations from around the world.

The graduate level programs offered by ISU are dedicated to promoting international, interdisciplinary and intercultural cooperation in space activities.

ISU offers the Master of Science in Space Studies program at its Central Campus in Strasbourg.

Since the summer of 1988, ISU conducts the two-month Space Studies Program at different host institutions in locations spanning the globe; more recently the Southern Hemisphere Space Studies Program; and the online Interactive Space Program.

ISU programs are delivered by over 100 ISU faculty members in concert with invited industry and agency experts from institutions around the world. Since its founding, more than 5000 students from 110 countries graduated from ISU.



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Introduction

Dear reader,

The academic year 2019-2020 has been blessed with a remarkable cohort of students who attended the 25th edition of the Master of Space Studies and adapted, together with staff and faculty, to the lock-down requirements imposed by the pandemics starting in mid-March.

The online Interactive Space Program (ISP) conducted in the summer was also a successful example of adaptation and innovation in distant education. The 86 graduates of ISP20 have joined an ISU Alumni community that now counts 5000 members in 110 countries.

Our community has been busy this year with three additional “I” aspects that capture well the new directions of the university as it adapts to our changing world. The new “I” complement well the traditional “3-Is” of International, Intercultural and Interdisciplinary space education for which the ISU is well known.

In orbit, both physically and virtually

“ISU will be augmented by an expanding base of campus facilities, networks, and affiliations both on and off the Earth.” – from the ISU Credo, 1995.

On the Earth, ISU has conducted joint courses and research activities with the Australian Space Agency; Embry-Riddle Aeronautical University (ERAU); European Space Agency (ESA) and Institute for Applied Research in Microgravity (ZARM); Florida Institute of Technology (FloridaTech); Portuguese Space Agency; University of South Australia (UniSA), and University of Strasbourg (UniStra / CNRS) to name a few.

Since mid-March 2020, ISU is operating in a simulated space environment where teams are distributed across the globe learning how to work effectively across time zones and meeting the interpersonal communication challenges posed by geographic distance.

In its 25th year of existence, the Master of Space Studies 2020 (MSS20) switched to remote operations where students and staff devised innovative group activities such as meditation, cooking, or gymnastics to keep team members engaged and mentally/physically fit during the confinement. MSS21 starts in September 2020 with a hybrid format combining face-to-face and remote classroom options for students and faculty.

The Interactive Space Program, adopted by the ISU Board in April, and conducted in July and August as a fully online professional development experience, has demonstrated that the interdisciplinary learning, teamwork and bonding among participants is also possible without face-to-face interaction.

ISU alumna and NASA astronaut Jessica Meir (MSS 2000) spent six months on board the International Space Station (ISS) and had several video interactions with the ISU students and alumni, providing a powerful role model for the younger generations and somehow paving the way for a future ISU Campus in orbit.

Also off the Earth and in collaboration with Space Application Services (SAS), the ISU designed, built, and operated the Hydra-3 experiment that has seen its stay onboard the ISS extended until 2021. Hydra-3 is the third in a series of ISU flown payloads that are giving shape to the newly established ISU Space Payloads Lab.

Interactivity, a challenge and an opportunity for distant education

“ISU is a place where students and faculty from all backgrounds are welcomed; where diversity of culture, philosophy, lifestyle, training and opinion are honored and nurtured.” – from the ISU Credo, 1995.

The massive use of tele-education and online communications triggered by the pandemics has facilitated the interaction among groups and individuals in all parts of the space community, as expert speakers have become more available and emerging groups are able to connect with them at a fraction of the cost of international face-to-face education.

The ISU Alumni Conferences have significantly grown in attendance, topical content and relevance to astrophile professionals external to ISU.

In January, the ISU Adelaide Conference was held in conjunction with the Southern Hemisphere Space Studies Program and was kicked off by the Premier of South Australia. The Conference offered very timely presentations and discussions on space applications for bushfire monitoring, mitigation, prevention, and preparedness.

In August, the first online ISU Alumni Conference, held in conjunction with the Interactive Space Program, was kicked off by the NASA Administrator and included live presentations and panels with Heads of Space Agencies from Colombia, ESA, Germany, Nigeria, Paraguay, Poland, Portugal, South Africa and the UAE.

Addressing a record attendance of 750 alumni and faculty, the 50 sessions and 100 speakers covered space activities in the African Continent, Australia, Canada, China, Europe, India, Israel, Latin America, the UAE and the USA, and allowed for informal alumni gatherings in virtual sessions that were highly appreciated by all.

Incubation of start-up entrepreneurship

Joe Pelton, former Chairman of the Board and first Dean of ISU said *“As I look back, .../... ISU students populate every corner of the world space community.*

I feel humbled to have been a small part of this amazing story of international cooperation, intercultural understanding, and entrepreneurial spirit.

The three founders started something of enormous importance”.

In 2019, the ISU Central Campus in Strasbourg began hosting start-ups offering products and services based on the use of satellite remote sensing and navigation data as well as software solutions and technologies taken from space programs to non-space customers.

Start-up entrepreneurs and employees are often ISU alumni who realize the physical and virtual advantages of the ISU campus where they can exchange ideas and access resources: experts, student interns for their future workforce, and financing strategies through ISU’s partnerships with agencies - from local and regional to the business incubation schemes of both CNES and ESA.

We hope you will find this annual report on the academic year 2019-2020 instructive and entertaining.

The ISU faculty and staff



1. Summary and Key Figures

1.1 Participants in the ISU Programs

Program	Location	#Participants
Master of Space Studies Year A (MSS-A)	Strasbourg Central Campus	42
Master of Space Studies Year B (MSS-B)	Strasbourg Central Campus	1
Interactive Space Program (ISP)	Online	86
Southern Hemisphere Space Studies Program (SHSSP)	Adelaide, Australia	53
Commercial Space Program (CSP)	Florida Institute of Technology	16
Space Resources Professional Course (SRPC)	Luxembourg	52
Executive Space Course 1 (ESC 1)	Seattle, USA	20
Executive Space Course 2 (ESC 2)	Canberra, Australia	15
Executive Space Course 3 (ESC 3)	Lisbon, Portugal	22

1.2 Employment statistics

Nine months after completing the program:

61 % of the MSS19 alumni reported having a job, and 16 % of the MSS19 alumni reported continuing studies. The SSP being a professional development program, the employment rate is significantly higher, but it cannot be attributed solely to the SSP learning because many participants return to their previous jobs.

1.3 Faculty

During the academic year 2018-2019, ISU counted:

- **71 Full Faculty** (see list in annex 1)
- **43 Adjunct Faculty** (see list in annex 1)
- **16 Associate Faculty** (see list in annex 1).

1.4 Alumni

After ISP20 and MSS20 graduation, ISU now counts **more than 5000 alumni** from 110 countries. See chapter 9 Alumni Affairs for more details.

2. Master of Space Studies - MSS20

2.1 Overview

The Master of Space Studies program 2020 (MSS20) counted 42 students from 25 countries in Year A. 60% of this cohort was female. Year B featured one thesis student who combined this with a role as a Teaching Associate.

An overview is given in Fig. 1.

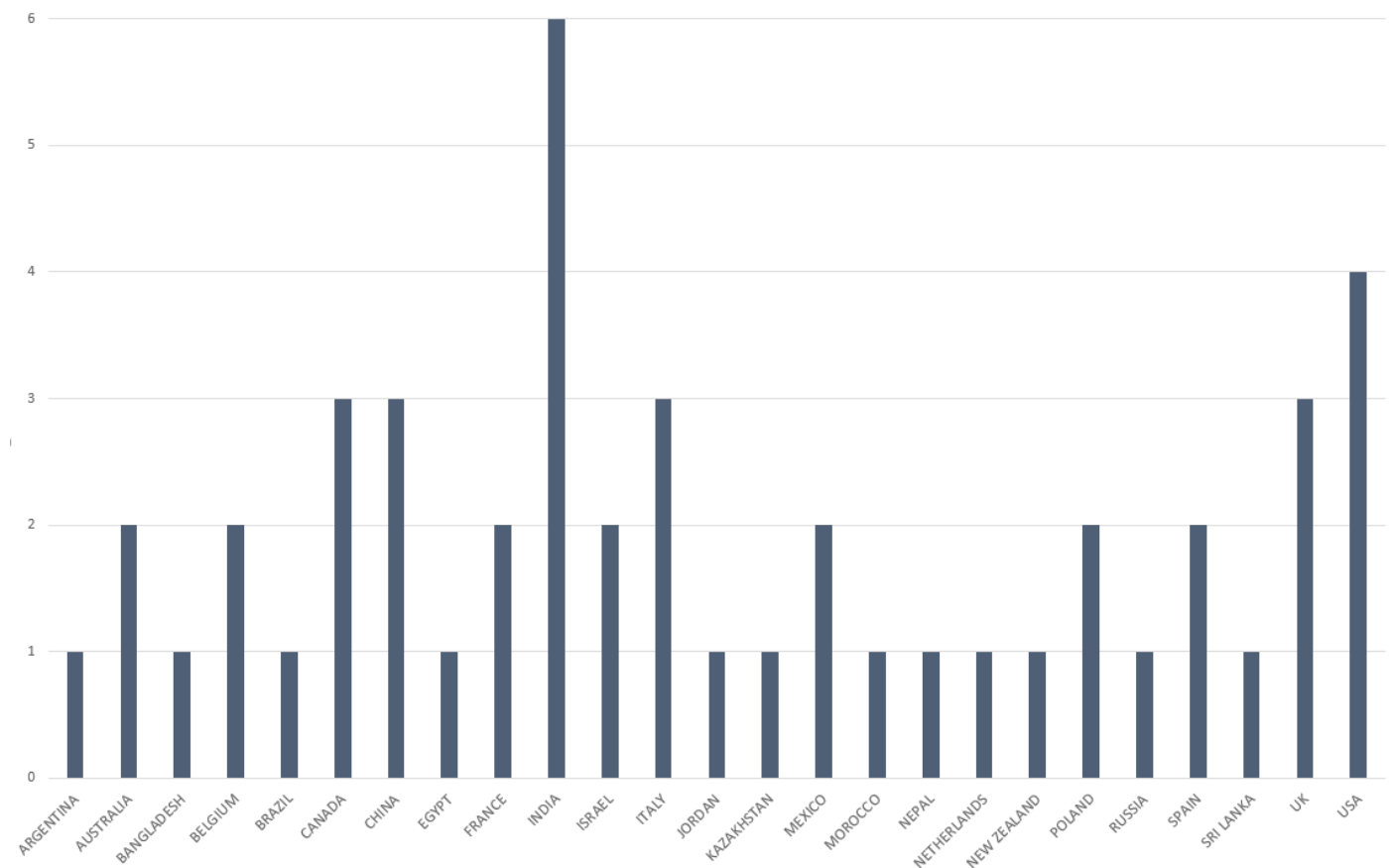


Fig. 1: Distribution of MSS20 participants per country including dual citizenships

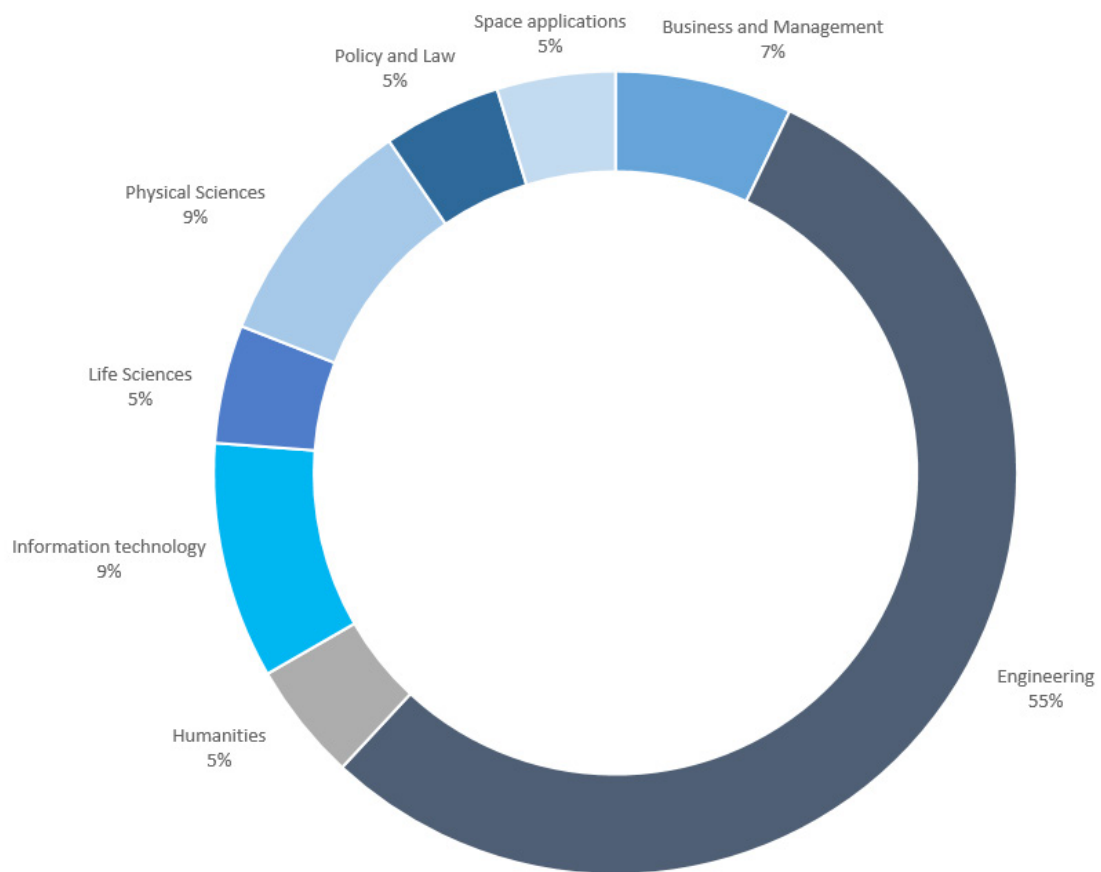


Fig. 2: Educational background of MSS20 participants

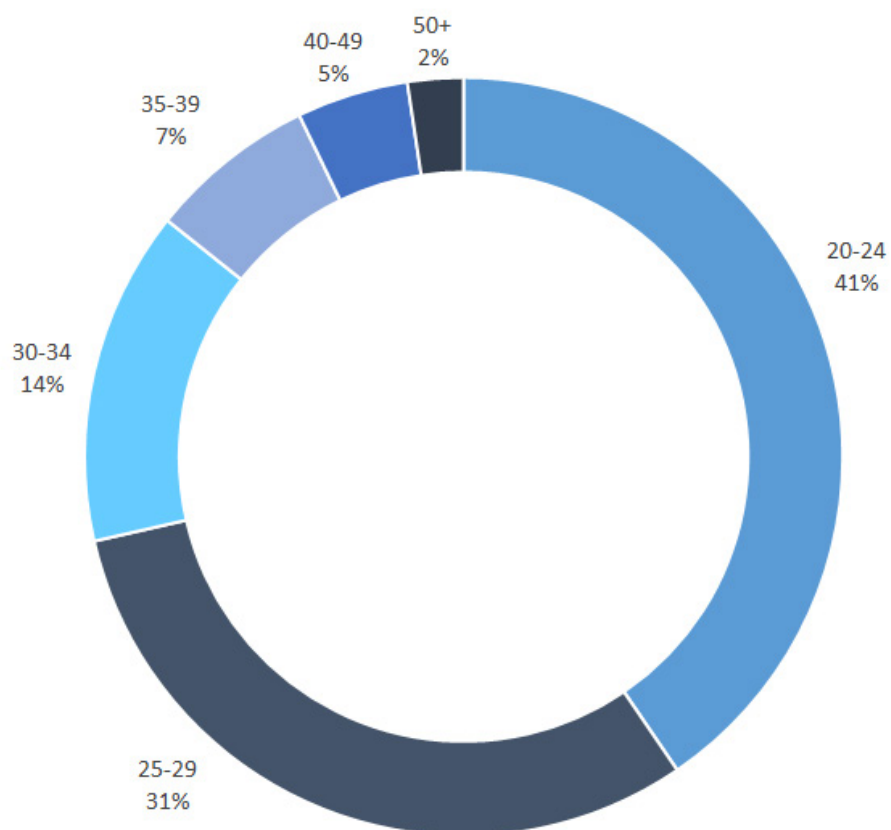


Fig. 3: Age Distribution of MSS20 participants

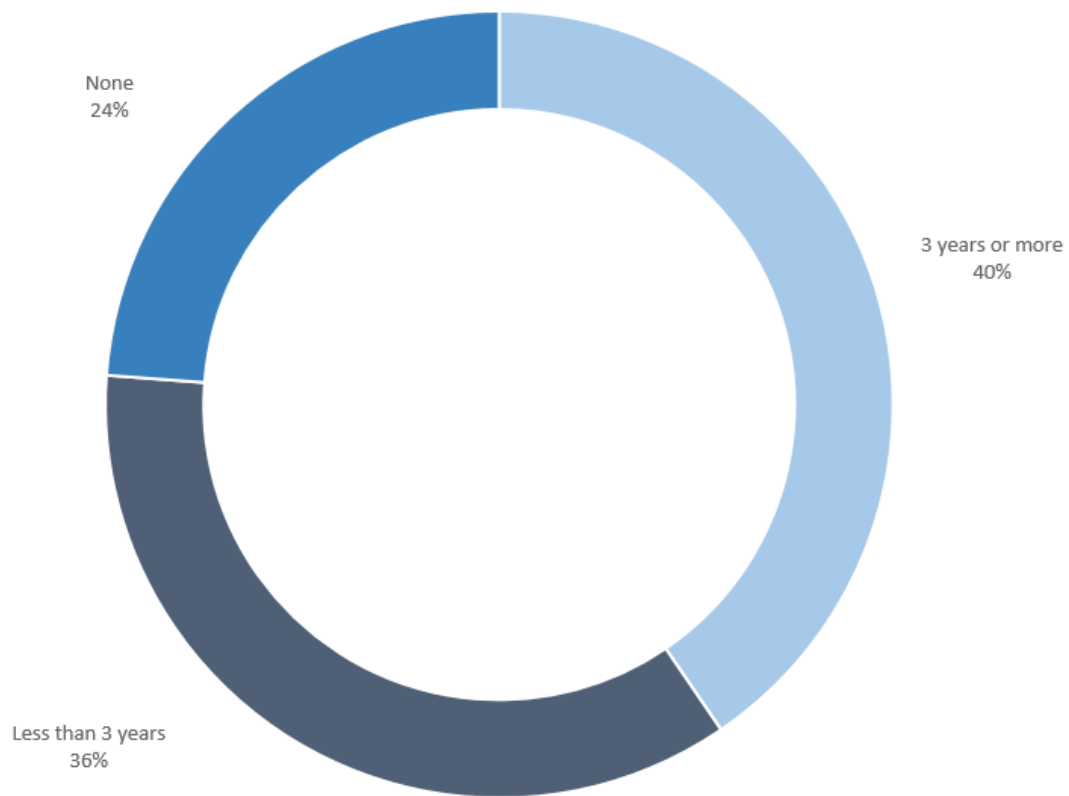


Fig. 4: Distribution of previous experience in MSS20

2.2 MSS Team Projects

The MSS20A class carried out two Team Projects:



ChipSats: New Opportunities

This team project looked at the potential applications of atto-sats.

The consistent trend in the miniaturization of electrical and mechanical components has enabled a steady downscaling in satellite sizing. This evolution has progressed from traditional heavy spacecraft to CubeSats, and now to a new generation of satellites: ChipSats. The ChipSat, with a mass of fewer than 10 grams, demonstrates several features atypical to those found in traditional satellite design; a uniquely low platform mass, inexpensive fabrication methods, and augmented redundancies. The appropriate leverage and synergy of these features have the potential to drive the design envelope toward innovative mission architectures while lowering traditionally high barriers of entry to space. There is an opportunity for future mission designers, academic institutions, and space-aspiring entities alike to benefit.

The International Space University has expressed interest in launching a ChipSat of its own within five years. This report states the benefits and anticipated challenges for pursuing this endeavor. The key elements concerning technical, educational, and legal aspects have been evaluated to inform the International Space University on a proposed path that must be navigated to ensure a successful ChipSat launch while adding value to the self-imposed institutional targets. The delivery of a ChipSat into space by the International Space University can serve as a model for other educational institutions. Concerning interested space agencies and commercial entities, a set of mission profiles have been put forward to illuminate the relevant mission orchestrators on the potential mission concepts that ChipSats can support. Although the literature provides coverage across all the mission-relevant disciplines, there are outstanding gaps that demand attention. A series of recommended next-steps have been put forward for the key decisionmakers to address the identified inadequacies. Ultimately, the value ChipSats may bring through the democratization of space, space education, and future mission design outweighs the hurdles that must be overcome.



Extraterrestrial Intelligence - The Search, the Science and the Significance was the second team project. Its abstract stated:

The search for extraterrestrial intelligence is one of the most inspiring modern scientific endeavors because of the profound impact that a positive detection would have on humanity. A literature review highlighted that there are several challenges to the progression of this field, including those related to science, technology, legal, and outreach endeavors. The current work is a multidisciplinary exploration of extraterrestrial intelligence, including the science and technology behind the search, the legal and policy implications of finding extraterrestrial intelligence, and the outreach required to engage various audiences in these initiatives. The current state of searching techniques was first reported, followed by general recommendations and a two-part proposal for technosignature detection in space. The Galactic Technosignature Observatory project (part one) is the development of an analysis tool that uses the data from space telescopes that detect exoplanets with light curves to detect prospective artificial artifacts orbiting these exoplanets.

The NoisyCube mission (part two) aims to characterize the distortion of the Earth's signature due to its satellite infrastructure. This work also contains a proposal to update the International Academy of Astronautics' post-detection principles and make these principles binding. In addition, an analysis of current approaches to various prospective intelligence forms, as well as insight into how the approach should be modified post-detection, is presented. This work highlights the attitude towards and treatment of animals and the environment and analyzes the ethical framework for perceiving the biological hierarchy. Lastly, an outreach plan to normalize the search for extraterrestrial intelligence in terms of scientific advancement and space exploration is proposed. The outreach plan contains a pilot survey to gain insight into public perception, which is supplemented by additional outreach material such as a website. Overall, this work goes beyond traditional approaches to the search for extraterrestrial intelligence comprehensively to contribute to initiatives in science, technology, law, policy, and outreach.

2.3 Structure of the MSS Program

No significant changes were made to the structure of the MSS. For MSS20, the electives were:

- M7-LSS M7-SPH Space Pharmacology
- M8-ISR Interstellar Studies
- M10-ABL Astrobiology
- M13-NSE New Space and Entrepreneurship

M7-LSS was a brand new elective for MSS20.

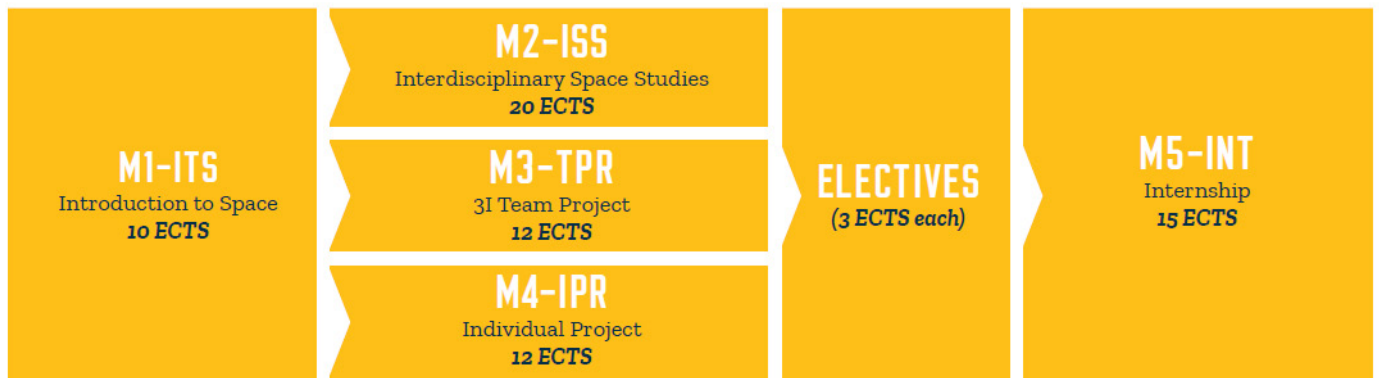


Fig. 5: structure of MSS20A

As in each year, the MSS20A program was enhanced by a number of offsite activities, as follows:

- Professional visit to Airbus Defence and Space, Friedrichshafen, Germany
- Professional visit to the Observatory of Strasbourg
- Professional visit to SES, Luxembourg
- Professional visit to DLR (Lampoldshausen) and IRS Stuttgart, Germany
- Professional visit to Eurospace and ESA HQ in Paris
- Professional visit to ESA-ESOC and Telespazio Vega in Darmstadt, Germany
- Field Trip to Ries Crater in Nordlingen, Germany



Fig. 6: Visit to DLR German Aerospace Center and IRS

The coronavirus pandemic had a very significant impact on the delivery of MSS20A, resulting in the program having to move to remote operation (all students and staff working from home) from the middle of March onwards. The remainder of M2-ISS, all the electives, and the team and individual projects were delivered online. The coronavirus also strongly affected the availability of internships for the MSS20 class. Some internships were able to be conducted remotely and some started much later than normal but, by the normal end of the academic year, only 30% of the class were in a position to graduate while around 20% still had to start their internships.

3. Interactive Space Program (ISP20) in lieu of SSP20

The Board of Trustees met virtually on 16 April, 2020, and considered the high uncertainty of international travel for the summer, as well as ISU’s wish to remain an inclusive university for participants and faculty from all countries.

The Board concluded that, unfortunately, the Space Studies Program SSP20 could not be held in residential mode this year, and decided unanimously to postpone it to next year and have a larger class of SSP21 in Granada, Spain.

The Board also decided that ISU would offer an online Interactive Space Program (ISP) during the summer: a 5-week full-time professional development opportunity for university graduates from any discipline and for professionals with any background wanting to pursue a career in the space sector.

ISP 2020 ran from Monday 20 July through Friday 21 August 2020 to prepare the 86 participants (“the crew”) for the challenges of producing quality work in a distributed environment, such as teams on Earth, Moon, or Mars, in orbit, and interplanetary space.

The ISP included a Team Mission to study how satellite applications can help prevent, monitor, and mitigate a major challenge to humanity such as a pandemic. During highly interactive seminars and mentorship sessions, participants had access to experts from academia, space agencies and industry from all over the world.

The ISP has been designed to prepare participants wanting to enter one of the face-to-face ISU programs such as the Master of Space Studies (MSS), the Space Studies Programs (SSP and SHSP), or the Commercial Space Program (CSP). The ISP has also served as a refresher or a training complement for ISU alumni seeking an update on the latest developments in the international space arena and wanting to enlarge their network of professional contacts.

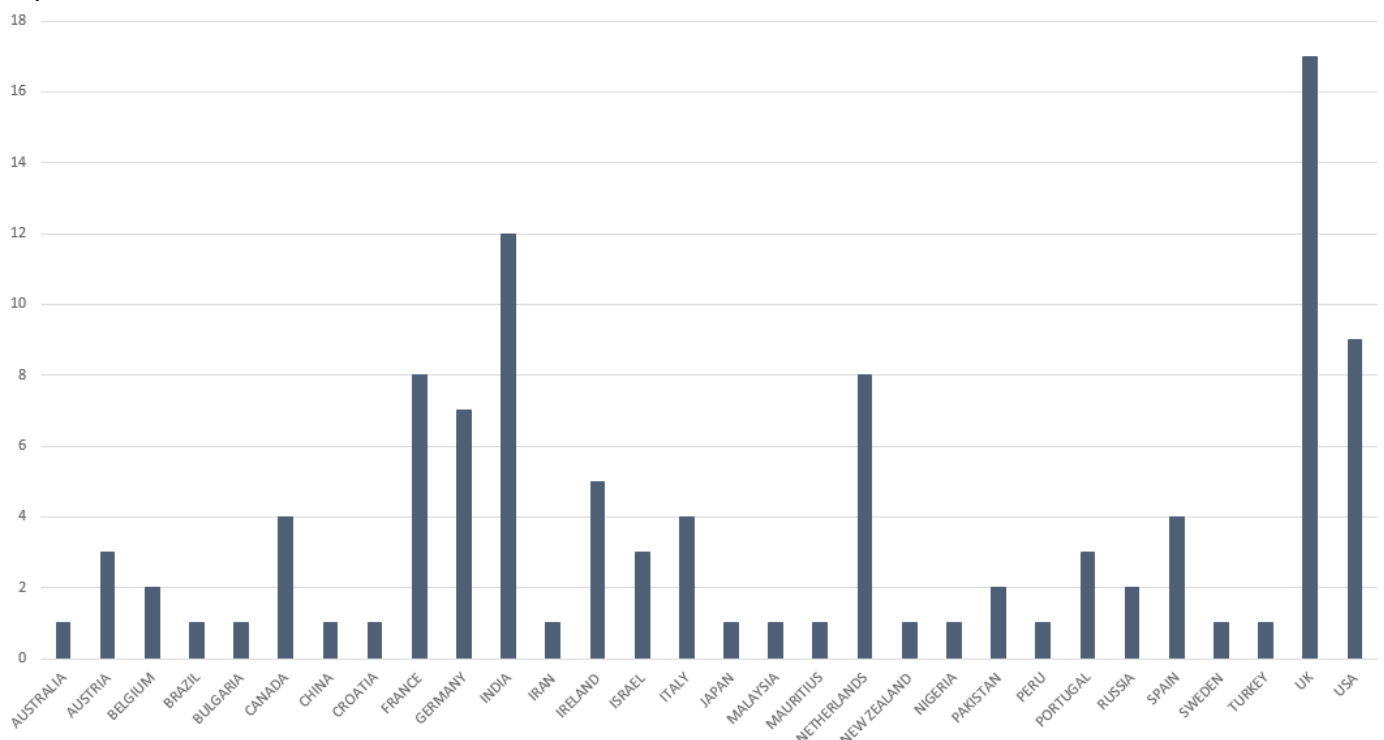


Fig. 7: number of ISP20 crew members by nationality (*)

(*) Stichting Space Professionals Foundation (SSPF) contributed to the selection and partial funding of 8 participants from The Netherlands, including 3 nationals from other countries who study or work in The Netherlands.

Forty percent were women. Their average age was 36, with ages ranging from 20 to 60 years. 70% had a master's degree or higher, and 50% had three years of professional experience or more.

Crew members and experts attended from all time zones, and came from disciplines spanning from public health and life sciences, to engineering, satellite applications, IT, management and business, policy, economics and law, and the humanities.

Recommendations to decision makers on how to prepare for the next pandemic

Through literature search and consultation with numerous experts, the crew studied the prevention and preparedness strategies adopted in the past to deal with pandemics across the globe in a time span of five weeks that ended with their final presentation on 21 August, 2020.

To optimize the use of existing satellite data on remote sensing of the Earth, the group has recommended an enhanced collaboration between space agencies, companies, and United Nations specialized organizations such as WHO and UNOOSA, through the creation of an international Charter on Space and Pandemics, modeled after similar existing charters.

Satellite data can also be processed to produce risk maps that help public health authorities produce early warnings and make better informed decisions.

Other findings and recommendations are in the use of satellite communications and related applications for tele-medicine, tele-education, and communication of precautionary measures to the populations. The use of satellite mapping and satellite positioning and navigation is considered a promising asset for a more systematic use of drones in medical emergency situations such as pandemics.

Finally, the use of microgravity environments, such as onboard the International Space Station, is recommended for the development of vaccines, based on positive experiences in this domain.

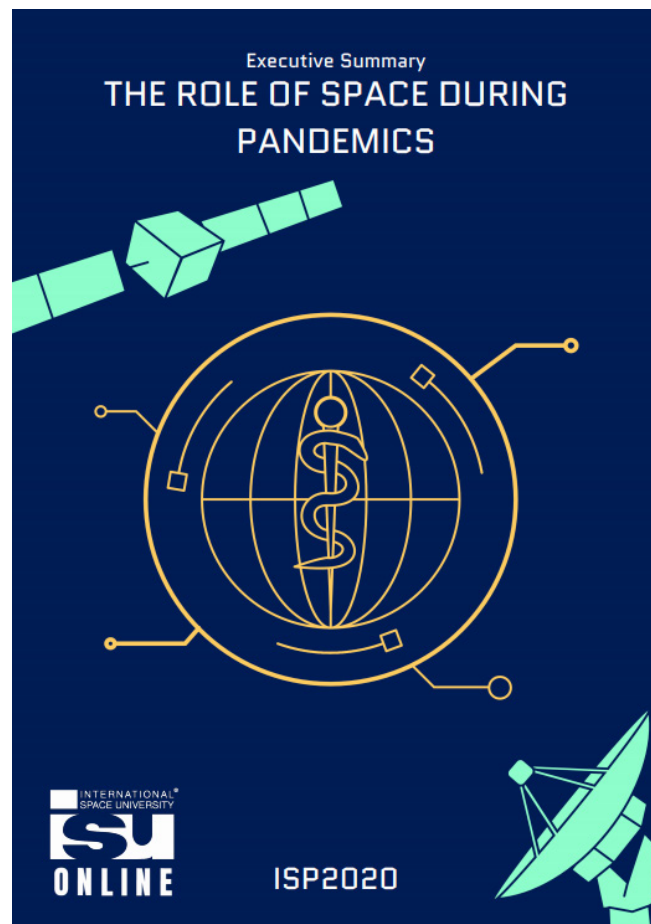
The ISU report on “How can space technology and applications help with monitoring, mitigation, prevention and preparedness for the next pandemic?” was published in early September 2020 on the Library portal at <https://isulibrary.isunet.edu>.

200 space experts as lecturers, coaches, and mentors, including nine Heads of Space Agency and six Astronauts

During the weeks preceding their “launch” of 20 July, the selected crew attended remote sessions on design thinking, teamwork, and expeditionary behavior to be able to work as teams in remote and extreme environments; they also practiced the use of the audiovisual and IT tools needed for an effective learning.

A series of 19 daily seminars provided the crew with introductory knowledge in all of the above-mentioned disciplines as they relate to space exploration and applications.

The Interactive workshops were an opportunity to discuss and conduct hands-on activities with subject matter experts in the following areas as they relate to space and public health.



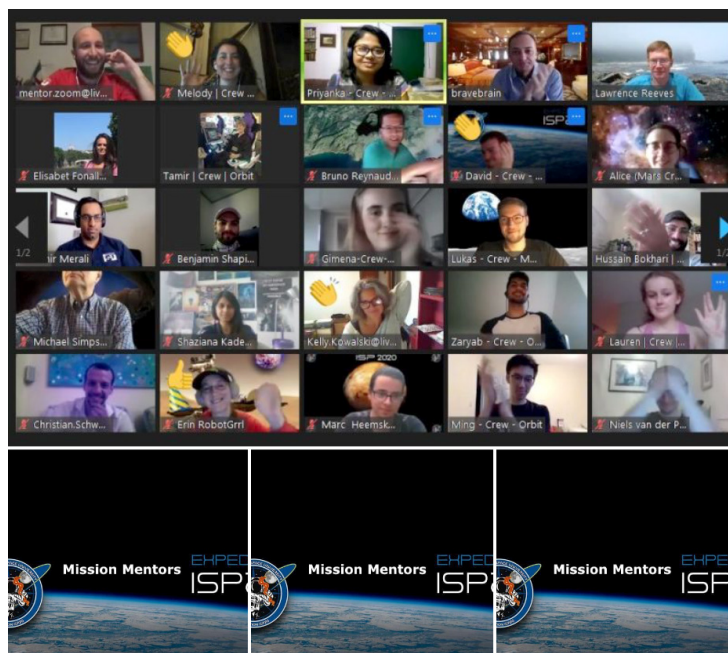
The program included interactive workshops in the disciplines of:

- Space Management and Business
- Space Policy, Economics, and Law
- Space Applications
- Space Humanities
- Space Engineering
- Space Science

Mentorship as a formal part of the program

To make for high interactivity in ISU's first purpose-designed online program, individual mentorship sessions for each crew member have made a difference and have received very positive feedback, both from the crew and the 74 mentors themselves – most of them senior in their field, and many in the ISU Global Faculty.

Thanks to their volunteer time dedication, the program has featured 268 mentoring meetings distributed over 25 sessions.



Program partners and sponsors

The Interactive Space Program was made possible thanks to the hard work of the ISU staff and faculty, skillfully lead by program director Goktug Karacalioglu, and with the generous contributions of time and dedication by an impressive list of volunteer alumni and members of the ISU community worldwide.

Special thanks go to the program partner, Strasbourg Eurometropolis, and to the space agencies, organizations and individuals listed below.



Association of Space Explorers (ASE) – Cosmonaut Oleg Atkov – Federal Aviation Administration (FAA) – Ilan Ramon Foundation – Israel Space Agency (ISA) – Lin and Jim Burke scholarship fund – Prof. Mike Simpson – Tohoku University – UK Ministry of Defence

4. Southern Hemisphere Space Studies Program - SHSSP20

The ninth Southern Hemisphere Space Studies Program was conducted from 13 January to 14 February, 2020, in Adelaide, Australia in partnership with the University of South Australia (UniSA). The program continues to grow and receive international recognition.

In addition to UniSA's contribution to the planning and the curriculum, on-site logistical, organizational and IT support is provided by UniSA staff. Program participants are registered as UniSA students and have full access to campus library, athletic, and computing resources. Accommodation is provided for faculty, staff, and participants in modern, well-equipped air-conditioned apartments located near the UniSA Mawson Lakes campus, a 10-minute walk from the campus. Dedicated catering of all meals is provided immediately adjacent to the campus.



Fig. 8: SHSSP20 participants

The five week program was modelled on and designed to complement the Northern Hemisphere SSP each year during the Southern Hemisphere summer. It attracts a diversity of students at various levels of experience from both the Southern and Northern Hemispheres. A total of 371 participants completed the program between 2011 and 2020. SHSSP20 attracted a record 53 participants from 14 countries:

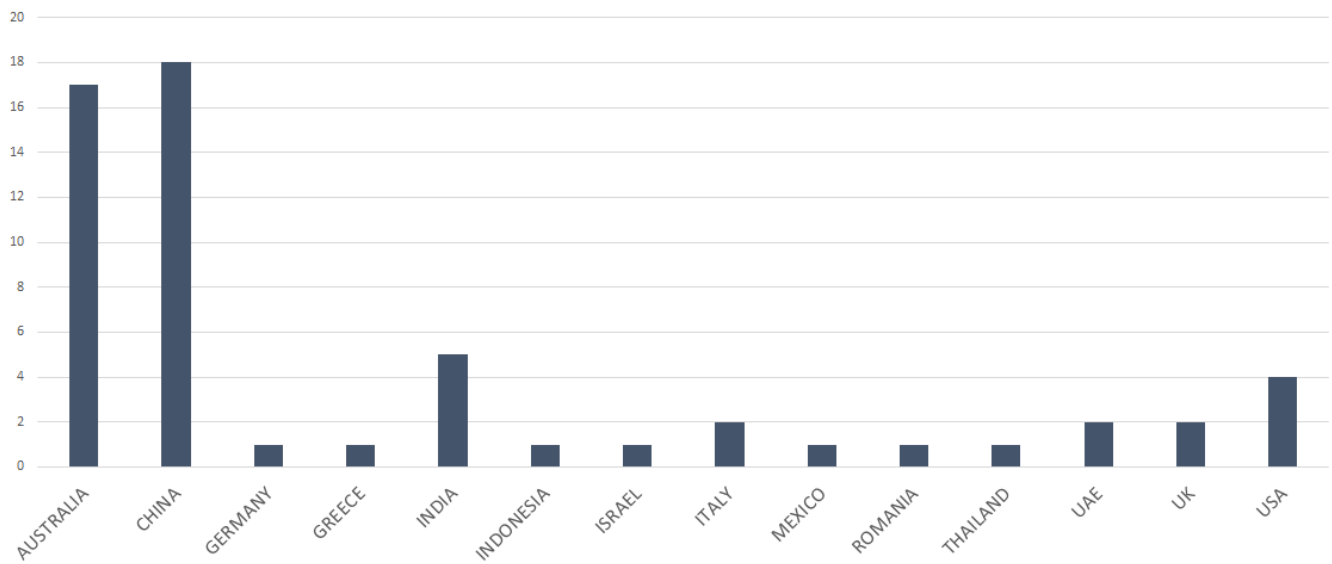


Fig. 9: Distribution of SHSSP20 participants by country

The distribution of educational backgrounds for SHSSP in 2020 continues to show a broad mix of disciplines:

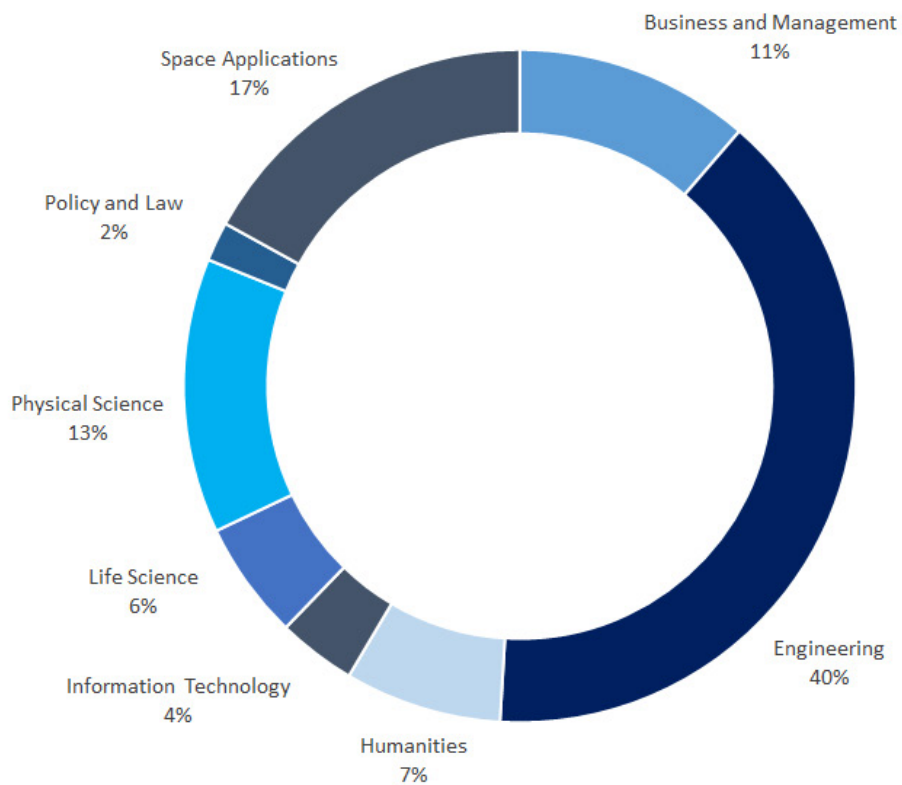


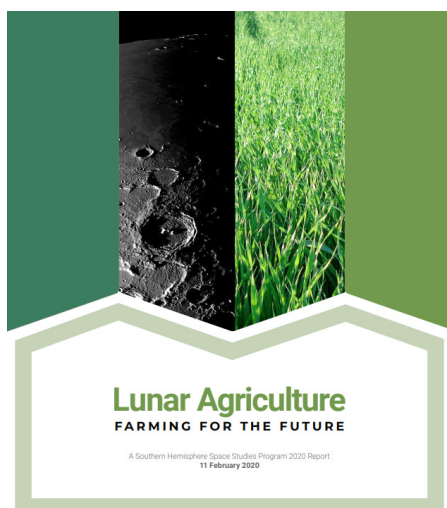
Fig. 10: Distribution of SHSSP20 participants by background

All participants received certificates of completion from ISU and executive certificates from the University of South Australia, and each year participants are eligible to receive 50 percent credit upon admission to the **UniSA Graduate Certificate in Space Studies**.

Week	1	2	3	4	5	
	<div>MORNING CORE LECTURES</div> <div>Satellite Applications • Space Engineering • Space Policy and Law • Business and Management • Physical Sciences • Life Sciences</div>			EXAM	White Paper Project	FINAL PRESENTATION
	<div>AFTERNOON WORKSHOPS AND VISITS</div> <div>Remote Sensing/GIS/GPS exercises and field trips • Ground station visits • Software workshops • Business and policy case studies • Skills exercises - communication, writing, etc.</div>					
		White PaperTeam Project				
Evening Special Events, Lectures and Public Events						

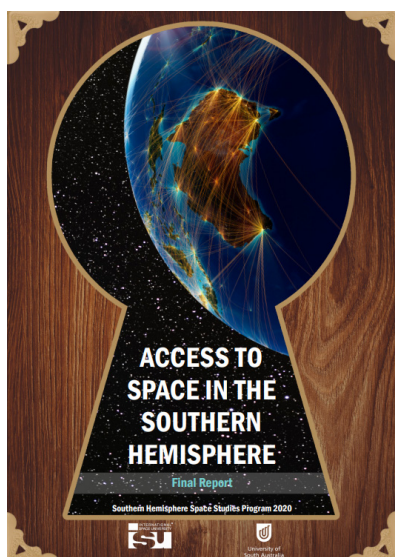
Fig. 11: Structure of the SHSSP program

In 2020 two team projects were delivered: one proposed by ISU and one by the Australian partners:



Lunar Agriculture – Farming for the Future

The goal of the project was to recommend and outline a vision for sustainable lunar agriculture that can support the nutritional requirements of humans in a lunar settlement and allow them to thrive. The report made recommendations for the early stages of lunar settlement, including agricultural practices that could be implemented to sustainably support the physical and psychological well-being of ten people, with the opportunity to expand to greater populations in the future.



Access to Space in the Southern Hemisphere

This report explored the need for reliable, effective, and efficient access to space in the Southern Hemisphere through market analysis. It concluded that there are several opportunities for nations in the Southern Hemisphere to pursue access to space. It recommended the implementation of an International State Based Framework to serve those countries that do not have launch facilities or launch vehicle development capability. It also concluded that Australia has potential to develop launch capability and would be well suited as a launching state within the framework.

5. Commercial Space Program - CSP20

The ISU Center for Space Entrepreneurship at Florida Institute of Technology completed its second Commercial Space Programs Graduate Certificate Program in June and July of 2020. Adopting a hybrid format featuring two weeks in Florida as the original plan, the program was compelled to run completely online as the number of COVID cases in Florida grew to the point where it was no longer advisable to conduct in-person classes. In spite of the challenges, the program was conducted successfully.

Matthew Cruikshank from South Africa summed it up well:

“This experience has been the highlight of my academic career. I truly hope I can make the best of it, and it fulfills my dream to transition to the broader space industry...I have been amazed at the level of content covered, the conversations that were had, and the speakers that were brought into the mix. I have learned so much; more than enough to confirm that this is where I need to be.”

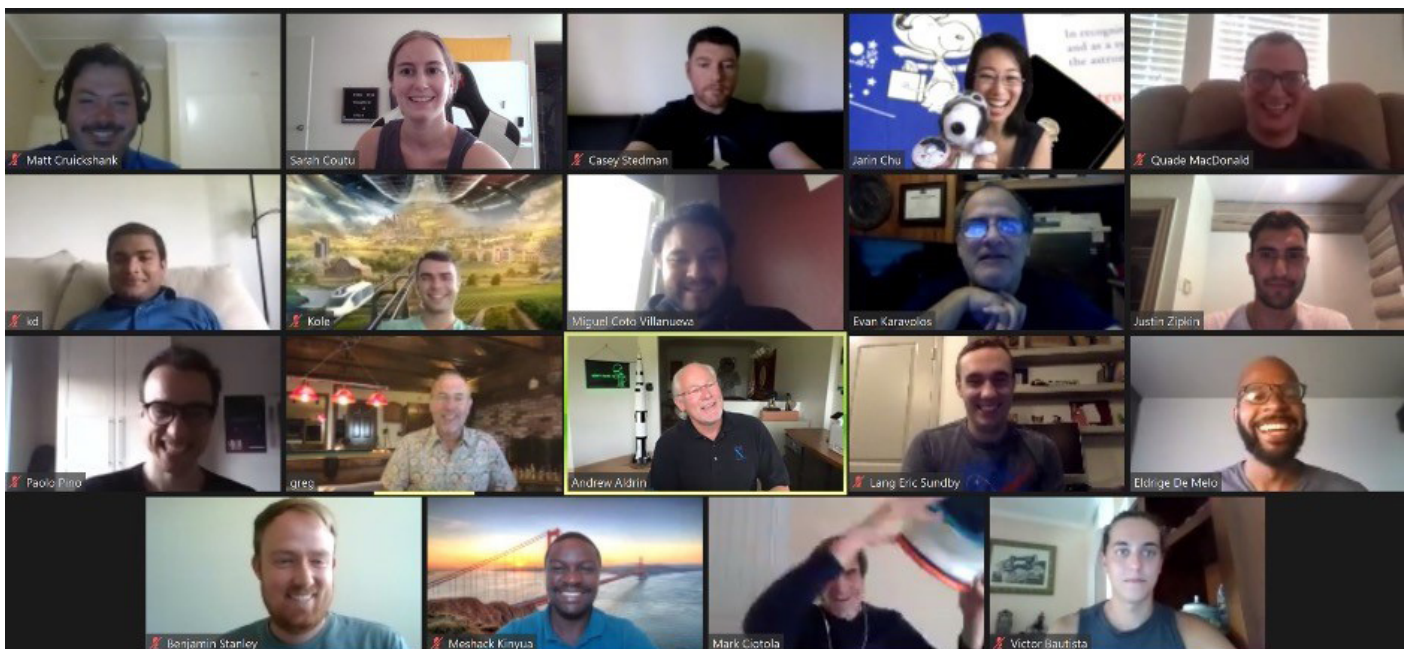


Fig. 12: CSP20 participants

Participants included three students from Africa in addition to the more traditional spacefaring states in Europe and North America. As was the case last year, students came from a range of disciplines including engineering, business and policy. Dr. Greg Autry, Professor of Entrepreneurship and nominee for NASA CFO, commented on the quality of the students:

“The experience at last summer’s ISU/FIT program was astounding. I wasn’t sure how this year’s online class would compare, but the students we got arrived with a significant amount of technical and industry knowledge along with a passion for the subject that I rarely encounter in my university teaching. Their output reflected that and the business pitches they presented would impress any VC.”

The online nature of the program incorporated a much broader range of guest speakers including current CEOs (ULA, Masten Aerospace, Mojave Air and Space Port, Elevated Materials), Government officials (Director Department of Commercial Office of Commercial Space, current and former Associate Administrators of NASA, and former Astronauts), and financial CEOs (Space Capital, Voyager Holdings).

As was the case last year, the program featured four courses that are all part of the Florida Tech main campus curriculum taught by a globally recognized faculty:

- Global Commercial Space Programs - Dr. Andy Aldrin (Founder and Director of ISU Center for Space Entrepreneurship)
- Technical Entrepreneurship - Dr. Greg Autry, (Nominee for NASA CFO)
- Space Technology and Systems - Dr. Angie Bukley (Aerospace Corp.) and Dr. Chris Welch, (ISU)
- Space Policy and Law - Dr. Andy Aldrin

For the planning for next year, a return to more normal conditions is anticipated. The hybrid format mixing online and face-to-face elements at the Kennedy Visitor Complex has proven to be the best option in the current circumstances, as it allows for future events to include space launches from Kennedy Space Center or Cape Canaveral Air Force Station. We are also looking forward to hosting events at space launches at KSC/CCAFS.

6. Short Courses

6.1 Executive Space Course (ESC) in Seattle



ESC-Seattle was held again this academic year in partnership with the Seattle Museum of Flight from September 30th to October 4th, 2019. Twenty participants attended the course, representing companies such as Blue Origin, Virgin Galactic, NASA Ames, and Vulcan Aerospace with backgrounds from a wide range of disciplines such as legal, investment management, manufacturing, IT, and business operations.

Fig. 13: ESC19 Seattle participants

The visiting lecturers represented an equally impressive cross-section of the space industry ranging from ISU mainstays such as Chris Welch, Dan Glover, and Su Yin Tan to guest lectures and facility tours from Spaceflight Industries and Planetary Resources. Lectures included all seven ISU discipline areas including engineering, physical sciences, business and management, policy and law, satellite applications, human performance in space, and humanities.

6.2 Executive Space Course (ESC) in Canberra



Fig. 14: ESC19 Canberra participants

Fifteen people from industry, government, and academia from around Australia converged in Canberra for the Executive Space Course in Canberra (18-22 November) where they attended lectures on space-related subjects delivered by some of the world's leading authorities in their fields.

Topics included the Moon and Mars, propulsion and space transportation, international space governance, the space economy, and principles of space law.

They also attended field trips to the Advanced Instrumentation Technology Centre at Mount Stromlo and the Canberra Deep Space Communication Complex at Tidbinbilla.

6.3 Executive Space Course (ESC) in Lisbon



Fig. 15: ESC20 Lisbon participants

A new partnership has been established with the Portuguese Space Agency for space education and training. The first tangible project was the Executive Space Course held from 31 August to 3 September 2020 at NOVA School of Business Economics in Cascais, near Lisbon. The course gathered 22 professionals from Portuguese government agencies, research centers, and universities, as well as from private companies and public agencies in Belgium, the Czech Republic, France, and Ireland.

The lectures and workshops were delivered in hybrid mode with some participants and some lecturers being remote, following the highly interactive mode that ISU has successfully demonstrated during the ISP program in the summer.

The ESC Lisbon course included the signing of an MoU by the Presidents of the Portuguese Space Agency and ISU that provides for collaboration in space education, professional training, and research, as well as for financial aid for qualified Portuguese candidates to ISU's programs.

Minister Manuel Heitor, in charge of Science and Technology at the Portuguese Government, witnessed the signing and had very encouraging words for the development of the Portuguese space sector with priorities in industrial growth, sustainable development in space and the oceans, and in education and training.

6.4 Space Resources Course - Luxembourg



Tremendous success for the first edition of the Space Resources Professional Course (SRPC) co-organized by the Colorado School of Mines CSM, ISU, and the Luxembourg Space Agency LSA which took place at the state-of-the-art facilities of the Chamber of Commerce in Luxembourg city.

Fig. 16: Space Resources Course 2019 participants

The two-day course attracted more than 50 professionals from all backgrounds and industries representing startups like Rio Tinto, OffWorld as well as long-established companies like Airbus, Total, and other organizations like ESA and NASA.

The curriculum was by developed and delivered by experts from the three organizations: **Chris Welch** is ISU's Master of Space Studies program Director and Professor of Space Engineering, **Angel Abbud-Madrid** is the Director of the Center for Space Resources at the Colorado School of Mines, and **Mathias Link**, Director of International Affairs and SpaceResources.lu at the Luxembourg Space Agency. Christopher Dreyer is the Associate Director for Engineering of the Center for Space Resources and faculty member of the Space Resources Program at the Colorado School of Mines.

The course provided an overview of the space resources field, including the current knowledge of available resources in the Solar System, identification, collection, extraction, processing, and utilization systems under development. Also covered were economic and technical feasibility studies, legal and policy issues, and space exploration architectures and commercial ventures that may be enabled by using extraterrestrial resources in the near future.

7. Research and Publications

7.1 Library Services

The academic year 2019/2020 was an enriching and challenging year for the Library and for our users. We continued to expand our tools to provide easier access to electronic resources which, due to COVID-19, were even more useful and used. We had to adapt quickly in terms of online services provided.

We have upgraded our subscribed [research Discovery tool](#), [EBSCO EDS](#), by integrating our complete online catalog in EBSCO. It enables library users to search for all types of documents at one place, including journal articles. We have made links to journal articles on Open Access more visible in search results and have integrated PlumX Metrics for article usage metrics.

When the ISU Central Campus was locked down due to the pandemic in mid-March 2020, the Library swiftly set up a [“Digital Services @ISU Library” webpage](#) to remind students about online resources and reassure them about our online availability for remote services. Many publishers in the world made their online resources temporary available for free! We have contacted many of them to be included in that scheme, which enabled us to expand our electronic resources even more for the benefit of our students!

LET'S GET DIGITAL!

An online escape from social distancing. If you are limiting your exposure to COVID-19 by staying at home, but still wish to use the Library services, we have good news for you!

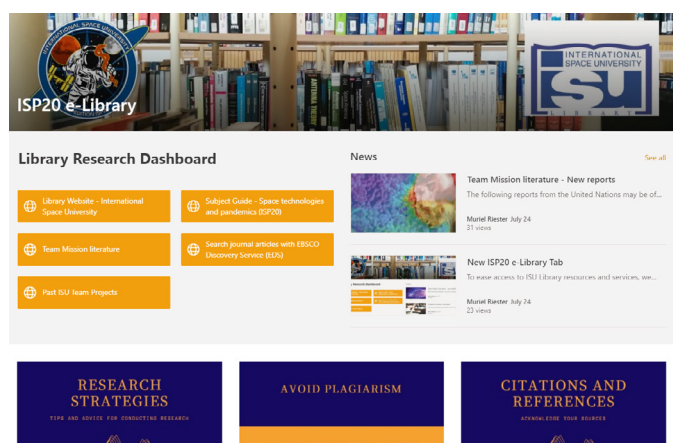
Digital Services @ ISU Library

ISU Library offers a large variety of digital options including eBooks, e-resources, e-magazines and online databases to search for primary resources. Our website isulibrary.isunet.edu is our online branch and it never closes!

[Updated - June, 29 2020]



ISP20 being virtual, we concentrated our efforts to develop online services: we provided 20 online training sessions to ISP20 participants prior the start of the program, created an [online subject guide for the Team Mission subject “Space and pandemic”](#) which lists useful books, reports and articles, moved to MS Teams and created a library webpage on SharePoint, which is specifically about library resources and services for the ISP20 participants.



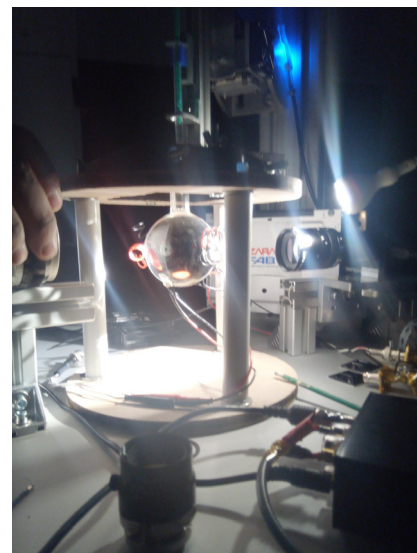
7.2 Research activities

The academic year 2019-2020 started with the arrival of two new faculty with a strong research background, Dr. Virginia Wotring in physiology and pharmacology, and Dr. Bertrand Goldman in astronomy, who also became the Research facilitator for the Central Campus. In early 2020, the Board of Trustees allocated resources for the Central Campus Resident Faculty to purchase equipment and laboratory consumables, and to hire research interns during FY21. To distribute those funds in a transparent and competitive manner, a committee of internal and external researchers was set up to select funding proposals to be submitted by the faculty throughout the year.

The ISU website was upgraded with a section that lists the work by each researcher, a description of the main research areas, and a presentation of the ISU Space Payloads Laboratory (SPL). A new series of Research Lunches was started in 2019 (see details in section 7.3).

James Hurrell (MSS19B) successfully defended his Year B thesis in December 2019. James had submitted his own proposal building up on the experience he had gained during his Individual Project, which was supervised by Prof. Chris Welch. During the course of his project, with the support of fellow MSS19 students and Mission Systems Engineer Yadvender Singh Dhillon, James Hurrell designed an apparatus to test the characteristics of single bubble sonoluminescence in microgravity.

Fig. 17: The ISU Single Bubble Sonoluminescence Experiment being readied for a series of test runs at the ZARM microgravity research drop tower in Bremen



Dr. Virginia Wotring supervised Ms. Olivia Siu, of Embry Riddle Aeronautical University, for a period of two months over the summer. Despite the difficulties in collecting and processing the data, the internship was highly successful, as Ms. Siu collected astronauts' demographic data, organized it in a database, and created tools to produce graphic displays of the information to support future analysis.

The ISU Space Payloads Laboratory, led by Prof. Chris Welch, Dr. Taiwo Tejumola, and Yadvender Singh Dhillon, continues the postflight analysis of its Hydra-1/PGL payload and a paper on the results of this analysis has been accepted for publication. The Hydra-3/Pulse payload marked its second year in orbit on board the International Space Station in June 2020 and has recently had its flight extended until at least the end of 2021. Two MSS students conducted SPL Individual Projects, redesigning aspects of the SPL SMiLE microgravity fluids payload. At the same time, SPL is examining several future payload opportunities for internal and external payloads and cubesats.

Several publications have studied various aspects of small satellite development. Vivenzio et al. (2019) have considered the use of femtosats (chipsats) to study the atmosphere of Venus. Tejumola et al. (2019) presented how cubesats could be used to ensure workforce development for developing countries and allow African nations to ultimately reap the benefits of space activities for the economic and sustainable development of their populations.

Regarding In Situ Resources Utilization, Ms. Danijela Stupar, Dr. Volker Damann, and a team of MSS students built up on the work of the Team Project "Sustainable Moon" to publish a paper presenting roadmaps to attain sustainability of Moon human settlements within the framework the United Nations Development Goals (Ritter et al. 2019). Another paper explores the benefits of Global Navigation Systems to obtain mm precision measurements of variation of the ground level due to mining activities, and the impact that those activities will have on vegetation and topological environment in the long term (Stupar et al. 2019).

In physiology, the most extensive study of female astronauts, with 38 astronaut-flights considered, was conducted to study the risk of venous thromboembolism (VTE) during both short and long duration missions, in connection with the use of combined oral contraceptives (COC).

The study of Jain et al. (2020) provides an evidence base supporting the safety of COC use by female astronauts and also reinforces the importance of healthy lifestyle for VTE risk reduction. It raised considerable media interest given its significance for the global Earth population.

Dr. Virginia Wotring and her collaborators have conducted a thorough review of the studies performed on the impact and counter-measures of micro-gravity environment experienced beyond low-earth orbits for astronauts in the Orion Crew Vehicle. They spell out recommendations to the space agencies to make the data collected during the flights available to researchers (Laws et al. 2020). Another paper explores the difficulties to translate our knowledge of ground-based usage of medication to future long-duration flights in terms of drug stability, safety, and effectiveness in space (Blue et al. 2019).

In astronomy, Dr. Hugh Hill and collaborators have studied how Artificial Intelligence (AI) could dramatically change the way the search for extraterrestrial intelligence could be conducted in the near future (Gall & Hill 2019).

Dr. Bertrand Goldman has continued his work on large proper star motion catalogs. These catalogues combine positional measurements taken over several years to allow for measuring the yearly motion of billions of stars and extragalactic objects. Tian et al. (2020) have used data from Sloan Digital Sky Survey (SDSS), Pan-STARRS1, and the most recent ESA Gaia Data Release 2, to create the deepest proper motion catalogue covering three quarters of the sky.

MSS19 Chen et al. (2019) have demonstrated how to use the educational 10-GHz ESA-Dresden Radio Telescope installed on the roof of the ISU building to conduct Periodical Variation Analysis of the Lunar Surface Temperature, after a previous study of the Sun using the same instrument.

Regarding space weather, MSS18 Ritter et al. (2019) outlined the legal and ethical issues associated with solar-geomagnetic super-storms (“Carrington events”) and provides recommendations for incorporating specific action plans.

In management, the impact of incubators in the European New Space Economy was presented in an article published in *New Space* (MSS19 Abi-Fadel & Peeters, 2019). Such studies contributed to the creation and development of the ISU incubator (see section 8). The development of the Chinese commercial space sector is in an article of *Astropolitics* (MSS19 Yuan & Peeters, 2019). The authors examine the support that the Chinese government is providing to the private sector through flexibility in regulations, particularly export controls and technology transfer.

7.3 Research Lunches

On October 16, 2019, we initiated a new series of research seminars on the Central Campus. The goals are multifold: discuss the research conducted on the Central Campus; learn from our visitors and Strasbourg colleagues about their research and think about possible collaborations; present to and educate our master’s students about what work researchers do and what topics are most promising. Some of our students have had little exposure to research, so we aim to introduce them to the special mindset of researchers, and open new doors for them, so that they can consider how they could contribute to forefront research, be it as early-stage researchers, research engineers, or legal consultants.

For this first season, we organized nine on-site sessions before moving online for another 11 meetings, for a total of 20. The talks are meant to be short, informal, and to allow for discussion and exchanges, for both experts in the field and laypersons. Throughout the academic year and despite their workload, a dozen students, along with faculty and staff, attended the research lunches. Flexibility is important and we had both longer, more formal talks, and shorter talks followed by a paper discussion.

The research lunches are truly interdisciplinary, with talks about engineering, biology, anthropology, astronomy, instrumentation, policy, robotics, and more.

Calendar of sessions during the academic year:

- 1 July 2020: Mohamed Elhariry (ISU) on Optical Communications, and Ezequiel González (ISU): Towards a global SETI initiative
- 17 June 2020: Henry Hertzfeld (George Washington): International Law, Economic Realities, and Space Resources: More Questions than Answers
- 23 June 2020: Olivier Hainaut (European Southern Observatory): Light Pollution by Satellite Constellations (jointly with the Astronomical Observatory of Strasbourg)
- 10 June 2020: Olivier White (U. Bourgogne): The brain, Gravity and Fractals
- 3 June 2020: Iya Whiteley (UCL): Human mission to MARS: Exploring Human Mind; Giuliana Rotola and Federico Rondoni (ISU): Life on Mars: To Terraform or not to Terraform
- 27 May 2020: Tricia Larose (NTNU): Spaceflight Preparation
- 30 April 2020: Sabine Klinker (IRS): Flying Laptop and new developments; Iliass Tanouti (ISU) on OneWeb bankruptcy and the spacenews webinar
- 5 May 2020: Ignasi Ribas (IEEC): the IEEC and Space Astronomy projects (jointly with the Astronomical Observatory of Strasbourg); and Sue Kaur (ISU): Women in Astronomy
- 16 April 2020: David Jeevendrampillai and Aaron Parkhurst (UCL): New Space and Space Exploration: a brief introduction to anthropology and its relation to outer space, an outline of the ETHNO-ISS project and some examples of work to date
- 1 April 2020: Pascale Ehrenfreund (DLR/ISU): New Space and Space Exploration
- 17 March 2020: Virginia Wotring (ISU): A new virus among us
- 4 March 2020: Gongling Sun (ISU): China Lunar Exploration Roadmap and Introduction of Chang'e-4 Mission
- 19 February 2020: Taiwo Tejumola (ISU): Space Systems – Requirements for small Spacecrafts ; Supreet Kaur (ISU): Human Factors at NASA Ames Research Center
- 6 February 2020: Stephanie Rochas: my week at EAC; Avner Bendheim: Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success (Tim Brown, CEO of IDEO)
- 23 January 2020: Hervé Cadiou, on the Geomagnetic Orientation of Animals
- 7 January 2020: Prof. Kazuya Yoshida (Tohoku University); paper: Anamol Mittal (ISU): the Space Generation Advisory Council
- 4 December 2019: James Hurell and Hameed Mohamed (ISU): Sonobubbles after ZARM, paper, Shreya Sarkar (ISU): Benefits of Multi-NGSS
- 20 November 2019: Vasilis Zervos (ISU) The European Space-industrial Complex: New myths, old realities, Giuliana Rotola (ISU): The legal framework protecting cultural heritage sites on the Moon and in situ preservation
- 6 November 2019: Jean-Marie Hameury (Observatoire de Strasbourg): CNES Science Projects, followed by a summary of the IAC of Washington by Juan de Dalmau
- 16 October 2019: Bertrand Goldman (ISU/Observatoire de Strasbourg): What the ESA Gaia mission tells us about nearby comoving stars; paper: Virginia Wötrung: The NASA Twins Studies

8. Space start-up incubator

The first start-ups settled in October 2019 in a dedicated section of the ISU Central Campus. The creation of the incubator has been strongly supported by local and regional authorities. The feasibility study was based on a survey conducted by an MSS19 Master's student among ISU alumni which showed that 80% of the recent alumni were in favor of such an ISU incubator.

Indeed, more than 80% of the recently graduated alumni applauded such initiative. Part of the building was dedicated to this incubator for potential start-ups. A full ecosystem was gradually developed from mid-2019 onwards that lead to the following features:

- The ISU incubator was recognized as an integral part of the ESA-BIC system
- For companies with regional interest, a financing mechanism for seed-funding has been developed
- Thanks to a grant of the Eurometropolis, furniture has been acquired as well as a support infrastructure for the start-ups
- A number of offices, ranging from 15-27 m2 were equipped
- The link with a booster, Rhinespace, has been established
- A dedicated coordinator, financed by the local partners, was installed in the incubator area
- Further audio-visual and meeting room infrastructure has been planned.

All the offices are equipped with basic furniture (an example of an available office is shown here).



First incubatees have installed themselves in this area, covering such topics as:

- Monitoring of water-quality using satellite images
- Development of tissue-material for the aircraft and space sector
- Use of drones in combination with GIS
- Provision of standardized, cloud based, end-to-end solutions for space projects

Fig. 18: One of the available accommodations at ISU

Other candidates are in the so-called pre-incubation phase, with the help of ISU and SEMIA experts, in order to refine the business plan for seed-funding.

Among the first start-ups, ISU has welcomed MSS and SSP alumni, and is hoping to expand this network further. Indeed, several requests are now coming regularly to ISU with proposals, in particular since more information on different start-up aspects is available on the ISU website, at <https://www.isunet.edu/incubator/>.

Fig. 19: Presentation of Watershed, the first ISU incubatee in 2019



9. Alumni Affairs

As in previous years, employment of the previous MSS class has been used as a benchmark, as most of the participants in the professional development programs returned to their previous jobs (which would give a distorted picture).

After an average of nine months of graduation, a questionnaire is sent to the MSS alumni asking for their job situation (together with feedback on the program).

As far as all alumni are concerned, the result show:

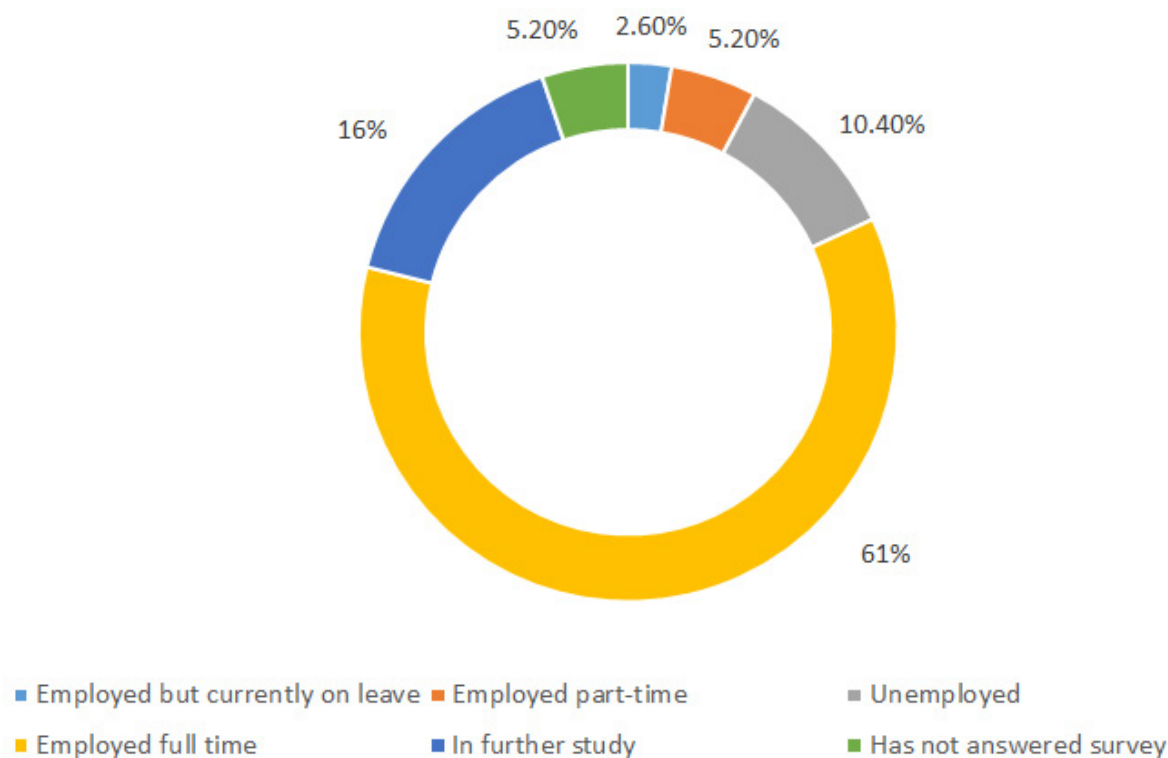


Fig. 20: Employment statistic of MSS19 alumni

The alumni who are fully employed declared obtaining this position:

- before graduation (44%)
- within 1 to 3 months (53%)
- within 3 to 6 months (0%)
- within 6 to 10 months (3%)

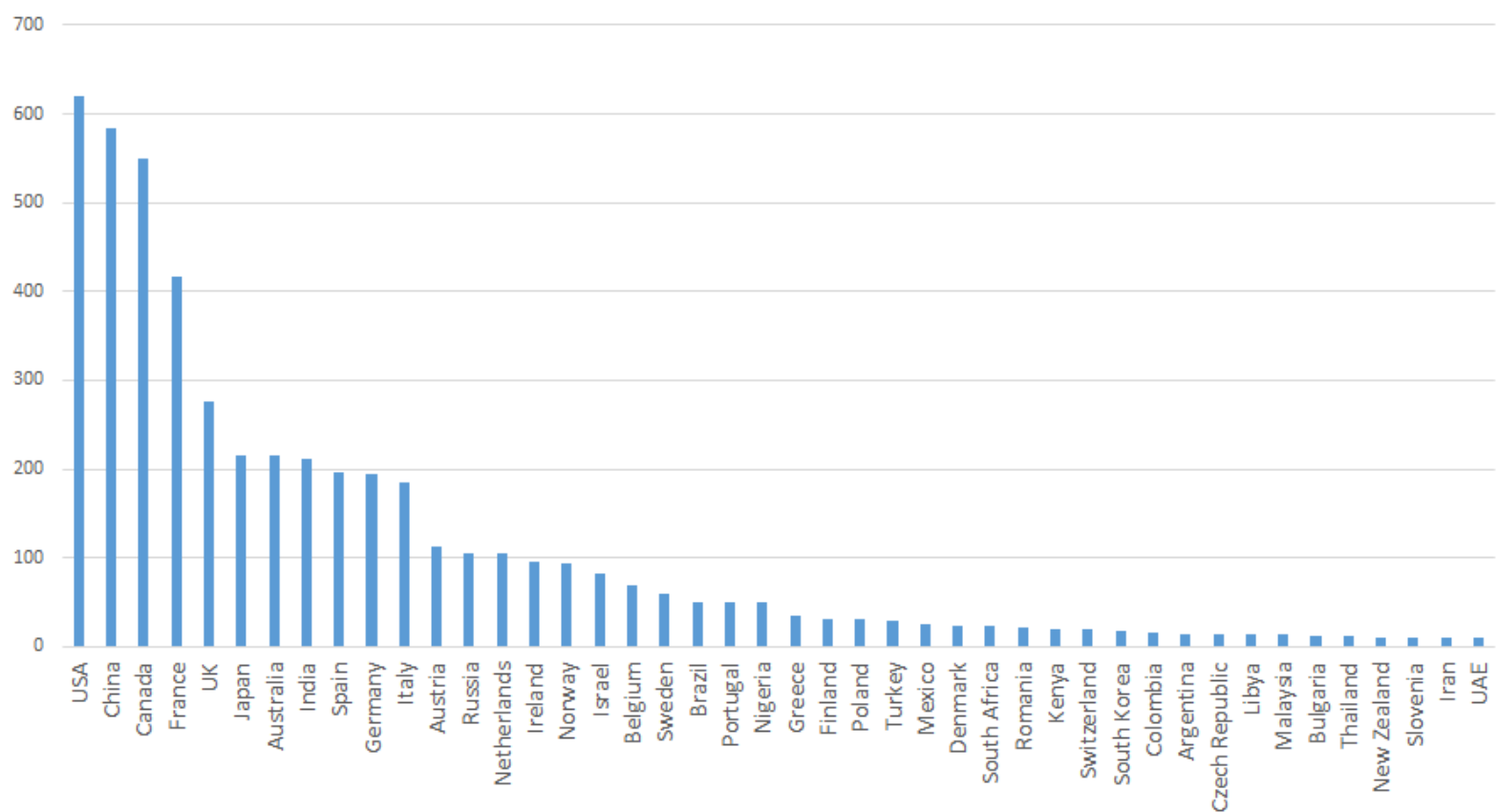


Fig. 21: Alumni distribution since start of ISU (top 40 countries only, September 2020)

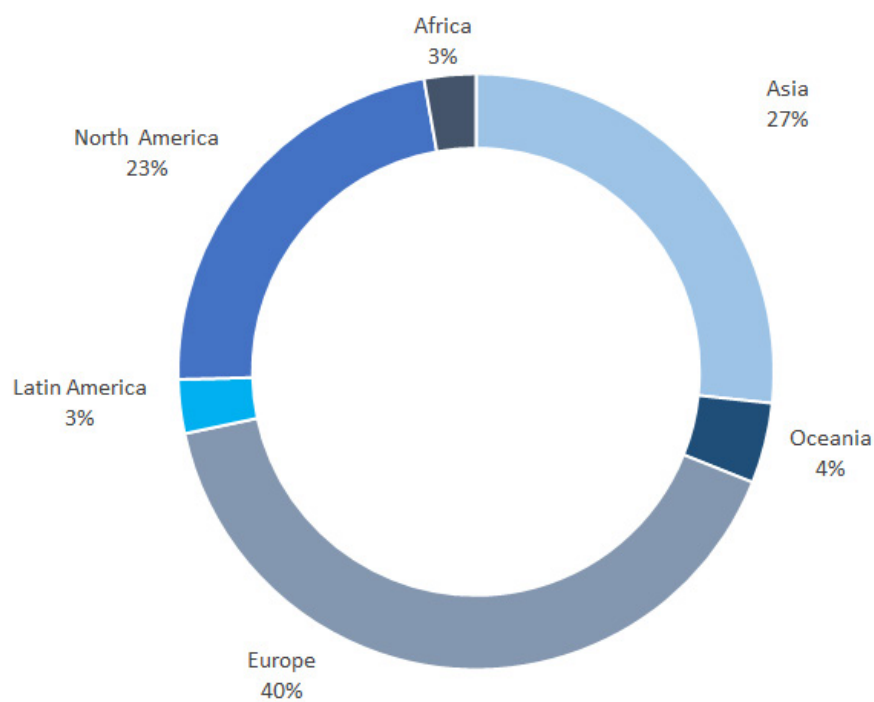


Fig. 22: Geographical distribution of ISU's 5000 alumni

A distribution of alumni in the different space sectors is provided in fig. 23.

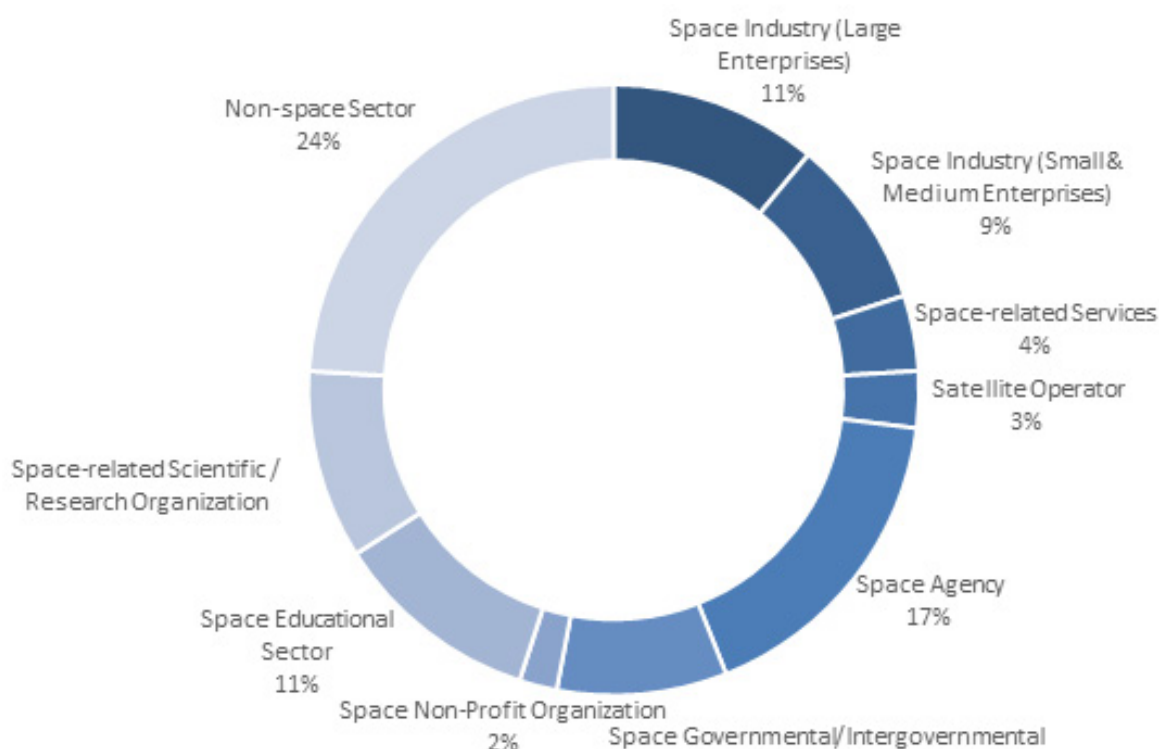


Fig. 23: Distribution of ISU alumni per sector

In January, the ISU Adelaide Conference was held in conjunction with the Southern Hemisphere Space Studies Program and was kicked off by the Premier of South Australia. The Conference offered very timely presentations and discussions on space applications for bushfire monitoring, mitigation, prevention, and preparedness.



In August, the first online ISU Alumni Conference ran for 48 hours non-stop to cater to all time zones. It was held in conjunction with the Interactive Space Program, was kicked off by the NASA Administrator, and included live presentations and panels with Heads of Space Agencies from Colombia, ESA, Germany, Nigeria, Paraguay, Poland, Portugal and South Africa.

Addressing a record attendance of 750 alumni and faculty, the 50 sessions and 100 speakers covered space activities in the African Continent, Australia, Canada, China, Europe, India, Israel, Latin America, the UAE and the USA, and allowed for informal alumni gatherings in virtual sessions that were highly appreciated by all.

10. Faculty and Executive appointments

10.1 New Faculty appointments

Emeritus Faculty:

Chiaki Mukai
Didier Schmitt
Henry Hertzfeld
Oleg Atkov
Paul Henry Tuinder
Scott Madry
Vladimir Lytkin
Yoshiki Morino
Yoshinori Fujimori

Faculty of ISU:

Robert Schichko
Christopher Johnson
Diego Urbina
Emmanouil Detsis
François Spiero
Gerhard Haerendel
Marcello Ingrassia
Ofer Lapid

Adjunct Faculty:

Cory Newman
Ewan Reid
Michaela Musilova
Niamh Shaw

Associate Faculty:

Alex Seneta
Annelie Schoenmaker
Arthur Guest
Doug Hamilton
Jonie Aiken
Milan Cermack
Ozgur Gurtuna
Philippe Berthe
Stacey Falzarano
Wiley Larson

10.2 New Executive appointments



After fourteen years of loyal services to the International Space University (ISU) as Vice President for North American Operations, Steve Brody has transitioned to a well-deserved retirement.

Steve joined ISU in 2006 after a long career at NASA, and as the ISU representative in North America he has been key in nurturing ISU's relations with government agencies, universities, and corporations.

The International Space University's Board of Trustees has appointed Mr. Gary Martin as Vice President for North American Operations. He has taken office on 20 January in succession of Mr. Steve Brody.

Mr. Martin retired from NASA after 32 years supporting space science missions, advanced technology development, technology transfer, and human spaceflight.

He was seconded by NASA to ISU as the Space Studies Program (SSP) Director for SSP06, SSP07, SSP12, and SSP13. In addition, he has been elected multiple times to the ISU Academic Council and continues to lecture and chair Team Projects for different ISU programs.

In 2017, Mr. Martin became a Senior Advisor to the Luxembourg Ministry of the Economy, where he contributed to the establishment of the Luxembourg Space Agency.

Mr. Martin holds a Master's in Mechanical Engineering/Astronautical Engineering from George Washington University, dual bachelor's degrees in Physics and Applied Mathematics from Virginia Commonwealth University and bachelor's in Anthropology from Colorado State University.



11. Special events and outreach

11.1 Special events

The number and quality of events and outreach activities where ISU is promoted increase from year to year. Many gatherings occur during or at the margin of professorial conferences such as the International Astronautical Congress (IAC) or Satellite2020 in Washington DC, and offer the occasion for members of the ISU community to reach out to new prospective students, lecturers, or sponsors.



The class of MSS20 marks the 25th session since the start of the Master program in 1994. A special event was held at Central Campus on 18 December 2020 with participation of students, alumni, faculty, staff, and guest speakers including Dean Emeritus Francois Becker and astronauts Helen Sharman, Reinhold Ewald and Paolo Nespoli.

Fig. 24: Astronaut panel including from left to right, Paolo Nespoli, Helen Sharman, Reinhold Ewald, led by ISU faculty Dr. Virginia Wotring

ISU welcomed the opportunity to take part in ESA's Space Talks. On 8 October, Resident Faculty Dr. Virginia Wotring lectured on human performance in space. The session included a live exchange with students from HEC Paris and the opportunity for all participants to have a say in future space activities via a live poll.

One of ISU's aims is also to "bring space down to Earth" and share the latest developments in that sector with the general public. There were several occasions during the Interactive Space Program that online viewers from all over the world could attend, among others:

- Astronaut panel on 27 July 2020: "Space and public health" discussed by three astronauts - Oleg Atkov, Bob Thirsk, Jessica Meir (ISU MSS2000 alumna) – and moderated by Dr. Kris Lehnhardt (ISU SSP08 alumnus). [The video recording can be found here.](#)
- Policy rationales for space activities by ISU faculty and George Washington University Space Policy Institute co-founder John Logsdon. [The video recording can be found here.](#)



Fig. 25: Astronauts Oleg Atkov, Bob Thirsk and Jessica Meir discussing "Space and Public Health"

The Heads of Space Agencies panel that took place on 03 August 2020 was open to the ISU community only. The theme was: "Pandemics in the Eye of Space Agencies". Speakers included the following heads of space agencies: ISU Chancellor Pascale Ehrenfreund (DLR), Val Munsami (SANSA - ISU alumnus), Jan Woerner (ESA), Chiara Manfretti (Portugal Space - ISU alumna), Francis Chizea (NASRDA - ISU alumnus), Michal Szaniawski (Polish Space Agency - ISU alumnus). The panel was moderated by ISU alumna Dr. Timiebi Aganaba-Jeanty.

11.2 Outreach

ISU wants to take its full place in promoting space exploration and studies to the younger generation. Space, thanks to its inspirational and fascinating power, has a strong impact on young and not so young people, to raise interests for the STEM (science, technology, engineering and mathematics) disciplines.

To achieve these goals, ISU benefits from a diverse staff and student body, and from its collection of space artefacts. A MSS20 student has created over the course of her Individual Project a set of educational cards that describe our collection and helps ISU staff and students become a tour guide of the building..

The ISU Space Cafe initiative has been further developed, especially in the USA and in India, where an online format has been launched that gives visibility to ISU and to the **“Kalpana Chawla Project for Innovation, Entrepreneurism and Space Studies at the International Space University”** (also known as the **Dr. KC Scholars**).



Fig. 26: Visit of a class of Rajkumar College (Gujarat, India), listening to Dr. Hugh Hill's explanations

ISU's Head of Admissions regularly attends space conferences and space-up gatherings, offering talks and information booths that prove to be an effective student recruitment tool.

This year again, ISU has welcomed several classes from schools in Strasbourg and Illkirch. Most were welcomed in French by French speaking students and professors, but one additional class of Lycée Pasteur was welcomed in English.

Starting in March of 2020, both the building and the schools were closed, and several planned visits had to be cancelled. ISU decided to move its efforts to virtual visits of the building. While the quality of the contact is altered, this allowed us to offer some change in the remote teaching for locked-down schools, but also to invite more distant schools that would have no possibilities to come and visit.

Indeed, MSS20 student Dr. Shreya Sarkar organized several visits by Indian teenagers and university students, both in Bengali and English. Along with Dr. Shreya Sarkar, President de Dalmau and Assoc.Prof. Bertrand Goldman talked with the visitors and could give the curious students accurate information on space technology and dreams of exploration and scientific discovery in real time.

This year, ISU also embarked on an international competition where teenagers join forces, guided by space experts, to prepare a project for space exploration and human settlement. MSS20 student Sahba El-Shawa promoted the project to the faculty, as she had previously organized the competition in Canada. ISU first envisioned a 2-day event over a week-end, but due to the pandemic, the event became a virtual one. Instead of working in large teams, French teenagers were offered a period of two weeks at the end of June to work on a project of human settlement in a lava tube on Mars. Thirteen teenagers competed and their work was assessed by a jury of experts from CNES, ESA, and ISU.

An award ceremony was organized online on July 18, 2020. Winners and participants received prizes (books on space and the Moon, ISU and CNES information material, free entries to the Strasbourg Planetarium) provided by our sponsors: CNES and the University of Strasbourg. The winners joined the international competition; here is what one French winner said of the experience: *“I had an amazing time and a wonderful weekend: being able to be (virtually) in presence of NASA engineers illustrates the kind of career I want to pursue and excites me for the years to come. Again, the meeting of such amazing people with whom I share a passion for space meant a lot to me and the only thing I hope is that I will be able to reiterate the experience next year!”*

12. Extra-curricular activities

The climate crisis that has been developing over the past decades is becoming a major societal and political issue, both for the younger generation that makes up most of our students, and for any organization and institution whose actions regarding climate change will sooner or later affect their reputation and attractiveness for all stakeholders.

A working group of staff members and master's students have initiated an effort to tackle those issues at the level of the organization. The goals of the working group are multifold: raise awareness among staff, students, and any partner and visitor of ISU, of the developing crisis and the means we have to contribute positively to the solution; help ISU stakeholders to decrease their individual greenhouse gas emissions when it comes to their ISU activities, and help ISU to decrease its global emissions, with the goal of eventually becoming carbon neutral; estimating the current ISU greenhouse gas emissions and monitor their evolution; take the opportunity of the necessary changes in the way we work, to improve our methods, our work relationships, and well-being.

The working group has met throughout the year, first onsite and then online, to discuss what could be improved, and work on a policy that would be proposed for the consideration of the Academic Council and the Board of Trustees. Some actions had to be delayed because of the lockdown, but activities and brainstorming have continued, nonetheless.

The meetings also created a new arena for the various users of the building to meet and develop new contacts more than they usually did, improving the working atmosphere and some of our methods. Following internal discussions and interaction with management and the staff at large, the working group led ISU to support its staff who would cycle to work through financial incentive; to improve recycling and decrease single-usage items; to consider local food production and better terrace usage; and to increase the place of the climate issue in the curriculum.

13. Conclusions

We hope you found this report useful and perhaps it has triggered some thoughts on how you could be (more) engaged with the International Space University in the future through participation in our education and research programs, or through contributions to their content, mentorship, or sponsorship.

We wish you a safe and enriching academic year 2020-2021 and we remain at your disposal to discuss any space-related topic.

The ISU staff and faculty



ANNEX 1: Faculty

ANNEX 1.1 ISU Faculty

Philippe Achilleas, IDEST, Université Paris Sud & ISU, France
Steve Brody, International Space University, USA
Angie Bukley, The Aerospace Corporation, USA
Carol Carnett, Legal Aid Bureau Inc. (retired), USA
Ed Chester, Goonhilly Earth Station, UK
Patrick Cohendet, Université de Strasbourg/HEC Montreal, Canada
John Connolly, NASA Johnson Space Center, USA
Bill Cowley, Institute for Telecommunications Research, Australia
Eric Dahlstrom, International Space Consultants, USA
Juan de Dalmau, International Space University, France
Volker Damann, International Space University, Germany
Michael Davis, International Space University, Australia
Emmanouil Detsis, European Science Foundation – ESF, France
Kerrie Dougherty, Australian Space Agency, Australia
George Dyke, Symbios Communications, Australia
Reinhold Ewald, University of Stuttgart, Germany
Stefano Fiorilli, European Space Agency – ESA, Spain
Daniel Garcia Yarnoz, Spain
Daniel Glover, NASA Glenn Research Center (retired), USA
Bertrand Goldman, International Space University, France
James Green, NASA Headquarters, USA
Gerhard Haerendel, Max-Planck-Institut für extraterrestrische Physik (retired), Germany
Omar Hatamleh, NASA, USA
Hugh Hill, International Space University, France
Jeffrey Hoffman, Massachusetts Institute of Technology, USA
Marcello Ingrassia, Italy
Dennis Irwin, Ohio University (retired), USA
Adil Rahim Jafry, Chandah Space Technologies, USA
Ady James, University of South Australia, Australia
Rüdiger Jehn, European Space Agency – ESA, Germany
Christopher Johnson, Secure World Foundation, USA
Joan Johnson-Freese, Naval War College, USA
Tarik Kaya, Carleton University, Canada
David Kendall, Canadian Space Agency – CSA (retired), Canada
Otto Koudelka, Technical University Graz, Austria
Ofer Lapid, Israel
Rene Laufer, Baylor University, USA
John Logsdon, Space Policy Institute, George Washington University (retired), USA
Ruth McAvinia, ATG Europe, The Netherlands
Christopher McKay, NASA Ames Research Center, USA
Bernd Madauss, Project Management Team Madauss, Germany
Gary Martin, International Space University, USA
Joshua V. Nelson, USA
Barnaby Osborne, European Space Agency, UK
Norah Patten, Irish Centre for Composites Research, Ireland
Walter Peeters, International Space University, France

Joseph Pellegrino, One Web, USA
Maria Antonietta Perino, Thales Alenia Space, Italy
Christian Sallaberger, Canadensys Aerospace, Canada
Noel Siemon, Australia
Michael Simpson, International Space University (retired), USA
Robert Shishko, NASA Jet Propulsion Laboratory, USA
François Spiero, CNES, France
Geoffrey Steeves, University of Victoria, Canada
Lucy Stojak, HEC Montreal, Canada
Chris Stott, ManSat LLC, Isle of Man
Danijela Stupar, International Space University, France
Gongling Sun, International Space University, France
Su-Yin Tan, University of Waterloo, Canada
Taiwo Tejumola, International Space University, France
Diego Urbina, Space Applications Services, Belgium
Alain Wagner, Airbus Defence and Space, France
Chris Welch, International Space University, France
Ray Williamson, Secure World Foundation (retired), USA
Pete S Worden, Breakthrough Foundation, USA
Virginia Wötring, International Space University, France
Soyeon Yi, Korean Astronaut, Republic of Korea
Kazuya Yoshida, Tohoku University, Japan
Vasilis Zervos, International Space University, France
Olga Zhdanovich, MODIS, Netherlands

ANNEX 1.2 ISU Adjunct Faculty

Andrew Aldrin, Florida Institute of Technology, USA
Heather Allaway, Texas A&M University, USA
Audrey Allison, The Boeing Company, USA
Julio Aprea, European Space Agency – ESA, France
Jacques Arnould, CNES – Headquarters, France
Farhan Asrar, McMaster University and University of Toronto, Canada
Merryl Azriel, Salient CRGT Inc. , USA
Jaime Babb, Canada
Melissa Battler, Mission Control Space Services, Canada
Nelly Ben Hayoun, Nelly Ben Hayoun Studio Ltd, UK
David Bruce, University of South Australia (UniSA)
Francis Chizea, National Space Research and Development Agency (NASRDA), Nigeria
Eric Choi, AeroScribe Consulting, Canada
Philippe Clerc, CNES, France
Jacob Cohen, NASA Ames Research Center, USA
Ana Diaz, Texas A&M University, USA
Kim Ellis, International Earth & Space Technology Pty Ltd, Australia
Stuart Eves, SJE Space Ltd, UK
Andre Farand, Institut du droit de l'espace et des télécommunications – IDEST, France
Barbara Imhoff, LIQUIFER Systems Group, Austria
Tricia L. Larose, Norwegian University of Science and Technology, Norway
Kris Lehnhardt, Baylor College of Medicine and NASA, USA
Zhuoyan Lu, China
Peter Martinez, Secure World Foundation, USA
Tanja Masson-Zwaan, International Institute of Air and Space Law at Leiden University, The Netherlands

Wallace John McDonald, University of Alberta, Canada
Ioannis Michaloudis, Institute of Nanoscience and Nanomaterials, Greece
Michaela Musilova, International Moonbase Alliance (IMA), Hawaiï, USA
Paolo Nespoli, European Space Agency – ESA (retired), Italy
Cory Newman, CAE, Canada
Andrée-Anne Parent, University of Quebec in Rimouski, Canada
Robert Parkinson, Astrium Ltd. (retired), UK
Ewan Reid, Mission Control Space Services Inc., Canada
Daniel Rockberger, NSLComm, Israel
Nahum Romer Zamora, KOSMICA Institute – Nahum Studio, Germany
Claude Rousseau, Northern Sky Research, France
Kai-Uwe Schrogl, International Institute of Space Law – IISL, France
Niamh Shaw, Ireland
Erin Telley (Tranfield), Instituto Gulbenkian de Ciência, Portugal
Madhu Thangavelu, University of Southern California, USA
Remco Timmermans, Seventy Media, UK
Robert Thirsk, Canadian Space Agency – CSA (retired), Canada

ANNEX 1.3 ISU Associate Faculty

Sheila Bailey, NASA Glenn Research Center, USA
Phillipe Berthe, European Space Agency – ESA, The Netherlands
Isabelle Bouvet, Airbus, France
Milan Cermack, Switzerland
Hansjörg Dittus, German Aerospace Center (DLR), Germany
Stacey Falzarano (Solomone), Chandah Space Technologies, USA
Arthur Guest, TreoScope Technologies, USA
Ozgur Gurtuna, Turquoise Technology Solutions Inc., Canada
Douglas Hamilton, KRUG Life Sciences, USA
Wiley Larson, Stevens Institute of Technology, USA
William Marshall, Cosmogia Inc., USA
David Miller, University of Oklahoma, USA
Todd Mosher, Amazon, USA
Annelie Schoenmaker, W.L. GORE & associates, Spain
Isabelle Scholl, Intitute for Astronomy – University of Hawaii, USA
Alexandra Seneta, Department of Industry & Science, Australian Government, Australia

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Dr. Bertrand Goldman

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- *Invited talk*: Space Generation Advisory Council Health in Space Series Jun 30, 2020

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