

The International Space University (ISU)

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Abstract

The International Space University (ISU) is a unique institution of higher learning and professional development whose mission is to "... develop future leaders of the world space community..." ISU offers two programs leading to Master of Space Studies (MSS) and Master of Space Business (MSB) degrees, a Summer Session Program (SSP), and a variety of seminars, workshops, round-table forums, and research services. ISU is accredited by the French Ministry of Education and has bilateral agreements with a number of affiliated academic, research, and industrial institutions in America, Europe, Asia, and Australia. This paper presents the ISU academic programs, illustrates its worldwide recognition, and provides information on the exceptional opportunities for education and international collaboration in space-related areas.

Introduction

The International Space University (ISU),¹ founded in 1988, is an accredited institution of higher learning providing intensive multidisciplinary graduate-level training in space-related disciplines including space science, space engineering, space policy and law, space business and management, and space and society. ISU conducts its activities at its Central Campus in Strasbourg, France,² and at various other locations worldwide. The ISU mission is to "...develop future leaders of the world space community by providing interdisciplinary educational programs to students and space professionals in an international, intercultural environment."³ Distinctive for ISU is its focus on the "3 I" characteristics: Interdisciplinary, International, and Intercultural. The exposure of the ISU students to multidisciplinary educational programs and the opportunity to teamwork and network across national and cultural boundaries are not available in any other educational institution. In 2004, the International Satellite and Communications exchange (ISCe) Conference and Expo awarded ISU its prestigious ISCe Education Award.

ISU currently employs seven full time resident faculty coming from six different countries (Belgium, France, Ireland, Japan, Russia, and the UK,) with extensive experience in research, business, and academia, and with previous affiliation with space agencies, space industries, universities, and governmental and non-governmental organizations. Their expertise spans over both technical and non-technical fields relevant to space, including: orbital mechanics, astrophysics, space applications, space business and management, rocket development, space information technologies, law, and humanities. In addition, seven part-time faculty (from Canada, France, Germany, Russia and the UK) and numerous (typically fifty) visiting lecturers representing different countries, contribute their expertise in various specialized topics such as: space utilization, space safety, project management, financing and insurance, human resources management, research, innovation, and technology transfer, patent and intellectual property, strategic alliances and international project management, etc.⁴

More than an educational institution, ISU is a forum for national and international events, and for bilateral and multilateral exploration of possibilities for partnership in space programs. For example, at the most recent (2004) ISU Summer Program in Adelaide, Australia, space agency representatives from Canada, China, European Union (ESA), France, Japan, Thailand and the USA learned about the direction of the Australian space policies and the possibilities for enhanced international cooperation. During the same ISU summer session, a week-long program of joint events, oral presentations, and poster sessions was organized together with the 8th Australian Space Development Conference of the Australian National Space Society. Based on its success and reputation, ISU has served as a model for the NASA Academy established in 1993 at the NASA Goddard Space Flight Center in Greenbelt, Maryland.^{5,6} Currently in its twelfth year of continuous activity, the Academy has developed a close collaboration with ISU and its alumni. NASA is also currently considering a proposal for recognizing the diplomas and certificates granted by ISU as valid components of its professional development programs. ISU has partnered with SPACEJOBS,⁷ an Internet Job Board connecting skilled aeronautics and space professionals with employers in the aerospace and defense sectors worldwide. The ISU activities and programs are often covered by local and national mass media, resulting in the dissemination of valuable information regarding the technological, economic, social, and environmental benefits of space research and applications.

ISU receives significant financial support from governments, organizations, space agencies, educational institutions, the private sector, and from its founders, alumni, and friends.⁸

ISU Programs

ISU offers the following three academic programs: an eleven-month Master of Space Studies (MSS) Program; an eleven-month Master of Space Management (MSM) Program, and a nine-week Summer Session Program (SSP). In addition, ISU organizes professional site visits, offers an Introductory Space Course, and hosts various topical Seminars, Symposia, Workshops, and Round-Table Forums. The curricula and training experiences are designed to broaden the knowledge and perspective of students with varied educational backgrounds, to enhance their appreciation of the complexity and challenges of international space activities, and to facilitate their integration into a network of professional, political, and cultural organizations with significant impact on space programs.

The Master of Space Science (MSS) Program⁹

This program begins in September of each year and is conducted at the ISU Central Campus in Strasbourg. Typically, about 50 students attend the MSS program, the majority of whom hold academic degrees at the Master's level or above. The program has a modular structure consisting of a core curriculum (Module 1,) a specialized curriculum (Modules 2 and 3,) an interdisciplinary team-project (Module 4,) and a twelve-week on-site internship¹⁰ concluding with individual project reports (Module 5). Examples of topics covered by the core curriculum are listed below:

- history and philosophy of space exploration
- the space arena and space players
- fundamentals of space science
- access to space: engineering fundamentals
- system engineering

- space mission design and management
- principles of scientific and commercial space applications
- humans and biology in space
- principles of space economics
- financing, costing, marketing, and insurance of space activities
- fundamentals of space and commercial law
- basics of information technology and knowledge management
- cross-cultural awareness
- principles of report writing, CV/résumé development, job search and interview skills

Specialized curriculum topics include:

- design of robotic and human spacecraft
- design of global space telecommunications and navigation
- advanced information systems and human-computer interactions
- remote sensing techniques and applications
- launch and ground facilities
- deep space missions
- architecture of space habitats
- space astronomy and astrophysics
- space hazards and their mitigation
- national space policies
- space risk management
- contracts management and regulations
- technology transfer
- image processing and interpretation
- information theory and signal processing
- space debris
- dual use of space technologies
- advanced space propulsion and transportation
- advanced space telecommunications and navigation
- new developments in remote sensing
- microgravity research in space
- space emergency medicine and telemedicine
- commercial space stations and space tourism
- selected topics in astrophysics
- astrobiology

Recent (2003-2004) Team Project titles include:

- Human Missions to Europa and Titan – Why Not?
- SPIN: Space-based Progressive Interoperable Networks

The students enrolled in the next (2005-2006) MSS session can select one of the following proposed projects:

- Manufacturing in a Microgravity Space Environment
- Space Weather Impact on Society

Language classes (basic French and advanced English) are being offered at the Institute of International Relations of the University Marc Bloch in Strasbourg. The MSS program can be completed in continuous attendance or on a modular basis over a maximum period of three years. The students who have successfully completed an ISU Summer Session within three years prior

to enrolling into the MSS Program are allowed to join at the beginning of Module 2. Academic performance evaluation is based on written examinations, special assignments, individual contribution to teamwork, written reports, and oral presentations. The MSS Program is currently recognized in France (University Louis Pasteur, University Paris Sud-XI, Ecole Centrale des Arts et Manufactures) and in the United States (California Institute of Technology, University of Nebraska) enabling the ISU graduates to apply directly for admission to Ph.D. programs in fields relevant to space activities.

The Master of Space Management (MSM) Program¹¹

Similar to the MSS Program, the MSM Program begins in September of each year and is conducted at the ISU Central Campus in Strasbourg. It also consists of five Modules: a core curriculum (Module 1,) a specialized curriculum (Modules 2 and 3,) an interdisciplinary team-project (Module 4,) and a twelve-week on-site internship concluding with individual project reports (Module 5). The core curriculum (Module 1) is common for the MSS and MSM programs. Modules 2 and 3 represent a specialized MSM curriculum. In Module 4 the MSS and MSM students meet and work together on Team Projects.

The Summer Session Program (SSP)¹²

The ISU SSP is an intensive nine-week program for postgraduates and young professionals of all disciplines relevant to space. Historically, it was the first program organized by ISU, following the vision of its founders Peter H. Diamandis, Todd B. Hawley, and Robert D. Richards who, at the time when they were still students at the Massachusetts Institute of Technology, realized the importance of shared knowledge, philosophy, and practices among the future leaders of the space enterprises. The location of the SSP program is chosen each year in different countries on different continents. The SSP program consists of interdisciplinary coursework followed by a teamwork project related to a complex space related issue, and ends with the publication of a comprehensive Report addressing various aspects of the selected issue.

The most recent Summer Session Program was held in Adelaide, Australia, from 27 June to 27 August, 2004. A detailed description of this session will illustrate the typical profile and content of an ISU program, the wide range of specific information and skills taught, the participation of prestigious contributors, and the level of students' accomplishments. This program was hosted jointly by the University of South Australia, the University of Adelaide, and the Flinders University. The Program Organizing Committee was chaired by Michael Davis, Esq., Adelaide attorney and ISU alumnus. Financial sponsorship was provided by the Canadian, European, Japanese, and US space agencies (CSA, ESA, JAXA, NASA), and by space industries from China, Europe, Japan, and North America. The 114 participants (between 20 and 46 years of age) from 27 countries represented a body of graduate students and professionals with educational backgrounds in the following areas:

- physical sciences
- life sciences
- various branches of engineering
- satellite communications
- navigation and control
- remote sensing
- information technology

- business and management
- journalism
- law
- government policies, and
- international relations.

Women participation amounted to 32%. Among the 170 lecturers and workshop leaders were academic faculty, space industry professionals, and other visiting experts. The academic curriculum included:

- core lectures (59 hours)
- workshops (27 hours)
- professional visits (over 30 hours), and
- team project work (over 122 hours)

The lecture topics included:

- space engineering, system analysis, mission design, and sounding rocket payload experiments
- space physical sciences
- space life sciences
- space information technology and knowledge management
- satellite applications
- space business and management
- space policy and law.

Workshop topics covered:

- orbital mechanics
- global satellite navigation system
- robot construction for planetary exploration
- microgravity drop tower demonstrations
- satellite image processing
- management of space debris
- Earth climate change
- crew selection for space missions
- cardiovascular measurements and diagnostic
- design of future Mars missions
- designing governance settlements on Mars
- communicating with extraterrestrial intelligence
- futures studies and strategic planning
- answering requests for proposals
- commercial negotiations
- crisis communication and media training
- intercultural awareness and team building
- report writing and communication skills

The following three Team Projects were published and presented in local public sessions and at international meetings (e.g. the IAC in Vancouver, Canada, and the Asia Pacific Regional Space Agency Forum meeting in Canberra, Australia):

- LunAres: Lunar Missions in the Framework of Current Space Exploration Initiatives for Mars

- CONNECTS: The Role of Satellite Communications in the Development of Rural and Remote Regions
- STREAM: Space Technologies for the Research of Effective wAter Management, with the case study of the Murray-Darling basin in Australia.

Field trips were organized to the Woomera launching facility, and to the proposed Mars Analogue Research Station at Arkaroola (in collaboration with the Mars Society). Two Zuni rockets launched by the Australian Space Research Institute carried the following seven experiments designed and built by ISU staff and students:

- Telemetry (linked the payload with the ground team for the entire flight duration)
- On-Board Camera (recorded the rocket's ascent and parachute deployment)
- Launch Environment (measured acceleration and temperature)
- I-Buttons (carried 114 temperature sensors programmed by ISU students)
- How Blue Is the Sky (measured color variation with altitude)
- OPEX: On-board Percentracy Experiment (contributed by the University of Stuttgart, ISU partner)
- Outreach (carried space-related drawings by children from the Children's Hospital in Adelaide)

A series of weekly public events sponsored by the host universities included a Robotics Competition, exhibition of a lunar rock from the Apollo 17 mission (on loan from NASA to ISU and to several Australian museums,) Theme Days, and Distinguished Panels conducted by a number of visiting world experts on topics including:

- Remote Sensing the Universe (Theme Day)
- Threats from Near-Earth Objects (Theme Day)
- Space and National Security (Theme Day)
- Space Industry: Priorities for the Next Decade (Panel)
- Astrobiology: The Search for the Origins of Life in the Universe (Panel)
- Major Space Agencies in the World (Panel)
- Space Policies in the Asia-Pacific Countries (Panel)
- Process and Results of the Space Shuttle Columbia Accident Investigation (Lecture)

The 2004 ISU SSP program was accredited by the University of South Australia. The University and ISU signed a Memorandum of Understanding regarding the initiation of an Affiliate Campus agreement. The ISU students were awarded a Graduate Certificate in Applied Science (Space Studies).

The next two ISU SSP sessions will be hosted by Canada (2005, the University of British Columbia in Vancouver) and China.

The Introductory Space Course¹³

This week-long course, offered in the spring, provides an overview of basic space-related topics for professionals of diverse backgrounds. The program consists of lectures, workshops, practical case studies, and a team project.

Professional Visits¹⁰

During the academic year, ISU students participate in group visits at some of the major space related facilities and organizations in Europe, and/or attend space related meetings. Occasionally,

visits to the European Space Agency launch facilities in Kourou, French Guiana, and to space-related facilities in Russia have also been organized.

The ISU Annual International Symposium¹⁴

This event represents an interdisciplinary forum enabling discussions and formulation of innovative solutions to space related issues. The 9th Symposium (December 2004) was entitled: "Civil, Commercial, and Security Space: What Will Drive the Next Decade?"

Other Programs¹⁵

ISU also organizes or co-sponsors (together with its affiliates or other organizations) conferences, symposia, professional development meetings, research services, three-day, two-day, and one-day courses, as well as other events dedicated to themes of interest and tailored to the specific needs of the participants. Among the topics covered in these programs are: space medicine, future space markets, privatization of space assets and operations, etc.

ISU also initiates or co-sponsors education outreach events, among which specially relevant are:

- the recent (October 2004) "ISU Physics on Stage (Fête de la Science) dedicated to promoting science studies to school children
- the "Training for Space-related Applications, Toulouse Forum" (November 2004), and
- the "First IAA International Conference on Impacts of Space and Society (March 2005, Budapest, Hungary).

Publications¹⁶

The ISU students' reports (the Team Projects and the MSS and MSM student Individual Reports) are available in paper format for purchase from ISU.¹⁷ The ISU Symposium Proceedings are available directly from the publishers. Lists of Titles and Executive Summaries of the Masters' reports¹⁸ and of the Summer Session Program reports¹⁹ are available online. The most recent Reports are also available on CD-Rom format. The ISU Alumni Association publishes a periodical Newsletter.²⁰

Scholarships²¹

ISU supports a limited number of students with scholarship funds provided by contributions from industry, government agencies, ISU affiliates, and individual donors.²² Qualified applicants are accepted from the member states of the European Space Agency, from the United States, from ISU affiliates, and from developing countries.

Library Resources

The ISU Library has acquired 60 periodicals and over 6,000 space-related books, reports, videotapes, and CD-ROMs. ISU is also the European Repository for NASA Central Operation of Resources for Educators (CORE).

The International ISU Alumni Organization

The International ISU Alumni Organization and its national and regional chapters maintain comprehensive online databases and provide support and networking opportunities to their members. Today, there are over 2200 ISU alumni in 28 countries of the world, that have attended the ISU Summer Session Program (SSP) alone. ISU graduates can be found in

leadership positions in universities, research laboratories, space agencies, space industries, and international organizations (e.g. the United Nations). Analysis of the past three years shows that 70% of the ISU alumni have found employment in the space sector, while 12% have continued their advanced graduate studies. Only 18% of the graduates have pursued careers outside the space sector.

Bibliographic Information

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3. General Information: http://www.isunet.edu/about_us/what_is_isu.htm
4. ISU Faculty: http://www.isunet.edu/about_us/faculty_lecturers.htm
5. NASA Academy: <http://www.nasa-academy.nasa.gov>
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Biographical Information

Dr. IRINA NELSON has taught and performed research work at a number of research institutions, universities and colleges in Europe and in the United States of America. She has held research and education appointments at NASA (in particular as Academic Dean of the NASA Goddard Academy) and has been a visiting lecturer at the International Space University (ISU).