2016, BUDAPEST, HUNGARY

H-SPACE 2016

2ND INTERNATIONAL CONFERENCE ON RESEARCH, TECHNOLOGY AND EDUCATION OF SPACE

ORGANIZED BY
FEDERATED INNOVATION AND KNOWLEDGE CENTRE OF
BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS
AND HUNGARIAN ASTRONAUTICAL SOCIETY

EGYESÜLT INNOVÁCIÓS ÉS TUDÁSKÖZPONT

Magyar Asztronautikai Társaság

EDITED BY LÁSZLÓ BACSÁRDI AND KÁLMÁN KOVÁCS

H-SPACE 2016

Proceedings of 2nd International Conference on Research, Technology and Education of Space

February 25-26, 2016, Budapest, Hungary
at Budapest University of Technology and Economics

Organized by
Federated Innovation and Knowledge Centre of
Budapest University of Technology and Economics
and
Hungarian Astronautical Society

Editors
László Bacsárdi and Kálmán Kovács

MANT 2016

Conference proceedings

H-SPACE 2016

2nd International Conference on Research, Technology and Education of Space
February 25-26 2016, Budapest, Hungary
BME building 'I', Hall IB 026
Magyar tudósok krt. 2., Budapest, H-1117 Hungary

Organizing and Editorial Board

Chair: Dr. Kálmán Kovács
Co-Chair: Dr. László Bacsárdi
Members:
Prof. József Ádám, Dr. Tibor Bálint, Prof. László Pap,
Prof. Gábor Stépán, Dr. Fruzsina Tari
Honorable Patrons:
Prof. Iván Almár, Prof. János Józsa, Dr. László Vajta

Készült a BME VIK és a BME EIT támogatásával
Szerkesztők: Dr. Bacsárdi László és Dr. Kovács Kálmán

Kiadja:
a Magyar Asztronautikai Társaság
1044 Budapest, Ipari park u. 10.
www.mant.hu
Budapest, 2016

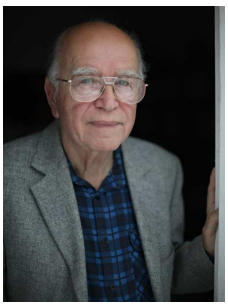
Felelős kiadó: Dr. Bacsárdi László főtitkár

ISBN 978-963-7367-10-6 (Revised edition)

WELCOME

Prof. Iván Almár

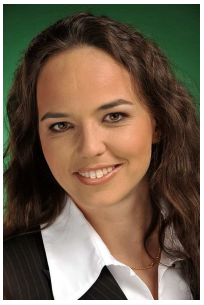
Honorary President of Hungarian Astronautical Society,
member of International Academy of Astronautics



„In the epoch of Fuze, Skype and other types of video conferences is such an international conference as H-SPACE still necessary and useful? I am convinced that the answer is yes. It is impossible to replace the personal contact with colleagues, who are working in the same field (space science and technology in our case) by anything else. I do hope this conference will help you to improve your view on this fascinating subject, including the experience on its education and dissemination. I do hope also that summarizing all aspects of the presentations will prove a definite, year by year development of the quality of space activities in Hungary."

Dr. Fruzsina Tari

Head of the Hungarian Space Office
Ministry of National Development



„Dear participants of the H-Space 2016 Conference organized in Budapest.
It is with great excitement that I'm addressing those welcoming words to you. Hungary has several decades of history in space research and space industry. Beside this long heritage, we have left a rather eventful and important year 2015. This was the year, when Hungary has become full member of the European Space Agency; we celebrated the 35th anniversary of the first Hungarian astronaut's space travel and gave place to more international conferences.
In 2015, the Federated Innovation and Knowledge Centre (EIT), within the Faculty of Electrical Engineering and Informatics at the Budapest University of Technology and Economics (BME) and the Hungarian Astronautical Society teamed up to fund a tradition by organizing the H-Space 2015 conference, which was a great success. This year we can follow this tradition and focus on "Roles of small satellites in space research and smart services". The selection of the very current topic invites you to get deep into the technical solutions and potential applicability of small satellites. Hungary is engaged also through the Hungarian Space Office to support the new trends in space innovation and that is way it accepted to be part of the Organizing Board.
In this spirit, I wish you all a successful meeting in Budapest also in the name of the Hungarian Space Office."

Welcome from the Organizing Committee

The Federated Innovation and Knowledge Centre (EIT), within the Faculty of Electrical Engineering and Informatics at the Budapest University of Technology and Economics (BME) – in cooperation with the Hungarian Astronautical Society - organizes an international conference on space research under the name H-SPACE 2016. Following the success of H-SPACE 2015, this becomes the 2nd International Conference on Research, Technology and Education of Space.

The organization of the conference comes at a time of growing opportunities arising from ESA recently granting membership to Hungary and the need for a joint presentation of space activities pursued at BME. The selection of the date of the event pays tribute to the successful deployment to orbit and mission of the first Hungarian satellite, the Masat-1.

The topic of this year's conference is "Roles of small satellites in space research and smart services". The topic covers applications and services from Earth Observation to future Smart City solutions. The agenda of the conference addresses scientific, technological and educational issues of space research and space activities. The conference is open for both local and international professionals and provides an opportunity to showcase Hungarian scientific, technological, educational and outreach activities, related to space.

The Organizing Committee has internationally recognized members: Prof. József Ádám, Dr. Tibor Bálint, Prof. László Pap, Prof. Gábor Stépán and Dr. Fruzsina Tari. We are grateful for their contributions to the success of the conference.

We invited four distinguished keynote speakers: Dr. Franco Ongaro (European Space Agency), Dr. Tibor Balint (Royal College of Art, London), Richard Jones (Flow Chemistry Society), Prof. Rainer Sandau (International Academy of Astronautics).

The conference will have three main sections: Science and Technology I, Education and Outreach (Hungarian only) and Science and Technology II. The best lectures will receive the option of publishing in a journal, thus the conference contributes to the scientific progress of the researchers as a publication opportunity.

After the conference, the Space Generation Advisory Council (SGAC) organizes its first European Space Generation Workshop (E-SGW), which will be held on February 26-27 in Budapest. The E-SGW is a two-day regional workshop for students and young professionals, between the ages of 18 and 35, primarily from the European region. The theme of the E-SGW is:

„Approaches to promoting European regional collaboration in the space sector – the next generation perspective". Delegates will discuss the most relevant and up-and-coming space topics in the European region. The participants will work in three Working Groups during the workshop and make recommendations, helping to shape and providing insight into the future of the European space sector.

We hope you will enjoy your time in Budapest and the H-SPACE conference could help to learn about new scientific and technological results and strengthen your network.

Dr. Kálmán Kovács
chair

Dr. László Bacsárdi
co-chair

2nd International Conference on Research, Technology and Education of Space

February 25-26, 2016
Budapest,
BME building 'I', Hall IB 026
Address: Magyar tudósok krt. 2., Budapest, H-1117, Hungary

Conference Program

February 25

13:30–13.50 Opening

János Józsa, Rector of Budapest University of Techology and Economics (BME)
Fruzsina Tari, Hungarian Space Office, Ministry of National Development
Franco Ongaro, Director of Technical and Quality Management (D/TEC), and Head of ESTEC in Noordwijk, the Netherlands
László Pap, National Council for Telecommunications and Information Technology of Hungary
János Solymosi, President of Hungarian Astronautical Society

13:50–15:00 Section of Science and Technology I/A

Keynote talk: Future Missions and Technologies
Franco Ongaro, Europian Space Agency
Space weather research and forecast services using CubeSats
Balázs Zábori, Centre for Energy Research, Hungarian Academy of Sciences

14:40–15:00 Coffee break

15:00–16:30 Section of Science and Technology I/B

The Communication and Spectrum Monitoring System of Smog-1 PocketQube-Class Satellite
Levente Dudás, Department of Broadband Infocommunications and Electromagnetic Theory, BME
Design Aspects of Future Astrochemistry Nano-Satellite Mission above LEO
Gábor István Varga, ESA-ESOC
The study of the midlatitude ionospheric response to geomagnetic activity in Széchenyi István Geophysical Observatory
Kitti Alexandra Berényi, Geodetic and Geophysical Institute, Hungarian Academic of Science

Keynote talk: Designing space design — from objects to organizations (a cybernetic perspective)
Tibor Balint, Royal College of Art, London

16:30–16:50 Coffee break

16:50-17:00 Opening the Section of Education and Outreach
Kálmán Kovács, Chair of Space Forum of BME

17:00–18:30 Section of Education and Outreach (in Hungarian)

Activity of the EUMeTrain project
Mária Putsay, Hungarian Meteorological Service
Space Generation in Hungary
Dorottya Milánkovich, Space Generation Advisory Council
Ten Years of the Simulated Mars Rover Model Competition
Pál Gábor Vizi, Wigner RCP, Hungarian Academy of Sciences
Programs for talented students at the Hungarian Astronautical Society
Sándor Frey, Hungarian Astronautical Society
The Years of Comets 2013-2016, Comet Project in Budapest High Schools
Zsuzsa Horváth, Kosztolányi Dezső High School, Budapest
Analogue work with ExoMars project: science-technology synergy and implementation to university Education
Ákos Kereszturi, Research Centre for Astronomy and Earth Sciences, Hungarian Academic of Science

* * * * *

February 26

9:30–9:40 Opening of the second day
László Vajta, Dean of Faculty of Electrical Engineering and Informatics, BME
László Bacsárdi, Secretary General of Hungarian Astronautical Society
Minoo Rathnasabapathy, Executive Director of Space Generation Advisory Council

9:40–10:55 Section of Science and Technology II/A

Keynote talk: The SpaceFlow Project – To drive chemistry discovery in space towards sustaining and extending human life and Exploration
Richard Jones, Flow Chemistry Society

Using Multi-hop Sensor Networks on the Surface of Solar System Bodies
Árpád Huszák, Department of Networked Systems and Services
Quantum-based solutions in Low Earth Orbit Satellite Networks
András Kiss, Institute of Informatics and Economics, BME University of West Hungary
Application of the Fleet of Micro Sized Space-Motherships (MSSM) Deploying Nano, Pico Space Devices and Robots (NPSDR) in Space
Pál Gábor Vizi, Wigner RCP, Hungarian Academy of Sciences
Ionospheric related research and development at the Geodetic and Geophysical Institute
Veronika Barta, Geodetic and Geophysical Insitute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences

10:55–11:10 Coffee break

11:10–13:00 Section of Science and Technology II/B

Keynote talk: Small Satellites: Status, Opportunities and Challenges
Rainer Sandau, International Academy of Astronautics
Comparison of algorithms using spherical harmonic analysis – the BME-SHS program
Márton István Kemény, Department of Geodesy and Surveying, BME
Psychological status monitoring by acoustic-phonetic analysis of crew talk
Gábor Kiss, Department of Telecommunication and Media Informatics, BME
Psychology – Language Technology – Space Research
Bea Ehmann, Institute of Cognitive Neuroscience and Psychology, Research Centre for Natural Sciences, Hungarian Academy of Sciences

12:50–13:00 Closing remarks

14:00–19:00 European Space Generation Workshop

* * * * *

February 27

9:00–19:00 European Space Generation Workshop

Table of Content

Keynote **13**
Designing space design – from objects to organizations (a cybernetic perspective) – Tibor Balint 15
The SpaceFlow Project – Richard Jones 18
ESA Future Missions and Technologies – Franco Ongaro 20
Small Satellites Status, Opportunities and Challenges – Rainer Sandau 21
Section Science and Technology **25**
Ionospheric related research and development at the Geodetic and Geophysical Insitute – Veronika Barta 27
The Communication and Spectrum Monitoring System of Smog-PocketQube-Class Satellite – Levente Dudás 29
Psychology – Language Technology – Space Research – Bea Ehmann 31
Using Multi-hop Sensor Networks on the Surface of Solar System Bodies – Arpad Huszak 33
Comparison of algorithms using spherical harmonic analysis – the BME-SHS program – Márton István Kemény 35
Quantum-based solutions in Low Earth Orbit Satellite Networks – Andras Kiss 37
Psychological status monitoring by acoustic-phonetic analysis of crew talk – Gábor Kiss 39
Design Aspects of Future Astrochemistry Nano-Satellite Mission above LEO – Gábor István Varga 41
Application of the Fleet of Micro Sized Space-Motherships (MSSM) Deploying Nano, Pico Space Devices and Robots (NPSDR) in Space – Pal Gabor Vizi 43
Space weather research and forecast services using CubeSats – Balázs Zábori 45

The study of the midlatitude ionospheric response to geomagnetic activity in Nagycenk – Kitti Berényi 47
Section Education and Outreach 49
Programs for talented students at the Hungarian Astronautical Society – Sándor Frey 51
The Years of Comets 2013-2016, Comet Project in Budapest High Schools – Zsuzsa Horváth 53
Analogue work with ExoMars project: science-technology synergy and implementation to university education – Ákos Kereszturi 55
Space Generation in Hungary – Dorottya Milánkovich 57
Activity of the EUMeTrain project – Mária Putsay 59
Ten Years of the Simulated Mars Rover Model Competition – Pál Gábor Vizi 61
Magyar nyelvű összefoglalók (Hungarian summary) 63
Diákok tehetséggondozása a Magyar Asztronautikai Társaságnál 63
Üstököprojekt két budapesti gimnáziumban, 2013-2016 Horváth Zsuzsa 64
Analógia kutatás az ExoMars programban: tudomány és technológia kapcsolata és alkalmazása az egyetemi oktatásban – Kereszturi Ákos . 66
Űrgeneráció Magyarországon – Milánkovich Dorottya 67
Az EUMeTrain projekt tevékenysége – Putsya Mária 68
10 éves az Alkalmazott Mérnöki Tudományok Versenye – Vizi Pál Gábor 69

Author Index 71

KEYNOTE

Designing space design — from objects to organizations (a cybernetic perspective)

Tibor Balint
tibor.balint@network.rca.ac.uk
Royal College of Art, Innovation Design Engineering,
School of Design Kensington Gore, United Kingdom

Dr. Tibor Balint is a researcher at the Royal College of Art, School of Design, working on his second PhD in Innovation Design Engineering. He spent 4 years at NASA Headquarters as the Senior Technical Advisor; the Program Executive for the Game Changing Development Program at NASA's Space Technology Mission Directorate; and a Senior Technologist at the Office of the Chief Technologist. At NASA's Jet Propulsion Laboratory he worked for 8 years as a mission architect and technologist. He earned a PhD in engineering from Warwick University, UK; an MPhil from Exeter University, UK; an MSc from the Technical University of Budapest, Hungary; and an MSS degree from ISU, France. He is a full member of International Academy of Astronautics.

Abstract

Today's space exploration efforts, which simply put, consist of mission architectures, objects, and processes, are predominantly conceived, designed, built and operated through technology and engineering approaches, including integrated thinking and systems thinking. The resulting space hardware are highly functional, reliable, safe, but also expensive. This paradigm led to many successful missions. At the same time, technological innovation within government funded space agencies also encountered innovation barriers. [1] Finding solutions to these innovation barriers can not be achieved within the same paradigm that created them. We need a new paradigm that may introduce new options and opportunities, but before that we need a new perspective to understand the complexities and wicked problems that these organizations face.
Cybernetics can provide this perspective. It is a trans-disciplinary field, initially defined by Wiener in 1948. [2] It affords novel

perspectives to understand how elements of a system interact through circular regulatory and feedback loops. Its applicability within the space arena can scale from project level to organizational level. In an organizational hierarchy, the project level can be described under linear-disciplines, and characterized under first-order cybernetics which focuses on the observed system. Here the objective is to execute the projects within given resources, schedule, and other requirements. At the organizational—or strategic—level, senior leadership has to deal with multi-disciplinary wicked problems in line with second-order cybernetics [3]. This now becomes an observing system, which can overwrite the rules of the lower first-order system.

Applying this perspective to an organization can help to identify touch points or fracture points, where improvements or changes can be implemented to benefit the overall system and reduce innovation barriers.

This understanding led the researcher to develop a novel strategic level project assessment tool, that helps strategic decision making on technology projects and portfolios at NASA. [4] These changes at all levels require effective, iterative, and circular dialogs. Building on these dialogs, the outcomes can be evaluated through a systematic approach to harmonize the opportunities and constraints. These Design Dialogs or design conversations are discussed in [5], in Pangaro's model of co-evolutionary design. It consists of four conversationally and circularly interconnected elements. Conversations to agree on the goals, and on the means, while designing the design process, and creating a new language.

These cybernetic circular conversations are the basis to reach agreements. These agreements strengthen the teams at any level within the organization, and can lead to trust, and establish the grounds for change. Change is a foundational requirement for innovation, but to think outside an established framework and its bound options, new languages are needed. Such new languages are created in these conversations. Therefore, the important part of a design framework is not to simply "dream up" a new language and present it as a given solution, but to introduce a new process that facilitates these Design Dialogs, leading to new languages, new discourses, and subsequently arriving to preferred outcomes, or even a new paradigm. Adopting Design Dialogs at space agencies, while focusing on the interactions in a human centered way, could

open up the mission and technology design trades beyond today's options, which are limited by and increasingly specialized language.

In my presentation I will provide a brief introduction to cybernetics and Design Dialogs, and highlight examples at NASA, where these concepts—combined with a focus on human centered design (HCD)—could play beneficial roles. The examples will include a tool to support strategic decision making, HCD for long duration space habitats, storytelling through research proposals, and dialogs between developers and space agencies to address requirements on flying their space objects.

Keywords:
space exploration, cybernetics, design dialogs, human centered design

References:
[1] Balint, T., Stevens, J., 2016. "Wicked problems in space technology development at NASA", Acta Astronautica, Volume 118, January–February 2016, Pages 96–108
[2] Wiener, N., 1948. CYBERNETICS or Control and Communication in the Animal and the Machine. Second ed. Quid Pro Books, New Orleans, Louisiana
[3] Glanville, R., 2004. "The purpose of second order cybernetics", Kybernetes, 33(9/10), pp. 1379-1386, Emerald Group Publishing Limited, 0368-492X, DOI 10.1108/03684920410556016
[4] Balint, T., Depenbrock, B., Stevens, J., 2015. "Design Driven Approach to Optimize the Research and Development Portfolio of a Technology Organization", Paper Number: IAC-15-D.1.6.1, 66th International Astronautical Congress, IAC-2015, Jerusalem, Israel, October 12-16
[5] Dubberly, H., Esmonde, P., Geoghegan, M., Pangaro, P., 2014. "Notes on the role of leadership & language in regenerating organizations", revised from its original publication in 2002 by Sun Microsystems and printed in Driving Desired Futures, ed. Shamiyeh, M., and Design Organization Media Laboratory (DOM), Linz (Germany), Website: http://pangaro.com/littlegreybook-dom.pdf, Viewed on May 7, 2015

The SpaceFlow Project: To drive chemistry discovery in space towards sustaining and extending human life and exploration

Richard Jones, Ferenc Darvas
richard.jones@flowchemistrysociety.com,
ferenc.darvas@flowchemistrysociety.com
Flow Chemistry Society, Hungary

Richard Jones was appointed as the CEO of ThalesNano in April 2012. Before holding this position, he was responsible for product direction and user experience for the entire line of ThalesNano instruments. He joined ThalesNano in July of 2004 where he started as Chief Research Chemist, helping to develop the chemistry on the H-Cube® and other flow reactors. He then went on to become Product Manager of the R&D 100 Award winning H-Cube® before becoming Director of Product Management. Prior to ThalesNano, Richard was at Biofocus Discovery and worked on the synthesis of several Kinase and GPCR inhibitor based compound libraries. Richard studied chemistry at the University of Bristol where he graduated with honors in 1999.

Abstract

Since the beginning of space exploration, chemistry has provided a vital role in space research from materials to propellants. Novel challenges to space research, however, require an enhanced role for chemistry including a semi-automatic and fully automatic lab in space.

One of the main challenges that we are faced with is how do we conduct long duration space flight with resources limited to what we can take with us. This throws up a number of problems that need to be solved:

• The supply of medical treatments for astronauts on long duration spaceflight1.

• Limitation of food and fuel resources

Reconversion of human biological waste to useful materials and the extraction of mineral resources on alien planets are also among the most important targets.

However, the study of synthetic chemistry in space has not been performed, mainly due to issues with performing traditional batch chemistry in a low or zero gravity environment. Flow chemistry is the most advanced branch of synthesis chemistry and amenable to both automation and synthesis under zero gravity and other harsh conditions2. Flow chemistry is performed by mixing a continuous flow of either 2 or more liquid/gas reagents under heating or cooling or under pressure in a tubular reactor.

The advantages are (i) no free headspace where chemicals can float around making results irreproducible (ii) reactions can be performed on a very small scale reducing the hazardous nature of a reaction (iii) multiple reactions and purification steps can be and combined (telescoping) to create complex molecules from simple building blocks in one continuous stream.

The scientific community beyond flow chemistry realises the potential advances of bringing flow chemistry to space and solving it under the auspices of the international flow chemistry society association.

The purpose of the lecture is to give an outline of the ongoing and future activity of the SpaceFlow project where, all together, 13 Universities and 4 industrial units are involved in US, UK, Hungary, Germany, and others. Interdisciplinary challenges of standardization, miniaturization, ultra-fast data communication are explored together with some results attained in the US and Hungary.

Keywords:
Space Chemistry, flow chemistry, drug on demand, quantum tunneling, space pharmacology

References:
[1] V.E. Wotring, Space Pharmacology, Springer Briefs In Space Development, 2012.
[2] Flow Chemistry Vol.1 Fundamentals, 2014, Edited by F. Darvas, V. Hessel, G. Dorman.

ESA Future Missions and Technologies

Franco Ongaro
Franco.Ongaro@esa.int
ESA/ESTEC, The Netherlands

Franco Ongaro took up duty as Director of Tech-nical and Quality Management (D/TEC), and Head of ESTEC in Noordwijk, the Netherlands, on 1 April 2011.
Franco Ongaro graduated as a Doctor of Aero-nautical Engineering from the University Poli-tecnico of Milan. In 1987 he joined ESA, working at ESA HQ in Paris on the Columbus project. In 1988, he moved to ESTEC in the Netherlands as Head of the Columbus Payload Interfaces Unit. He was shortlisted as candidate in the European astronaut selection of 1991.
In 1994, Franco Ongaro moved back to HQ, to join the ESA Strategy Directorate as General Studies Programme Manager. In 2001, he initiated and managed the start of the Aurora exploration prog-ramme until 2005, when he became head of the ESA Advanced Concepts and Technology Planning Department, issuing the first ESA Technology Long Term Plan and creating the Advanced Concepts Te-am.
From 2007, he led the preparation and implementation of the Iris programme to develop a 'satcom' component for air traffic management. In 2009 he became Head of the Telecom Technologies, Products and Systems Department in the Telecommunications and Integrated Applications Directorate at ESTEC. From 1994 until 2009, he taught a one-semester graduate course in spacecraft design at the University Politecnico of Milan.

Abstract

ESA mission plans extend beyond 2030. The talk will give an overview of the currently planned missions and of the advance work in new fields such as debris management (Cleanspace), NEO mitigation (the Asteroid Impact Mission), etc. From this overview the talk will identify which key technologies are being addressed by ESA to support these future missions, e.g. the technologies for human and robotic Exploration.

Keywords: Future missions and technologies, Cleanspace, Asteroid Impact Mission

Small Satellites
Status, Opportunities and Challenges

Rainer Sandau
rainer.sandau@iaamail.org
International Academy of Astronautics, Germany

Rainer Sandau is retired from the German Aerospace Center (DLR) and acts currently as adjunct Professor at Baylor University, Texas, USA and Director, Satellites and Space Applications of the International Academy of Astronautics (IAA). He is Honorary President of the "Society for Academic Youth Promotion" (gemeinnützige Gesellschaft zur Förderung der akademischen Jugend, GeFaN), Bberlin, Germany
He has over 30 years of experience in airborne and spaceborne activities. He has led and been involved in instrumentations of five space missions to Venus, Mars and Earth, and also in numerous concepts for instruments and small satellites for or with different countries and space agencies, ranging from Earth observation applications, e.g. the concept of a German stereo camera on-board the French SPOT 5 mission, to a lander concept jointly done with NASA/JPL for ESA's cometary mission ROSETTA. His stereo camera WAOSS (Wide-Angle Optoelectronic Stereo Scanner), developed for the Russian Mars 96 mission, flies also on DLR's micro satellites BIRD (launched Oct. 2001), dedicated for forest fire detection and assess-ment from the Earth orbit, TET-1 (launched April 2012), a German technology demonstration satellite) and BIROS (to be launched in 2014), a BIRD successor flying in constellation with TET-1.
During his career he held different positions, including Deputy Director of the Institute of Space Research of the Academy of Sciences and DLR's Institute of Space Sensor Technology both in Berlin, Germany, and Director R&D of the Swiss/US Company LH Systems based in Switzerland (Leica Company). He is member of various national and international associations where he served in different functions. For instance, in the period of 2008 – 2012 he served as the Chairman of the International Policy Advisory Committee (IPAC) of the International Society for Photogrammetry and Remote Sensing (ISPRS) and represented ISPRS at the UN COPUOS and COSPAR, and he is emeritus member of the Board of Trustees of the International Academy of Astronautics (IAA).

He is founder and Chair of the biannual International IAA Symposium on Small Satellites for Earth Observation, the 10th taking place in April 2015 in Berlin, and Program Committee member of several international conferences.

Abstract

The paper gives some background information about what a small satellite is and why we are developing small satellites for space research and many applications to serve the needs of our societies.. The advances in various fields of technology are the basis for miniaturized sensors which allow small satellite missions with performances comparable or even better than those of former large satellite missions. The concentration on a single physical phenomenon allows optimizing the (small) satellite/payload system. The requirements for the very different application areas in terms of spatial, spectral and temporal resolution are provided, and the actual status of small satellites with associated payloads is shown. Two examples in the areas of forest fire detection and assessment and interactive surveillance give details of the design process for remote sensing and smart service systems.
The recent trend of miniaturization accompanied with increased or even novel high performance features allows implementing affordable distributed space systems with different basic characteristics. Distributed space systems with satellites carrying different payloads can for instance replace larger spacecraft providing also the potential of realizing performances and missions unachievable using the monolithic approach. After an introduction to the different concepts of distributed space systems like inspection and docking systems, formation flying, satellite constellations and spacecraft swarms, the paper concentrates on constellations and formations. Their widespread possibilities are presented by means of example missions.

Finally, an outlook is given in terms of technology development and application areas.

Keywords:
small satellites, space research, space application, satellite constellations, satellite formations

References:
[1] R. Sandau (Ed.), International Study on Cost-Effective EaRTH Observation Missions, Taylor & Francis London/Leiden/New York/ Philadelphia/Singapore 2006, ISBN 10: 0-415-39136-9.
[2] M. D'Errico (Ed.), Distributed Space Missions for Earth System Monitoring, Springer New York, Heidelberg, Dordrecht, London, 2013, ISBN 978-1-4614-4540-1.
[3] Sir Martin Sweeting, Will entrepreneurs change the face of the EO space industry?, Proc. of the 10th International Symposium of the IAA on Small Satellites for Earth Observation, keynote paper IAA-B10_0000, Berlin, April 20-24, 2015.
[4] C. Underwood, S. Pellegrino, C. Bridges, J. Baker, Using small satellite technology to demonstrate the autonomous assembly of a reconfigurable space telescope (AAReST), Proc. of the 10th International Symposium of the IAA on Small Satellites for Earth Observation, paper IAA-B10_1502, Berlin, April 20-24, 2015.
[5] S. Neeck, The NASA Earth Science Program and Small Satellites, Proc. of the 10th International Symposium of the IAA IAA on Small Satellites for Earth Observation, keynote paper IAA-B10_0101, Berlin, April 20-24, 2015.

Section of Science and Technology

Ionospheric related research and development at the Geodetic and Geophysical Insitute

Veronika Barta[1]*, Tamás Nagy[1], Kitti Berényi[1], Gergely Pieler[2], János Kalmár[1], Károly Kovács[1], Gabriella Sátori[1], Árpád Kis[1], †Pál Bencze[1]

bartav@ggki.hu, nattomi@ggki.hu, Berenyi.Kitti@csfk.mta.hu, pielerg@gain.nyme.hu, kalmar@ggki.hu, kovacs@ggki.hu, gsatori@ggki.hu, akis@ggki.hu

[1] Geodetic and Geophysical Institute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of sciences, Hungary

[2] Institute of Informatics and Economics, University of West Hungary, Hungary

The variations in the electron density and the height of the different layers of the ionosphere are measured by the ionosondes from which a series of short-wave radio pulses are transmitted, typically in the frequency range of 1–15 MHz. The reflection occurs when the plasma frequency of the ionospheric electrons equals to the radio frequency. The intensity of a layer is parameterized by the peak plasma frequency (ordinary mode: foE, foEs, foF1, foF2) which is a measure of the maximum ionization of the layer. The height of a layer is inferred from the time-of-flight of the radio pulse. The VISRC-2 digital ionosonde has been installed at the Nagycenk Geophysical Observatory, Hungary in 2007. The following measurements are performed: vertical sounding in every 15 minutes, oblique sounding in the collaboration with the Space Research Centre, Warsaw. Additionally an automatic and semi-automatic ionogram evaluation software have been developed in the recent years [1], [2].
Using the data of the ionosonde the variation of the electron density and the heights of the different ionospheric layers have been investigated. The troposphere-ionosphere electrodynamic and mechanical coupling mechanisms have been studied analyzing denser sampled ionosonde measurements during two thunderstorms passing through the Czech Republic on 20th of June, 2013 (18:00–24:00), and the West part of Hungary on 30th of July, 2014. (11:00-24:00). During these times ionograms were

* corresponding author

recorded every minute in Pruhonice and every two minutes in Nagycenk. In addition, transient luminous events (TLEs) were also observed in both nights. The ionosonde observations show peaks of ionospheric fmin values to have occurred more frequently and with higher amplitudes mostly in the period of sprite occurrences. Moreover, no sporadic E layer (Es) activity was detected during those hours. Further analysis of the observations indicate that the reduction of the critical frequency of Es is likely attributable to the thunderstorm activity [3].
The effect of geomagnetic storms on the different layers, especially F layer of the ionosphere have been studied in wintertime. The geomagnetic disturbances have been classified according to their strength and the ionospheric data has been analyzed in the case of different storms. The results showed significant differences between the peak plasma frequencies of the F layer (foF1, foF2) on quiet and strong stormy days [4].

Keywords:
ionospheric sounding, ionosonde, ionogram evaluation software, troposphere-ionosphere coupling, geomagnetic storms

References:
[1] J. Kalmár, The separation and approximation of ionogram curves with parabola and hiperbola, Hungarian Space Forum 2015, Sopron, Hungary, 07. 05. 2015- 09. 05. 2015 Presentations summaries. p. 38., (ISBN:978-963-7367-07-6), [publication in Hungarian]
[2] Pieler G., Development of a computer application supporting the filtering and analyzing of ionogram data, Msc Thesis, Institute of Informatics and Economics, University of West Hungary, Sopron, Hungary, 2015, [publication in Hungarian]
[3] V Barta, D Buresova, J Chum, G Sátori, P Bencze, J Bór, H D Betz, Thunderstorm - lower ionosphere relationship as shown by ionograms recorded at Pruhonice in two summer campaigns of 2013, In: 2nd TEA-IS Summer School. Collioure, France
[4] K. A. Berényi, The study of the state of Earth's ionosphere in the function of geomagnetic activity, Thesis, Geophysics Msc, Space Research - remote sensing specialization, Eötvös University, Budapest, Hungary, 2015, [publication in Hungarian]

The Communication and Spectrum Monitoring System of Smog-1 PocketQube-Class Satellite

Levente Dudás*, András Gschwindt
dudas@mht.bme.hu, gschwindt@mht.bme.hu
Department of Broadband Infocommunications
and Electromagnetic Theory,
Budapest University of Technology and Economics, Hungary

After the successful, almost three-years operation of the first Hungarian satellite, Masat-1, a group of students at Budapest University of Technology and Economics had been started to develop a PocketQube-class satellite called Smog-1. The project is the educational continuation of whole-satellite development in Hungary, a cooperative work by students coming from the Faculty of Electrical Engineering and Informatics and from the Faculty of Mechanical Engineering.

Our aim is to monitor the digital video broadcasting terrestrial (DVB-T) signals around the world during the satellite path. The DVB-T transmitters on the Earth surface radiate a huge amount of radio frequency (RF) power. The majority of the radiated electromagnetic waves is lost power, because this ultra-high frequency (UHF) radio signal is able to go through the atmosphere and ionosphere causing electromagnetic smog. This is why the name of the satellite is Smog-1. This lost power is heating the space and causing electromagnetic disturbances and interferences to the low-Earth-orbit (LEO) satellites including cubesat- and PocketQube-class satellites.

In 2014, there were four experimental spectrum-monitoring in-situ measurements flown by high altitude meteorological balloons (HAB). The flown hardware consisted of simplified and preliminary subsystems - spectrum-monitoring, communication, on-board computer and electrical power – of the future Smog-1 satellite.

In accordance with the measurement results of these HAB flights, the signal of the DVB-T transmitters can be measured in high altitude ranges with very high power level. If the effective radiated power to the main direction of the DVB-T antenna is 100 kW, the measured power level in 20-30 km altitude ranges is between 1-20 kW (from e.g. Széchenyi-hill DVB-T transmitter).

Smog-1 is a PocketQube-class satellite, which means a 5x5x5 cm cube sized satellite with less than 175 g mass. There will be several subsystems on-board the satellite: electrical power system (EPS), on-board computer (OBC), communication system (COM), spectrum-monitoring system (SP) and total-dosimeter as payload. With the spectrum-monitoring system of Smog-1, a global UHF band electromagnetic smog map can be recorded around the Earth on a LEO (approx. 600 km) sun-synchronized circular orbit.

---

* corresponding author

All of Smog-1 subsystems are designed to be single-point failure tolerant, so at least two EPS, OBC, COM and SP will be on-board. All subsystems have their own intelligence realized by local micro-controllers, but the OBC will control the whole operation of Smog-1.
The incoming average DC power of Smog-1 is calculated as 300 mW (caused by the limited 46x46 mm solar panel surface), with 500 mW in peak. The measured total efficiency of the COM will be 33 % working on the 437 MHz radio amateur band. So, the maximal effective radiated RF power can reach 100 mW from a quasi-semi-directional communication on-board antenna. Due to the limited RF power of the satellite and the long distance, the received RF power on the ground station will be very weak. Usage of a high-gain antenna on the satellite is impossible, because its almost random movement in the orbit and the limited size and mass. So sufficient controlling ground stations (GS) are necessary to be able to receive and control the satellite.
There are two remote controlled and automatized ground stations: the primary one is on the top of building "E" (its call-sign is HA5MRC) and there is a secondary one in Érd (HA7WEN). These ground stations contain hardware and software defined radios and more than 100 W UHF RF power with high-gain antennas: building "E" has a 4.5 m diameter parabolic reflector based aperture antenna, Érd has 17 element cross-Yagi antennas, both of them with circular polarization.
The radio-amateur call-sign of Smog-1 is HA5BME. According to the frequency-coordination request of our PocketQube, the licensed bandwidth is 20 kHz for down-link and 12.5 kHz for up-link meaning 13 333 bit/s and 8 333 bit/s maximal data rates respectively in case of 2-GMSK modulation. The allocated center frequency is 437.345 MHz (70 cm UHF band).

Keywords:
PocketQube, Smog-1, UHF-radio, spectrum-monitoring

References:
[1] Dudás Levente , Szűcs László , Gschwindt András, The Spectrum Monitoring System of Smog-1 Satellite, 14th Conference on Microwave Techniques, COMITE, Pardubice, Csehország, pp. 143-146
[2] Levente Dudás , Levente Pápay , Rudolf Seller, Automated and Remote Controlled Ground Station of Masat-1, the First Hungarian Satellite, Radioelektronika, 24th International Conference, Bratislava, Slovakia
[3] Levente Dudás, Lajos Varga, Masat-1 COM, Antenna Systems & Sensors for Information Society Technologies COST Action IC0603, Dubrovnik, Croatia
[4] Proakis, Digital Communications, McGraw-Hill Higher Education, 2005
[5] Roddy, D, Satellite Communications, Fourth Edition, McGraw Hill Higher Education, 2006

Psychology – Language Technology – Space Research

Bea Ehmann*, László Balázs
ehmann.bea@ttk.mta.hu, balazs.laszlo@ttk.mta.hu
Institute of Cognitive Neuroscience and Psychology,
Research Centre for Natural Sciences,
Hungarian Academy of Sciences, Hungary

Since the existence of the International Space Station and at the dawn of manned interplanetary voyages, psychology has a rapidly emerging role within life sciences in space research. Beyond engineering constraints, physical and habitability stressors, such as microgravity, ionizing radiation, vibration, and so on, many psychological issues have been identified and studied in the recent decades. These include isolation, confinement, monotony, cognitive impairment, personality conflicts, leadership problems, etc. [1,2]. These psychological problems have been broadly studied for nearly a hundred years in small groups working in terrestrial isolated, confined environments, mostly in in Polar Regions, for example, among Antarctic winteroverers; and recently in space analog simulations, for example in the Mars-500 experiment in Moscow. The lessons of these studies form the basis of psychological countermeasures for future manned flights into the Deep Space.

The aim of the presentation is to report on our research on the distant monitoring of psychological states and processes of isolated small groups by the use of multilingual, automatized, Natural Language Technology (NLP)-based psychological content analysis methods, originally developed in our Institute in the recent years.

Our first project was the HungaroMars in 2008. We analyzed personal diaries written in Hungarian language by a crew of six Hungarian volunteers (five males and one female) who spent two weeks on the Mars Desert Research Station operated by the Mars Society in Utah, USA [3].

Our second project was our cooperation with the Institute for Biomedical Problems (IBMP) in the Mars-500 space analog simulation in Moscow. With considerable participation of the European Space Agency, this simulation modeled a travel to Mars, the landing, and the return to the Earth with an all-male international crew (3 Russians, 2 Europeans, and 1 Chinese) who spent a total of 520 days, from June 2010 to November 2011, in the facility. Our research team worked together with the Russian Partner Institute in the psychological content analysis of the English and Russian language communication between the Crew and the Mission Control [4].

Our third, present activity is the analysis of English, French, and Italian language video diaries of three subsequent winterovering crews in the Concordia and Halley VI Research Stations at the Antarctica, in the scope of the COALA/CAPA ESA Project.

---

* corresponding author

In the presentation, we discuss the theoretical background and the main types of psychological content analysis, with special focus on our automatic, multilingual, corpus linguistic methodology. We demonstrate our main results obtained in the respective projects with the psychological constructs of Crew Autonomy, Team Spirit, Emotionality, Time Consciousness, and Achievement Motivation [5].
NLP-based content analysis is flexible, repeatable, controllable and statistically analyzable; analyses can be standardized and refined with accumulating space psychological knowledge; and, finally, crews cannot habituate to it, cannot control their communication for dozens or hundreds of direct and indirect psycholinguistic markers. In the future, these and similar efforts may contribute to the development of objective, non-invasive, fully automatized, onboard content analysis systems for real-time terrestrial Mission Control monitoring of psychological states and processes of crews in the Deep Space.

Keywords:
Psychology, Content Analysis, Natural Language Technology, Isolated Groups, Space Analog Environments

References:
[1] Kanas, N. & Manzey, D. (2008): Space Psychology and Psychiatry. Kluwer Academic Press, Dordrecht, The Netherlands
[2] Balázs L., Barkaszi, I., Czigler, I. & Takács, E. (2015): Agyműködés súlytalanságban: Kísérlet a Nemzetközi Űrállomáson. Magyar Tudomány, 9, 1045–1052. [Brain Function in Microgravity: An Experiment at the International Space Station, in Hungarian]
[3] Ehmann, B., Balázs, L., Fülöp, É., Hargitai, R., Kabai P., Péley, B., Pólya, T., Vargha, A., & László, J. (2011): Narrative Psychological Content Analysis as a Tool for Psychological Status Monitoring of Crews in Isolated, Confined and Extreme Settings. Acta Astronautica, 68 (9-10) 1560-1566.
[4] Gushin, V., Shved, D., Vinokhodova, A., Vasylieva, G., Nitchiporuk, I., Ehmann B, & Balazs, L. (2012). Some psychophysiological and behavioral aspects of adaptation to simulated autonomous Mission to Mars. Acta Astronautica, January–February 2012, Pages 52–57
[5] Ehmann, B., Balazs, l. (2015): Concordia Antarctica winteroverers: psychological content analysis of weekly video diaries. IAA-HIS-15 Abstract Book. Prague, Czech Republic. 2015.06.29-2015.07.03. Prague: 2015. p. 79.

Using Multi-hop Sensor Networks on the Surface of Solar System Bodies

Árpád Huszák[1*], László Bacsárdi[2]
huszak@hit.bme.hu, bacsardi@inf.nyme.hu
[1] Department of Networked Systems and Services,
Budapest University of Technology and Economics, Hungary
[2] Institute of Informatics and Economics,
University of West Hungary, Hungary

There are several solutions to discover and continuously investigate a selected area on a surface of a Solar System body, which are based on expensive devices and sometimes on human monitoring. Instead of complex and expensive robots, we propose to deploy high number of cheap mobile sensor devices on the orbital planet surface to make the exploration more effective. These sensors form a multi-hop network and communicate with each other offering many challenges from communications point of view. The sensor network can be used on surface of distant planet for different measurement and exploration. In this work, we examined a possible sensor network in area of Mars, including some surface factors (sandstorm, craters, dunes), which have influencing effect on positioning and energy management of network elements. Sensors are able to perform different measurements (e.g., radiation detection, atmospheric measurement, magnetic field measurement), visual recording. In addition, there are some higher power sensor, which can communicate with control center on the Earth and forward the common data.

Sensor devices were already used to explore and analyze the bottom of oceans or even active volcanos [1], but utilizing mass of sensor devices for distant planet exploration can be also very promising. In most of the cases the accurate position of the sensors is also needed. Several localization scheme exist based on triangulation (AOA) or trilateration (TOA, TDOA, RSS) [2], however, all the positioning systems assume that reference points exist is the network with precisely known coordinates. Recursive positioning [3], [4] is an alternative solution that can increase system coverage iteratively, as nodes with newly estimated positions join the reference set.

In most space missions, the localization of each node is essential in order to know where each measurement has been made. But without energy, no communications nor positioning is possible. In case of recursive positioning the number stalled sensors reduces the overall positioning accuracy. In this work, our goal was to show how an energy efficient analyses of a sensor network can be performed in a space-based environment and what types of key questions should be identified and answered. We developed a C++ program for simulation, which models the behavior of a sensor net-

* corresponding author

work, its recursive positioning method on the area of Mars and energy consumption efficiency. For this reason, the state diagram of the energy consumption of sensors was defined. The movement, communication, measurements and measurement processing entail energy loss, however these activities will be performed only if the energy level of given sensor is high enough. In order to ensure that the sensors are useable in a long term interval, external resources are needed, which are able to reload the accumulators. In case of sensors with solar cell, this external resource is the Sun.
In the simulated environment every sensor starts its movement from a common start point and they have to reach a predefined endpoint or target point. These analyses were made in the function of accumulator capacity. We examined how much time is necessary to reach the target point of the simulation, if lower capacity accumulators are used. As a result, we got an upper estimate for accumulator capacity, but we were interested in the minimal value as well. Thus, the change of positioning error value in function of accumulator capacity was also analyzed.
We utilized the concept of a sensor network which consists of large number of simple sensors moving on the surface of a distant solar system body. A complex framework was developed to analyze the movement, positioning and communication in such a network.

Keywords:
sensor networks, space communications, energy efficiency

References:
[1] G. Werner-Allen, K. Lorincz, et al., “Deploying a wireless sensor network on an active volcano,” IEEE Internet Computing, vol. 10, no. 2, pp. 18–25, 2006.
[2] I. Amundson and X. D. Koutsoukos, “A Survey on Localization for Mobile Wireless Sensor Networks”, R. Fuller and X.D.
Koutsoukos (Eds.): MELT 2009, LNCS 5801, pp. 235–254, 2009,
[3] J. Albowicz, A. Chen, and L. Zhang, “Recursive position
estimation in sensor networks”. In IEEE Int. Conf. on Network
Protocols, pp. 35–41, Nov 2001.
[4] A. Szeile, A. Huszak and L. Bacsardi, “Advanced Sensor Based Positioning and Monitoring System”, Global Space Application
Conference (GLAC 2014), Paris, France, 2-4 Jun 2014.

Comparison of algorithms using spherical harmonic analysis – the BME-SHS program

Márton István Kemény[1]*, Lóránt Földváry[2]
kemeny.marton@epito.bme.hu,
foldvary.lorant@amk.uni-obuda.hu
[1]Department of Geodesy and Surveying,
Budapest University of Technology and Economics, Hungary
[2]Alba Regia Faculty of Technology Institute of Geoinformatics,
University of Óbuda, Hungary

The aim of the inquiry is the development of optimal proceedings for the determination of the spherical harmonic coefficients of the gravity potential field of the Earth. The proceedings were performed according to the least squares method, during that we analyzed the application, and efficiency of different matrix-inversion algorithms (like Gauss-Jordan elimination, LU decomposition, singular value decomposition, Cholesky decomposition). For purpose of later program development the investigation has been performed in C++ programming language, which is able to handle large data systems. We performed the analysis on the data derived from the EGM08 gravity potential model by synthesis, which served as the accuracy investigation's base of comparison.

The computational program for spherical harmonic analysis, called BME-SHS (Budapest University of Technology and Economics – Spherical Harmonic Solver) is now able to compute the spherical harmonic coefficients for as large number of order as the memory of the computer allows us. We performed the validation of the program as executing spherical harmonic analysis and synthesis several times one after another (at first synthesis on the spherical harmonic data, then analysis on the received spatial data, and then iterating this process), and after that we examined the difference between the first and the received data system. The difference was as little as we expected, less than 0.00000001 percent after three times of iteration.

The analysis program is able to calculate coefficients till degree and

* corresponding author

order depending on the memory of the computer, as the number of order can either be 100 or more. The program is able to handle ten types of the spatial quantities of the potential field: the 6 independent elements of the Eötvös- (Marussi-) tensor, the potential field, the gravity anomaly, the geoid undulation, the gravity disturbance, compute them in the spatial domain and calculate the coefficients from them.

We use other techniques to calculate coefficients to compare them with the most common least squares method, such as semi-analytical and PCGMA method. These algorithms use the fact that the normal matrix of the problem is a sparse matrix, so the memory efficiency and the rapidness of the calculation can be developed. However, this is a question that the results will be enough accurate with the above mentioned methods, or they lose more of their precision than it is permissible with the presumption that the normal matrix is a sparse matrix.

Keywords:
Geodesy, Satellite gravimetry, Geoid height calculation, BME-SHS, Spherical harmonic analysis

References:
[1] Barthelmes F (2009): Definition of Functionals of the Geopotential and Their Calculation of the Spherical Harmonic Models. Scientific Technical Report, STR09/02, Revised Edition, January 2013
[2] Földváry L (2004): A 2000-es évek első évtizede: A gravimetriai műholdak korszaka. Magyar Geofizika, 45(4) [in Hungarian]
[3] Krasbutter I. et al (2011): Refinement of the stochastic model of GOCE scientific data in a long time series. in: Ouwehand, L. (eds.) Proceedings of the 4th International GOCE User Workshop, ESA Publication SP-696, ESA/ESTEC
[4] Mughal A.M. et al (2006): Computational Algorithm for Higher Order Legendre Polynomial and Gaussian Quadrature Method. Conference paper: Proceedings of the 2006 International Conference on Scientific Computing, CSC 2006, Las Vegas, Nevada, USA, June 26-29
[5] Rummel R. et al (1993): Spherical harmonic analysis of satellite gradiometry. Neth. Geod. Comm., Publications on Geodesy, 39, Delft, the Netherlands

Quantum-based solutions in Low Earth Orbit Satellite Networks

András Kiss*, László Bacsárdi
kissa@gain.nyme.hu, bacsardi@inf.nyme.hu
Institute of Informatics and Economics,
University of West Hungary, Hungary

The quantum computing is one of the most promising subfield of the Information Technology due to the quantum-based algorithms and protocols. These algorithms are significant different from the classical algorithms, which are used in classical computation. An important property of the quantum algorithms is the quickness of the paralleling, it has a big advantage in factorization and encryption [1].

Satellite communications could benefit from the advantages of the communication theory based on quantum mechanics [2]. The quantum key distribution (QKD) is based on the laws of quantum mechanics and offers the possibility of a key exchange process which cannot be attacked or eavesdropped without the notification of the communication parties, since any attempt of eavesdropping the key will disturb the quantum states revealing the presence of an eavesdropper. The result of the exchange process is a classical string of bits, which can be further applied in nowadays used symmetrical coding protocols. This means that QKD could enhance the security of our existing systems. There are two groups of the currently used quantum key distribution (QKD) solutions. The first generation protocols use singe-photon sources, while coherent laser is used and the wave properties of light is exploited in the second generation protocols. This first approach is named as Discrete Variable QKD (DV-QKD), the second one is named as Continuous Variable QKD (CV-QKD).

The use of QKD is limited in wired networks due to the physical properties of the optical fiber. But using free-space solutions like satellite systems, the quantum communication should be able to realize key exchange over long distances [3]. In 2006, the distance of 144 km was reached by an international research group. In 2008,

---

* corresponding author

Italian researchers reported the experimental implementation of single-photon exchange between a ground station and the LEO satellite Ajisai [4]. (The satellite's orbit has a perigee height of 1,485 km.) In the last years, several studies dealt with laser-based space communications, but the quantum-based communications is still an unrealized technique in the satellite communications.

Our aim is to analyze the quantum-based space communication in optical satellite communication. The QKD-based satellite networks offer revolutionary solutions for the near future since a complex, satellite-based network could enable a global quantum key exchange service.

Due to the nature of quantum-based protocols, the noise of the channels need to be estimated since the errors introduced by an eavesdropper could be masked by the natural noise of the channel. With our model based on the behavior of single-photon sources, we are able to analyze the effects of losses originated from beam spreading and pointing error on the first generation QKD protocols. Several parameters need to take into account while calculating the Quantum Bit Error rate (QBER) of a complex communication network. To help the calculation, a simulation platform was developed in Java language to simulate ground–satellite and satellite–satellite communication. We studied different QKD protocols which can be used in Low Earth Orbit.
The research was supported by the Hungarian Scientific Research Fund – OTKA PD-112529.

Keywords:
quantum communications, satellites communications

References:
[1] S Imre, "Quantum Computing and Communications - Introduction and Challenges" COMPUTERS & ELECTRICAL ENGINEERING 40:(1) pp134-141 (2014).
[2] L. Hanzo, H. Haas, S. Imre, D. O'Brien, M. Rupp and L. Gyongyosi: Wireless Myths, Realities, and Futures: From 3G/4G to Optical and Quantum Wireless, Proceedings of the IEEE, Volume: 100 , Issue: Special Centennial Issue, pp. 1853-1888.
[3] L. Bacsardi. „On the Way to Quantum-Based Satellite Communication", IEEE Comm. Mag.51:(08) pp. 50-55. (2013)
[4] P. Villoresi et al., "Experimental verification of the feasibility of a quantum channel between space and earth", New Journal of Physics, Vol. 10, No. 3, p. 033038, 2008.

Psychological status monitoring by acoustic-phonetic analysis of crew talk

Gábor Kiss*, Klára Vicsi
kiss@tmit.bme.hu, vicsi@tmit.bme.hu
Department of Telecommunication and Media Informatics,
Budapest University of Technology and Economics, Hungary

Our research, the Psychological Status Monitoring by Computerised Analysis of Language phenomena (COALA-phonetics, 1. October 2012.-30. September 2018) belongs to a big ESA Program: For Medical, Physiological and Psychological Research Using Concordia Antarctic Station as Human Exploration Analogue (AO-13-Concordia). The proposed experiment trace the process of psychological and physiological adaptation to the challenges of Antarctic environment by automated analysis of speech samples, in two Research stations: Concordia Station (organized by European Space Agency (ESA)) situated at 3,233 m above sea level where Cerebral hypoxia occur and Halley VI. Station (organized by British Antarctic Survey (BAS)) situated nearly at sea level, where the oxygen concentration in the air of the familiar. Both stations are in extreme circumstances for two reasons: the lack of sunshine and the isolation of the crew members.
Individual read speech and diaries are collected regularly from the crews. State of the art speech technology is used for processing and analysis of acoustic-phonetic characters of speech as a function of the psychological and physiological condition of crews.
The following aspects are monitored: Cerebral hypoxia, Seasonal Affective Disorder (SAD).
We have two hypotheses:
1. SAD will be reflected in speaker prosody parameters, like stress, intonation, vocalization/pause ratio and rhythm. The machine-learning classifier trained on clinically depressed and normal patients will discriminate crewmembers developing severe depressive symptoms [1].
2. Hypoxia primarily modifies the acoustic-phonetic-parameters of articulation: Compared to the baseline measures Prolonged Voice Onset Time and increased vowel duration should be present in the early period. In some crew-members these markers will remain different from baseline for an extended period associated with a decline in general health status [2].
Our main aim is the development of a metric that alert crews at early stage of cognitive dysfunction (automatic detection) on the base of their speech. For that purposes the examination of the sensitivity of acoustic-phonetic parameters of speech to hypoxia and to SAD is necessary using large and well-constructed databases of different languages [3]. Thus Speech data is collected from all crews using their mother tongue, signed up for the study in every two weeks during their stay at the two research stations. This way

* corresponding author

the inflections due to hypoxia and occasional occurrence of SAD symptoms can be monitored.
Baseline data is collected in normal circumstances once before arrival as well as one month after departure from Antarctica.
Parallel with the data collection in the Concordia Station and Halley Station another data collection is also necessary from the SAD patients in normal atmospheric conditions, practically in a consulting room of the doctors. This database is necessary for the development of a good metric to detect SAD. Certainly, speech recording is necessary in symptomatic as well as in symptom free period of the same patient, for seeing the differences between the examined parameters. At the recording Beck Depression Inventory (BDI) score (given by the doctors) is used to classify each recordings into categories of severity. Correlation between this severity core of depression and the change of the acoustic-phonetic parameters is examined.
We have already found some speech parameters which show significant difference between healthy and depressed speech: pitch frequency (f0), range of f0, range of intensity, the first and second formants, jitter, shimmer, articulation rate, length of pauses, and rate of transients. We have some early results in the detection of hypoxia possibilities. We are examining the language dependency of SAD, and we have found that, SAD may be detected in language independent way too.

Keywords:
Seasonal Affective Disorder, depression, hypoxia, speech processing

References:
[1] G Kiss, K Vicsi: “Physiological and cognitive status monitoring on the base of acoustic-phonetic speech parameters”, In: Lecture Notes in Computer Science: Statistical Language and Speech Processing. Grenoble, France, 2014. pp. 120-131.
[2] G Kiss, D Sztahó, K Vicsi, A Golemis: “Connection between body condition and speech parameters - especially in the case of hypoxia”, In: 5th IEEE International Conference on Cognitive Infocommunications: CogInfoCom 2014. pp. 333-336.
[3] Gábor Kiss, Miklós Gábriel Tulics, Dávid Sztahó, Anna Esposito, Klára Vicsi: “Language Independent Detection Possibilities of Depression by Speech”, In: “Recent Advances in Nonlinear Speech Processing”

Design Aspects of Future Astrochemistry Nano-Satellite Mission above LEO

Gábor István Varga*
gabor.varga@esa.int
TERMA@ESOC, Germany

Nano-satellite platforms (or Cubesats) offer a reliable and low-cost method to perform small scientific experiments or technological demonstrations in Low Earth Orbit (LEO) [1]. There are well-established and tested commercial off-the-shelf components to choose from that expedite the design and manufacturing process. Therefore, the time from initial design to commissioning is greatly reduced compared to dedicated developments.

Astrobiology experiments already exist [2] but the feasibility study of using medium to high Earth orbits (MEO, HEO) is justified by the scientific demand of investigating the high-radiation environment present at this altitude range. Piggyback launch opportunities are numerous in these cases, as geostationary satellites are relatively frequently added and replaced. With initial geostationary transfer orbit (GTO), the nano-satellite would spend considerable amount of time at high altitudes that facilitates examining the effect of radiation on chemical or biological samples. This is essential on our way to permanently extend the human exploration range above LEO in the future.

The additional challenges that come with such a mission require deep investigation regarding all the subsystems of the satellite. The power budget is tight, thus the placement of the solar arrays are critical. The power system needs to tolerate medium to long eclipses of possibly several hours, which is not present at lower altitudes, thus a well-sized battery is to be included. At the same time, the mass budget has to be met as well. Crossing the radiation belts also expects adequate shielding, that continues to contribute to the final mass. Communications is restricted to a minimum and maximum altitude range. Below a certain altitude it is hard to keep track of the spacecraft since the perigee velocity is higher than usual, whereas at high altitudes the data rate diminishes quickly without

---

* Mission Analyst, TERMA on behalf of ESA-ESOC HSO-GFA Mission Analysis Section

high-gain antennas. De-orbiting of the spacecraft also has to be taken care of to comply with space debris mitigation requirements [3].

The modified technical requirements need assessment. The current work is related to the mission analysis aspect with focus on eclipse duration, de-orbit lifetime, radiation dosage and ground station communications.

Keywords:
cubesat, HEO, astrochemistry, mission analysis

References:
[1] Elsaesser A., S. F. (2014). Organics Exposure in Orbit (OREOcube): A next-generation space exposure platform. 40th COSPAR Scientific Assembly. Moscow.
[2] G. Horneck, E. R. (2011). The EXPOSE-R Experiment ROSE-3 SPORES in artifical meteorites. European Planetary Science Congress. Nantes.
[3] ESA. (2011). Space Debris Mitigation for Agency Projects. ESA.

Application of the Fleet of Micro Sized Space-Motherships (MSSM) Deploying Nano, Pico Space Devices and Robots (NPSDR) in Space

Pál Gábor Vizi
vizi.pal.gabor@wigner.mta.hu
Wigner RCP, Hungarian Academy of Sciences, Hungary

Nowadays technology allows us the application of the fleet of Micro Sized Space-Motherships (MSSM) carrying and deploying Nano, Pico Space Devices and Robots (NPSDR) in space activities e.g. the domain of space weather, space climate and solar system observation. This means a smaller, cheaper and more efficient technology.
The application of the NPSDR focuses on detections and measurements which can be carried out with a new strategy, i.e. a multiple and parallel use of these instruments. The great number of NPSDR cubic centimetre sized devices allows larger surfaces covering on the planet or fulfilling bigger volume in the Cosmos and measuring several focused parameters. [1][2].
New devices in wide scale of shapes and sizes applicable to use for space missions, e.g. reduced MSSMs (jet-carrier analogue) nearly cube decimetres, are to carry and distribute fleet of nano probes of NPSDRs as sensor ships. NPSDRs are different shaped according to target and with wide spectrum of possible independent or more multiplied sensors - fleet of analytical sensor ships – and with reduced smart telecommunication systems. In case of MSSMs for NPSDR sensor probes, it is enough to communicate with motherships, which gather, pack and transmit the collected data towards to Earth.
The small units should be equipped by sensors for signal about different features from the particle detectors through space weather sensing to the primitive life forms.
NPSDRs can be environmentally friendly because of their structure. It can contain only environmentally friendly resources as far as structure and content are concerned. Natural materials as e.g. in the cosmic and terrestrial abundances of elements and isotopes which naturally and frequently fall from the space e.g. meteorites and cometary dust.
Meteorite like landing: In case of an asteroid they can be reached by lower difference of speed between probes and target in orbit. In case of the bigger gravity the bigger accelerating force affect is from the Sphere Of Influence (SOI) of a planet or a moon. To reach a surface of a planet braking is necessary. In case of atmospheres aerobraking is possible. This braking we may use in cases of meteorite like probes. In case of a container probe aerobraking methods are solved. In case of individual small probes there is a promise to calculate the entry and braking from meteoritic studies also. During aero brake the lagging behind fragmentation catches the heat and the remaining inner part can be kept in cooler temperature. Additional

possibility comes from nanotechnology at bit of drills. Nano layer coatings at top of the bits are elongating their life eight times, and can insulate the inner important body from the high temperature. [3]
Our department involved in several successful Solar System deep space missions:
- VEGA missions to Venus and Comet Halley: Imaging and Tracking System.
- NASA's Cassini mission: EGSE for particle detector system (CAPS) and magnetometer (MAG) and physical analysis of the data.
- International Space Station: Distributed Computing System of the Plasma Wave Complex.
- Rosetta Lander Philae: Central data acquisition and control computer [4] The Command and Data Management System mass is 2.9 kg in total, doubled redundancy in hardware, 10 years in space and successful operation during an unexpected jumping.
- EXOMARS: orbiter's camera software.
- JUICE: Jupiter icy moons the power supply solution.
MSSMs with NPSDRs show how to increase the possibilities of earned data in shorter time and in bigger field of surfaces or volumes of space to be measured and discovered. Fleets of NPSDRs are deployable to realize and to accomplish in situ modern analytical methods in wide range of space sciences based on our recent activities.

Keywords:
micro, nano, pico, space technology, research

References:
[1] Vizi, P.; Horváth, A.; Hudoba, Gy.; Bérczi, Sz.; Sik, A. 'Lump Sugar and Salt Shaker'-Like Nano and Pico Space Devices and Robots 2012LPICo1683.1122V;
[2] Vizi, P. G.; Dulai, S.; Marschall, M.; Bérczi, Sz.; Horváth, A.; Hudoba, Gy.; Pocs, T. (2013): Possible Identification Method for Martian Surface Organism by Using a New Strategy of Nano-Robots. 44th Lunar and Planetary Science Conference #2281.
[3] Vizi P. G., Horváth, A., Hudoba Gy., Bérczi Sz., Sik A.: Meteorite Like Nano and Pico Space Devices and Robots and the Polar Region of Mars (29-M-7), The Third Symposium on Polar Science, The 34th Symposium on Polar Biology, www.nipr.ac.jp/symposium2012/program/Met/ E34_M_PalVizi_2.pdf
[4] Trotignon JG, Bostrom R, Burch JL, Glassmeier KH, Lundin R, Norberg O, Balogh A, Szego K, Musmann G, Coates A, Ahlen L, Carr C, Eriksson A, Gibson W, Kuhnke F, Lundin K, Michau JL, Szalai S: The ROSETTA Plasma Consortium: Technical realization and scientific aims; ADVANCES IN SPACE RESEARCH 24:(9) pp. 1149-1158. (1999)

Space weather research and forecast services using CubeSats

Balázs Zábori*,[1], Attila Hirn[1], Sándor Deme[1], Tamás Pázmándi[1], Gyula Horváth[2], István Apáthy[3], Zsolt Várhegyi[2]

zabori.balazs@energia.mta.hu, hirn.attila@energia.mta.hu, deme@aeki.kfki.hu, pazmandi.tamas@energia.mta.hu, gyula.horvath@c3s.hu, apathy.istvan@energia.mta.hu, zsolt.varhegyi@c3s.hu

[1]Centre for Energy Research, Hungarian Academy of Sciences, Hungary

[2]C3S Ltd., Hungary

[3]REMRED Technologies Ltd., Hungary

The research on space weather and its effects will be more and more important in the near future, as a continuous increase in human presence is in progress in the Near-Earth region and the technology dependency of the human civilization is becoming higher than ever mainly in the fields of energy and telecommunication systems. The radiation level in orbit may be two orders of magnitude higher than under the shield of Earth's atmosphere and magnetosphere. The disturbances generated by our Sun can reduce the shielding capability of the magnetosphere resulting significantly higher radiation intensity in the atmosphere of the Earth.

Generally the incoming primary cosmic rays (the Galactic Cosmic Rays originating from the Universe and the Solar Cosmic Rays originating from the Sun) interact with the Earth's magnetosphere and the atmosphere providing a complex radiation environment changing with the geomagnetic latitude [1]. One of the key indicators of the space weather is the cosmic radiation level, which can have significant influence on our everyday life through its possible effects on the technologies used. The influence on the energy and telecommunication systems is the most critical question; these systems need to be protected by a reliable forecast system about the space weather in the Near-Earth region. Additionally needs to be mentioned that space weather can have

* corresponding author

influences on the weather conditions of the Earth and thus the climate itself, which underlines the importance of space weather research. To study the space weather, as a first step, a detailed monitoring system needs to be built up to provide scientific data about the cosmic ray intensity level and the status of the magnetosphere in order to provide possibility for a reliable forecast database. Since the monitoring instruments are relatively small this kind of monitoring system can be realized using several CubeSats in the same orbit and in different orbits as well providing the possibility to monitor the cosmic radiation with sufficient statistics in the Near-Earth region. The Centre for Energy Research has a very long history in the research of the cosmic rays in the Near-Earth region and the development of radiation monitoring instruments [2].

The present paper provides a short overview about the space weather and its possible effects in the Near-Earth region, some past results from the cosmic ray and space weather research of the Centre for Energy Research [3] and a detailed study about the possible future use of CubeSats in space weather monitoring and forecast services.

Keywords:
space weather, cosmic rays, CubeSat

References:
[1] Schaefer, H. J., Radiation and man in space. Adv. Space Science 1, 267-339, 1979
[2] Pázmándi, T., Deme, S. Láng, E., Space dosimetry with the application of a 3D silicon detector telescope: response function and inverse algorithm, Radiation Protection Dosimetry, Vol. 120, pp. 401-404, 2006.
[3] Zábori, B., Hirn, A., Deme, S., Apáthy, I., Csőke, A., Pázmándi, T., Szántó, P., Space dosimetry measurements in the stratosphere using different active and passive dosimetry systems, Radiation Protection Dosimetry; doi:10.1093/rpd/ncv442, 2015

The study of the midlatitude ionospheric response to geomagnetic activity in Nagycenk in Széchenyi István Geophysical Observatory

K. A. Berényi[1]*, Á. Kis[2], V. Barta[3]
Berenyi.Kitti@csfk.mta.hu , akis@ggki.hu , bartav@ggki.hu
Geodetic and Geophysical Institute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of sciences, Hungary

Geomagnetic storms affect the ionospheric regions of the terrestrial upper atmosphere, causing several physical and chemical atmospheric processes. The changes and phenomena, which can be seen as a result of these processes, generally called ionospheric storm. These processes depends on altitude, part of day, and the strength of solar activity, the geomagnetic latitude and longitude. The differences between ionospheric regions mostly come from the variations of altitude dependent neutral and ionized atmospheric component, and from the physical parameters of solar radiation.

We examined the data of the ground-based radio wave ionosphere sounding instruments of the European ionospheric stations (mainly the data of Széchenyi István Geophysical Observatory), called ionosonde, to determine how and what extent a given strength of a geomagnetic disturbance affect the middle latitude ionospheric regions in winter. We chose the storm for the research from November 2012 and March 2015.

As the main result of our research, we could show significant differences between the each ionospheric (F1 and F2) layer parameters on quiet and strong stormy days. When we saw, that the critical frequencies (foF2) increase from their quiet day value, then the effect of the ionospheric storm was positive, otherwise, if they drop, they were negative. With our analysis, the magnitude of these changes could be determined. Furthermore we demonstrated, how a full strong geomagnetic storm affects the ionospheric foF2 parameter during different storm phases. It clearly showed, how a positive or negative ionospheric storm develop during a geomagnetic storm. For a more completed analysis, we compared also the evolution of the F2 layer parameters of the European ionosonde

* corresponding author

stations on a North-South geographic longitude during a full storm duration. Therefore we determined, that the data of the ionosonde in Széchenyi István Geophysical Observatory in Nagycenk are appropriate, it detects the same state of ionosphere like the European ionosondes. Also we studied the prominent phenomena (e.g. TIDs- Travelling Ionospheric Disturbances), and plasma irregularities (e.g. spread-F) in the ionosphere in the function of geomagnetic activity. As we compared the occurrences of TIDs and spread-F phenomena on the quiet days with their occurrences on moderate and strong stormy days, we can see significant correlation between the magnitude of the Ae-index and the daily number of the occurrence of TIDs, but at the same time there is no definite connection between the daily number of the occurrence of spread-F phenomenas and the intensity of geomagnetic activity.

Keywords:
ionospheric layers, ionospheric storms and phenomenas, geomagnetic storms, neutral winds, thermospheric-ionospheric composition disturbances

References:
[1] Buonsanto, M.J. (1999) Ionospheric storms – a review. Space Sci. Rev. 88, 563–601.
[2] Kane, R.P. (2005) Ionospheric foF2 anomalies during some intense geomagnetic storms, Annales Geophysicae, 23, 2487–2499.
[3] Prölss, G.W. (1995) Ionospheric F-region storms, in: Handbook of Atmospheric Electrodynamics, 2, edited by: Volland, H., CRC Press, Boca Raton, 195–248.

Section of Education and Outreach

Programs for talented students at the Hungarian Astronautical Society

László Bacsárdi, Sándor Frey*
bacsardi.laszlo@mant.hu, frey.sandor@mant.hu
Hungarian Astronautical Society, Hungary

The Hungarian Astronautical Society (abbreviated as MANT in Hungarian) is a civil organization, with its first predecessor established in 1956. The main missions of the Society include fostering cooperation between various actors in the Hungarian space research community, and raising public awareness about space exploration and applications by means of professional information dissemination.

Since the beginning of the 1990s, the emphasis has been gradually increased towards programs targeting young students aged between 11 and 18 years. The first space-related student competition calling for creative essays was announced in 1991. The competitions open to native Hungarian students living in the country or abroad are organized every year. The categories of the competition are much broader nowadays: apart from the essays, one can submit artworks (drawings, computer graphics), short videos or web pages [1]. The selected topics of the competitions vary from year to year. Individuals and small groups of students are also encouraged to apply. Occasionally, the Society played an active role in popularizing and organizing international space competitions for students in Hungary. We celebrated the 50th anniversary of the beginning of space age by a complex national student competition in 2007.

The history of the annual Hungarian Youth Space Camps [2] can be traced back to 1994. Since the very beginning, the main goal of the camps has been to introduce the space activities in general, the Hungarian space research establishments, and the researchers themselves to the participating students, in a hope to make such a career attractive for at least some of them [3]. The camps target students of 11–18 years of age. The program gradually changed over

* corresponding author

the years. By now, the leisure activities and excursions became as important as the professional lectures and teamwork. The Space Camp visited many different locations in Hungary over the past more than two decades. Special emphasis is made on the students' teamwork which spans the entire duration of the summer camp. The participants are divided into small groups that have to perform a complex task related to the main topic of the camp, based on the information obtained from the lectures, their own knowledge and creativity.

A telltale signature of the success of our education activities, the student competitions and the Space Camps, is that many participants from the 1990s and 2000s indeed chose a career in space-related science or engineering subjects. They already form the core of the new generation of the members and even the elected leaders of our Society. On the other hand, those who pursue a different career are equally valuable as they hopefully preserve their positive attitude to space.

Keywords:
space research, education, civil society, student competition, space camp

References:
[1] MANT student competition webpage, http://www.mant.hu/diakpalyazat (Last retrieved: Jan 27, 2016)
[2] MANT Space Camp webpage, http://www.mant.hu/urtabor (Last retrieved: Jan 27, 2016)
[3] Bacsardi L., Horvath M., “Unforgettable Memories in the Hungarian Space Camp – Lessons from 18 Years of Organization”, In: Proc. 62th International Astronautical Congress, Cape Town, South Africa, 2011

The Years of Comets 2013-2016, Comet Project in Budapest High Schools

Éva Gócz[1], Zsuzsa Horváth[2]*
goczeva@lonyay.edu.hu, hosu@pro.hu
[1]Lónyay Reformed Secondary Grammar School, Hungary
[2]Kosztolányi Dezső High School, Hungary

Comets are very rare sights in the sky for ordinary people, though these are always up there above in the sky. For our observation we need (huge) telescopes. We can see a comet if it gets closer to the Sun or to the Earth, but it happens very rarely. Since the early discovery of comet ISON we've decided that we are going to have a series of programmes for our students. We hoped that during this project our students will not only get real knowledge about comets but by observing comet ISON naked-eye they will enjoy a real astronomical adventure [1]. We also wanted to make our students to be more interested in Physics.

As an introduction of our comet project we measured the knowledge of our students about comets. Our students aged between 12-19 could take part in these programmes. For junior students, we offered drawing tasks about comets. From their drawings we could find out that our students do not have even basic scientific knowledge about the comets as they get their information from the mass media. The topics of their drawings were associated with the information which they got from the media, films, video-games, for example a comet approaching and threatening Earth, its tail pointing towards the Sun. We expect more knowledge from senior students, because in Geography curriculum they study the Solar System and the comets. We had a survey in which there were questions like these: "Have you ever seen a comet?; What is the size of comets?; What are they made of?; Why does a comet have a tail?; What is it made of and how dense is it?; Where are the comets that appear in the centre of the Solar System and near Earth from?" [2]. The survey showed they had little knowledge about the topic. Their answers were spontaneous and they had misconceptions.

* corresponding author

We organized activities outside and inside school. We visited the Planetarium, where we saw a spectacular presentation about comets. We had a joint project day, and we invited famous scientists (Béla Lukács and Pál Gábor Vizi). The main attraction of the day was making a model of a comet together. In the break-time the students of the two high schools talked in groups. They played comet puzzles, and completed comet quiz. Unfortunately, the ISON comet was destroyed near the Sun, and we could not observe it. Instead of watching ISON by ourselves we could watched videos of the "death" of the comet on internet [3].

Although we had not any spectacular comets in 2014 and 2015, these two years are very important because of comets, as well. We were planning to visit a comet, of course not personally, but with the help of the spacecraft called Rosetta, which was launched in 2004. We respect this comet project organised by ESA because Hungarian researchers, engineers also produced instrument for the spacecraft and for the lander called Philae. We followed this scientific project with our students. We were very excited when Rosetta woke up, and we followed the detailed pictures from the comet nucleus. We visited the Planetarium again, where we followed how Philae landed on the comet with some of Philae's designer engineers. After seven months of hibernation we were hoping that Philae would wake up again near the perihelion of the Comet 67P [4].

Not only did we teach properties of comets, but some of our students made a comet nucleus model, too. We are still following the Rosetta mission [4].

Keywords:
comet, education, misconceptions, Rosetta, Philae

References:
[1] NASA webpage: http://www.nasa.gov/mission_pages/asteroids/comet_ison/#.VqVHyln9zwg
[2] Hédervári Péter: Üstököskutatás az űrkorszakban. Magvető Kiadó, Budapest, 1983
[3] Gócz Éva, Horváth Zsuzsa: 2013-Az üstökösök éve, Üstökösprojekt két budapesti gimnáziumban, Fizikai Szemle, 2015/2
[4] ESA webpage: http://www.esa.int/Education/Teach_with_Rosetta/

Analogue work with ExoMars project: science-technology synergy and implementation to university education

Ákos Kereszturi
kereszturi.akos@csfk.mta.hu
Research Centre for Astronomy and Earth Sciences,
Hungarian Academic of Science, Hungary

Analogue research provides ideal method to connect scientific background, field activity, laboratory work [1], and also to support education related to space research. The ExoMars rover (EXM) mission aims to make the first drills on Mars down to 2 meter depth, and In ideal case confirm the probable occurrence of microscopic liquid water/brine on Mars, among other tasks. At the Research Centre for Astronomy and Earth Sciences analogue work related to the drills, subsequent laboratory analysis, and the preparation of the HABIT brine analyzer instrument is being done.
The Hungarian project COOP-NN-116927 (NKFIH) aims to realize analogue field and laboratory research to support the targeting and interpretation of the drills. During the project indicators ("smoking guns") are to be identified to infer formation conditions (especially the past action of liquid water) of sedimentary strata at Mars analogue terrains.

During the sample acquisition, in-situ, and later laboratory work are to be made by methods analogous to that of the EXM rover will do on Mars. The borehole wall is to be scanned by an optical-near-infrared camera (partly similar to EXM MaMISS equipment), the acquired sample is analyzed by optical NICON Eclipse E600 POL microscope (analogous to CLUPI equipment onboard EXM), infrared spectrometer Shimadzu UV-VIS-NIR 3600 (analogous to MicrOmega onboard EXM), joint Raman and particle analyzer facility Malvern Morphologi 3G ID - Malvern Zetasizer ZS 100 (analogous to RSL equipment onboard EXM).

Correlation between the laboratory and field facilities' data point to such indicators of the formation conditions, what EXM on the red planet should also focus. Outcrops nearby the drills at sedimentary strata in Hungary, Morocco, Tunisia and Iceland are to be used to

understand context, connect drilled and outcropped layers. The analysis of Mars relevant parameters helps to extrapolate to Martian conditions, outline mission scenarios, forecast ideal target selection [2], and optimize sampling intervals and instrument usage for EXM. The educational aspects are exploited at MSC and PHD courses at ELTE university, focusing on how the mission scenarios could be improved by analogue work. Technology aspects are supported by the optimized and simplified facilities. The realized parallel laboratory measurements support the extrapolation to formation conditions [3], using the mineral and sedimentary properties already learned during regular university courses. The conclusions on mission scenarios provide ideal ways to formulate applied technology and laboratory related aspects to a real mission.

Keywords:
planetary missions, surface exploration, ExoMars rover, analogue research.

References:
[1] Kereszturi A., Bradak B., Újvári G. 2015. Hogyan vizsgálhatnánk más égitesteket a Kárpát-medencében? Természet Világa 4, 172-175.
[2] Kereszturi A. 2012. Landing site rationality scaling for subsurface sampling on Mars—Case study for ExoMars Rover-like missions. Planetary and Space Science 72, 78 -90.
[3] Kereszturi A., Újvári G., Bradak B. 2014. Estimating the origin and transport process of grains expected to find during the drill of ExoMars rover mission. 45th LPS Conference, abstract 1496.

Space Generation in Hungary

Dorottya Milánkovich*, László Bacsárdi
dorottya.milankovich@spacegeneration.org,
laszlo.bacsardi@spacegeneration.org
Space Generation Advisory Council, Austria

Nowadays space exploration and humans in space is natural for humanity, however in our country the majority of young people do not know the opportunities in this field. For the young Hungarians who are interested in space, the international Space Generation Advisory Council (SGAC) could be the first step to get involved in the national and international space research and industry.
SGAC is a non-profit organisation established by the United Nations in 1991, that represents 18-35 year olds in international space policy at the United Nations, at agencies, in industry, and in academia.

The goal of this organisation with a volunteer network of more than 4000 members is to provide a dynamic forum in which students and young professionals can expand their knowledge of international space policy issues, build networks and think creatively about the future direction of humanity's use of space. Furthermore to present the student and young professional viewpoint around the world. They organise conferences, special projects and events, project groups and propose scholarships to the talented members.

In Hungary the SGAC in collaboration with the Hungarian Astronautical Society offer several possibility to the youth.
During the summer we organise the Hungarian Space Academy, which is a four-day-long program for university students and young professionals interested in space research.

The participants are working on a project in one of the most relevant and up and coming space topics. To assist with the participants' work, tutorial lectures were given by Hungarian professionals from industry and academy. The aim of the program

* corresponding author

is to develop and maintain a forum where the potential members of the next generation of the national space sector can access knowledge about the different space related opportunities, build relationships and work on a better future.

During the academy's year every second month the Space Academy Club is held in different universities in Budapest. It is a two-hour-long open workshop with two lectures with space topics followed by a free talk for university students and young professionals.

The SGAC members can also take part in the work of the international project groups throughout the year. The project groups are working on recent problems and possibilities in space, besides they prepare reports and recommendations to the United Nations Committee on the Peaceful Uses of Outer Space. In addition the members have the opportunity to participate in competitions sponsored by international space companies and organisations.

Keywords:
education, competitions, ages 18-35, Space Academy

References:
[1] Space Generation Advisory Council http://spacegeneration.org/ (Last retrieved: January 31, 2016)
[2] MANT Űrakadémia, http://mant.hu/urakademia (Last retrieved: January 31, 2016)
[3] Űrakadémia Klub, https://www.facebook.com/urakademiaklub/ (Last retrieved: January 31, 2016)

Activity of the EUMeTrain project

Mária Putsay*, Zsófia Kocsis
putsay.m@met.hu, kocsis.zs@met.hu
Hungarian Meteorological Service, Hungary

EUMeTrain is an international training project [1] sponsored by EUMETSAT to support and increase the use of meteorological satellite data.

EUMeTrain is a cooperation of six European National Meteorological Services to provide mainly online training in the field of satellite meteorology. The project started in 2004. The Hungarian Meteorological Service has joint EUMeTrain in 2014. EUMeTrain focuses on the provision of online training material and training courses complementing EUMETSAT's satellite programmes. EUMeTrain addresses to weather forecasters, students, and professionals in meteorology. The aim is to grant an easy access to training resources via the web browser and teleconferencing tools.

EUMeTrain organises Event Weeks, Weather Briefings and Courses on a wide variety of meteorological topics. For example in 2015 two satellite courses on 'Marine Meteorology' and two event weeks were organised on 'Convection' and 'Precipitation'.

The online presentations are transformed into video format (mp4) and stored in the resources library [2]. The online training material can be accessed any time. Several guides, manuals, training modules are published on the website. More than 300 training modules are presently in the resource library. The training materials include also interactive elements, like movies, tests, questionnaires.

The so-called 'e-port' [3] is a web visualisation tool. One can visualise 6 hourly satellite, radar and Numerical Weather Prediction (NWP) data from the recent years.

* corresponding author

Keywords:
satellite meteorology, EUMETSAT, training events, courses

References:
[1] http://www.eumetrain.org/
[2] http://www.eumetrain.org/resources.html
[3] http://www.eumetrain.org/eport.html

Ten Years of the Simulated Mars Rover Model Competition

Attila Sipos[1], Pál Gábor Vizi[2]*
siposattila@magyarokamarson.hu, vizi.pal.gabor@wigner.mta.hu
[1]Competition of Applied Engineering Sciences, Hungary
[2]Wigner RCP, Hungarian Academy of Sciences, Hungary

This is a report about the organization and management of the Simulated Mars Rover Model Competition events from 2006 to 2015.
Ideas: Challenge is the engine of evolution. The young grow old and the replenishment is needed. Knowledge doesn't bear with us. To empower skills can be speeded up by a forced evolution in competitions. Today's teenagers where get that little spark that can start them on the difficult but nice scientific course?
In every year we take significant effort to organize and realize this traditional competition of applied engineering sciences. Ten years of success - www.magyarokamarson.hu. ('Hungarians on Mars'). We presented in our earlier works (Sipos et al 2009-2015) [1,2,3,4,5] at 40th-46th Lunar and Planetary Science Conferences.
Simulation and Realization: Organizers and authors of this article prepared CGI and physical simulations of the dashboard, robots and race and presented them before the date of competitions. Importance for researching and developing is to reach the capability to supply a good emulation environment before any mission, first at our competition and next in a wide spectrum of space and planetary environments. The style of appearance is entertaining-educational to reach the attention of the possible younger competitors also and similar to a sci-fi trailer.
Missions: In all year the most important task is to command the robots with automatism. To become a winner can be reached only by an automatic device.
2006: The actual goal of the competition can be achieved by building a moving device (usually a rover) with manipulators. The track is an 8x8 square meter sized field of special material and tracks, different during years. Controlling of rovers was necessary behind of a folding screen and using a delay to simulate the distances between planets.
2006.: Competitors have to build a rover which starts from either corner of the field to reach the target crater at the opposite other corner and to collect debris or soil of the crater.
2007: Competitors have to search power cubes to collect energy across of field.
2008: Competitors have to collect fluid material.
2009: The goal of this year could be achieved by building an amphibian rover with sensors, manipulators and advanced communication.

---

* corresponding author

2010: To reach the target place and to read and send back to base a DNA sequence represented by a 16 character display and to collect soil, and to carry and put the specimen into the harbor where a space-elevator model is. The end of mission is to reach the top of the space-elevator.
2011: More than one rover was on the stage from this year due to the increased and large number of competitors and full mission time was not enough to complete the contest one by one. The mission was to reach and occupy marked places on one's own field and to try to occupy other marked places on the fields of other competitors, thus some robots had to be substituted by other robot.
2012: Spider like robots occupied pyramid like targets by "eggs" and pushed down other's eggs.
2013: Doubled wheel robots in a 8mx8m labyrinth putting magnet own eggs and collect from others.
2014: All skills just before but with hovercraft to simulate the micro gravitation in 2D.
2015. All skills just before, in addition robots were necessary to build in situ at the place and during the time of the competition from locally available materials.
Conclusion: Competitors have to be capable of designing, developing and constructing complex autonomous robots, and moving them by driving in order from wheel and caterpillar, through amphibians, elevator climbers, legs, balanced double wheels and air cushion.

Keywords:
education competition space model engineering

References:
[1] SIPOS,A., VIZI,P.G.: LPSC40 #2519 ; http://www.lpi.usra.edu/meetings/lpsc2009/pdf/2519.pdf
[2] LPSC41 #2649 ; http://www.lpi.usra.edu/meetings/lpsc2010/pdf/2649.pdf
[3] LPSC42 #2014 ; http://www.lpi.usra.edu/meetings/lpsc2011/pdf/2014.pdf
[4] LPSC 44 #2850 ; http://www.lpi.usra.edu/meetings/lpsc2013/eposter/2850.pdf
[5] LPSC 46 #2602 http://www.hou.usra.edu/meetings/lpsc2015/eposter/2602.pdf

Az oktatási és ismeretterjesztési szekció magyar nyelvű összefoglalói

Hungarian summary – section of education and outreach

Diákok tehetséggondozása a Magyar Asztronautikai Társaságnál

Bacsárdi László, Frey Sándor*

A Magyar Asztronautikai Társaság (MANT) egy közhasznú egyesület, amelynek első jogelődje 1956-ban alakult. Fő feladatai közé tartozik az űrkutatás, az űrtevékenység különböző területein tevékenykedő magyar szakemberek összefogása és a széles nagyközönségnek szóló, szakszerű tudományos ismeretterjesztés.

Az 1990-es évek elejétől kezdődően egyre nagyobb hangsúlyt kaptak a MANT tevékenységében a 11–18 éves korosztálynak, mint célcsoportnak meghirdetett rendezvények. Az első diákpályázatot, amelyen az űrkutatással kapcsolatos önálló írásművel vehettek részt a diákok, 1991-ben hirdettük meg. A pályázatokon mind magyarországi, mind a határainkon túl élő, magyar anyanyelvű diákok részt vehetnek. Az évente kiírt pályázatok műfajait azóta bővítettük, ma már többek között rajzokkal, számítógépes grafikai alkotásokkal, bemutatókkal, weboldalakkal és videókkal is lehet jelentkezni a versenybe – minden évben más-más kijelölt témakörhöz kapcsolódva [1]. A pályázók egyénileg és kis csoportokban is indulhatnak. A MANT az évek során aktív szerepet vállalt egyes nemzetközi szervezetek űrkutatási témájú pályázatainak hazai népszerűsítésében, lebonyolításában is. Az űrkorszak kezdetének 50. évfordulóját pedig 2007-ben többfordulós országos diákvetélkedővel ünnepeltük.

A fiatalok számára évente szervezett nyári űrtáboraink [2] története 1994-ig nyúlik vissza. A cél kezdettől fogva az volt, hogy megismertessük az érdeklődő fiatalokat az űrkutatással, a hazai intézményekkel és szakemberekkel, nem utolsósorban azért, hogy a résztvevők közül néhányan később az űrtevékenységgel kapcsolatos pályát válasszanak. A 11–18 éves korosztályt megcélzó táborok programja az évek során folyamatosan változott [3]. Mára a szakmai előadásokkal és csoportmunkával egyenlő súllyal szerepelnek benne a szabadidős programok, kirándulások is. Az elmúlt több mint két évtized alatt a változó helyszínű táborokkal bejártuk szinte az egész országot. Az űrtáborban nagy hangsúlyt fektetünk az egész progra-

mon átívelő feladatra, amelyet csapatokra osztva oldanak meg a táborozók. A tábor során elhangzó szakmai előadások információi, a diákok hozott ismeretei és kreatív képzelőereje egyaránt fontos a komplex feladat megoldásához.
A diákpályázatok és űrtáborok sikerének egyik látványos jele, hogy az 1990-es és 2000-es évek résztvevői közül sokan az űrrel kapcsolatos pályát választottak, s egyesületünk aktív tagjainak, választott vezetőinek utánpótlását jelentik. Akiket pedig más pálya irányába vitt az élet, azok is maradandó élményekkel gazdagodtak és bizonyára megőrizték a világűr iránti érdeklődésüket.

Üstökösprojekt két budapesti gimnáziumban, 2013-2016

Gócz Éva, Horváth Zsuzsa*

Az üstökösök ritka égi jelenségnek számítanak az átlagember számára, pedig üstökösök mindig vannak az égbolton. Megfigyelésükhöz általában távcsövekre van szükség. Szabad szemmel csak akkor látunk üstököst, ha némelyikük közel kerül a Naphoz vagy a Földhöz, és ez ritkán történik meg. Az ISON-üstököst már 2012-ben felfedezték a Jupiter pályáján kívül, és az előrejelzések szerint igen látványosnak jósolták napközelsége idején, ezért egy üstökösökről szóló programsorozatot szerveztünk két nyolc osztályos gimnázium tanulóinak. Reméltük, hogy e projekt alatt nemcsak diákjaink üstökösökkel kapcsolatos tudása bővül, hanem az ISON üstökös megfigyelésével életre szóló csillagászati élményben lesz részük. Úgy gondoltuk, hogy az üstökösök témáján keresztül felkelthetjük tanulóink érdeklődését általában a fizika iránt is.
Az üstökösprojekt bevezetőjeként felmértük, hogy milyen ismeretekkel rendelkeznek diákjaink a témáról. A 11-12 éveseknek azt kellett lerajzolniuk, hogy milyennek képzelik el az üstökösöket. Az elkészült képek azt mutatták, hogy a kisdiákok elképzelései nem terjednek túl a bulvármédiából, filmekből, vagy éppen számítógépes játékaikból szerzett információkon. A rajzaikon látható színes üstökösök becsapódással fenyegetve száguldanak a Föld felé, csóvájuk pedig a Nap irányába mutat. Az idősebb, 13-18 éves diákoktól több tudást vártunk, hiszen földrajz órán már tanultak a Naprendszerről és így az üstökösökről is. Tájékozottságukat kérdőíves módszerrel mértük fel. Kíváncsiak voltunk arra, hogy diákjaink láttak-e már valaha üstököst, mit gondolnak, milyen nagy, miből áll egy üstökös. Miért van csóvája az üstökösöknek, és az milyen sűrű lehet. Azt is megkérdeztük többek között, hogy honnan jönnek az üstökösök. A

kapott válaszokból kiderült, hogy a legtöbbjüknek nagyon kevés (helyes) ismerete van a témáról, több tévképzetükre is fény derült.
Foglalkozásaink között voltak kiscsoportos iskolai beszélgetések, többször voltunk a Planetáriumban és egy közös rendezvényt is tartottunk a két iskola tanulóinak. Erre neves előadókat hívtunk (Lukács Béla és Vizi Pál Gábor), de a nap fénypontja mégis egy üstökös modell elkészítése volt. Rendeztünk üstökös képkirakó versenyt és egy üstökös kvízt is kitöltöttek tanulóink, a programok közötti szünetekben pedig a két iskola diákjai beszélgettek, ismerkedtek egymással egy kis pogácsa és üdítő mellett. Mindannyiunk sajnálatára a legjobban várt esemény, az ISON szabadszemes és távcsöves (csillagvizsgálóban történő) megfigyelése elmaradt, mivel az üstökösünk a Nap közelében szertefoszlott. Meg kellett elégednünk ennek az „üstökösvégnek" videón történő megnézésével.

Bár nem jósoltak a következő évekre látványos üstököst, sikerült folytatnunk az üstökösökkel való foglalkozást. Úgy gondoltuk, hogy mi megyünk el egy üstököshöz, persze nem személyesen, hanem a Rosetta űrszonda segítségével. Az űrszondát már 2004-ben elindították a Csurjumov-Geraszimenko üstököshöz és a hosszú út során hibernálták is, az ebből való felébredéshez szurkolhattunk 2014 elején. A sikeres felébredés után újra feltámadt diákjaink kedve az üstökösökkel való további foglalkozáshoz. Miközben követtük a Rosetta misszióval kapcsolatos híreket elmondhattuk, hogy magyar mérnökök, kutatók is jelentős szerepet vállaltak ebben az űrmisszióban. 2014 őszén már szép képeket nézegettünk az üstökös magjáról. A Philae novemberi üstökösre szállását együtt izgulhattuk végig a Planetáriumban a tervező mérnökökkel. Ez az esemény is meglepő fordulatokkal volt tele, így az elkövetkező hónapokban is kíváncsian követtük a kapcsolódó híreket. 2015 tavaszán a diákjaink is szerettek volna üstökös modellt készíteni. Hosszas felkészülés, a veszélyek megbeszélése után, erre sor is került tanulóink nagy örömére. A nyári szünetre szintén egy üstökös hírrel bocsájtottuk diákjainkat: "felébredt" a leszállóegység. Ősszel az üstökös napközelsége alatt készült képeken tanulmányozhattuk a gázkilövelléseket. Tervezzük a Rosetta missziót teljesen a végéig követni.
A többéves programsorozatba több új diák is bekapcsolódhatott, az éveken keresztüli üstökösökkel való foglalkozás reméljük egy életre rögzítette tanulóinkban a helyes ismereteket.

Analógia kutatás az ExoMars programban: tudomány és technológia kapcsolata és alkalmazása az egyetemi oktatásban

Kereszturi Ákos

Az analógia/analógiás kutatás ideális módszer a tudományos vonatkozások, terepi munka és laboratóriumi tevékenység összekapcsolására [1], valamint mindennek az űrtudományi oktatásba illesztésére. Az ESA ExoMars rover (EXM) küldetésének fontos céljai az első 2 méter mély fúrás elkészítése és elemzése a Marson, valamint a felszínen a mikroszkopikus skálájú cseppfolyós víz azonosítása. Az MTA Csillagászati és Földtudományi Kutatóközpontjában zajló analógia kutatómunka a fúrásokhoz, a kiemelt minták laboratóriumi elemzéséhez, valamint a HABIT műszerrel a mikroszkopikus sóoldatok megjelenésének megértéséhez kapcsolódik.

A magyar COOP-NN-116927 (NKFIH) projekt célja a fúrások és laborelemzések tervezésének és értelmezésének támogatása. A munka keretében olyan indikátorok keresése zajlik, amelyek segítenek az egykori folyékony víz nyomainak azonosításában, főleg üledékes kőzetekben, Mars analógiás területeket vizsgálva.

A mintavétel, a helyszíni és a későbbi laborelemzések során hasonló műszerekkel és módszerekkel zajlik a vizsgálat, mint amiket az ExoMars használ majd a bolygón. A furatlyuk falát egy optikai-közeli infravörös kamera pásztázza (hasonlóan az EXM MaMISS műszeréhez), és a kiemelt mintát elemző eszközök: NICON Eclipse E600 POL mikroszkóp (hasonló az EXM CLUPI műszeréhez), infravörös spektrométer Shimadzu UV-VIS-NIR 3600 (hasonló az EXM MicrOmerga műszeréhez), valamint kapcsolt Raman Morphologi 3G-ID szemcseelemző (hasonló az EXM RLS műszeréhez).

A labor és terepi műszerekkel azonosított korrelációk segítenek a keletkezési viszonyok megbecslésében, amelyekre az EXM a Marson is fókuszál. A fúráshoz közeli üledékes feltárások Magyarországon, Marokkóban, Tunéziában és Izlandon segítik a kontextus, a környezet megértését. A Mars releváns paraméterek elemzése alapján becslések tehetők a vörös bolygón majdan végzendő mérésekkel kapcsolatban, lehetséges forgatókönyvek vázolhatók, miként lehet a küldetéshez illeszkedő méréseket tervezni és végezni [2], és a mintavételezés stb. jellemzőit az EXM számára optimalizálni.

Az ELTE TTK keretében BSC, MSC és PHD kurzusok sokán több alkalommal is megjelenik a témakör, különös tekintettel az analóg munka lehetőségeire. Emellett technológiai vonatkozások is tárgyalásra kerülnek. A megvalósított laboratóriumi mérések segítenek a keletkezési körülmények becslésében. [3], a korábban tanult ás-

ványtani és üledékföldtani ismeretekkel összekapcsolva. A küldetéshez készülő módszertani javaslatok ideálisak a megfelelő tudományos-műszaki kérdésfeltevés gyakorlásához, és az alkalmazott tudományos vonatkozások elmélyítéséhez.

Űrgeneráció Magyarországon

Milánkovich Dorottya*, Bacsárdi László

Napjainkban a fiataloknak már természetesnek számít az emberiség jelenléte az űrben, ám hazánkban kevesen tudnak arról, miként lehet aktívan részt venni jövőnk alakításában e területen. Az űrtevékenység iránt érdeklődő magyar fiatalok számára a nemzetközi Space Generation Advisory Council (SGAC) jelenthet ugródeszkát a hazai és nemzetközi űrkutatási és űripari világba való bekapcsolódásba.

Az SGAC egy az ENSZ által 1999-ben alapított, 18 és 35 év közötti űrkutatás iránt érdeklődő fiatalokat tömörítő nemzetközi nonprofit szervezet. A több mint négyezer tagot számláló szervezet feladata, hogy az űrtevékenységgel foglalkozó hallgatókat és fiatal kutatókat egymással összekötve, a fiatal kutatók elképzeléseit, meglátásait és érdekeit képviselje különböző nemzetközi fórumokon, többek között az ENSZ Világűrbizottságában. A szervezet ennek érdekében munkacsoportokat üzemeltet, konferenciákat szervez, és aktív kapcsolatokat ápol a világ különböző űrügynökségeivel, űripari cégeivel és űrkutatással foglalkozó szervezeteivel, valamint népszerűsíti az űrtevékenységet a fiatalok körében.

Magyarországon az SGAC a Magyar Asztronautikai Társasággal (MANT) együttműködve számos lehetőséget kínál az űr iránt érdeklődő fiatalok számára ismereteik bővítésére.

A nyár folyamán megrendezésre kerülő MANT Űrakadémia egy négy napos rendezvény, melyen részt vehetnek mérnök, fizikus, informatikus, jogász, orvos, biológus, kémikus, menedzser és mindazon területeken tevékenykedő főiskolás, egyetemista hallgatók és fiatal szakemberek, amelyek kapcsolódhatnak az űrtevékenységhez. A program során a résztvevők egy aktuális űrkutatási témát körüljárva, csoportos feladatokban kamatoztathatják tudásukat és tehetségüket. A munkacsoportokban zajló munkát segítendő a rendezvényen áttekintő jellegű előadások hangzanak el hazai űrkutatással foglalkozó szakemberektől. A rendezvény célja, hogy a fiatalokat megismertesse a hazai és nemzetközi lehetőségekkel, alkalmat te-

remtsen egy projekt részvételében, amely hozzájárul a magyar űrtevékenység fejlődéséhez, valamint közösséget teremtsen.
A nyári program mellett, az év folyamán különböző budapesti felsőoktatási intézményekben két havonta megrendezésre kerül a MANT Űrakadémia Klub nevű rendezvénysorozat. A klubon elhangzó előadások az űrtevékenység sokszínű világába engednek betekintést, mely érdekes lehet jogász, orvosi vagy mérnöki nézőpontból is. Az előadásokat kötetlen beszélgetés követi.
Az SGAC tagjai a hazai programokon kívül részt vehetnek a nemzetközi projektcsapatok munkáiban is, amelyek az egész év folyamán folyamatosan működnek. Ezen munkacsoportok a jelenlegi űrkutatási problémákkal, felhasználási területekkel és témakörökkel foglalkoznak, emellett űrpolitikai cikkekkel, tanácsokkal és javaslatokkal segítik az ENSZ Munkacsoportjait, valamint tájékoztatják az ENSZ Világűrbizottságát és az ENSZ Világűrirodáját az SGAC tevékenységeiről és elképzeléseiről. Továbbá különböző versenyeken és pályázatokon is összemérhetik tudásukat külföldi társaikkal (pl. „Move an asteroid", „Space is business"). Ezeket a pályázatokat különböző nemzetközi szervezetek és cégek támogatják, és az első díj rangos elismerést jelent.
A szervezet a tehetséges fiataloknak ösztöndíjakat is kínál űrtevékenységhez kapcsolódó konferenciákon és eseményeken való részvételre, melyeken találkozhatnak az űrkutatás nemzetközileg elismert vezetőivel és a következő űrgeneráció tagjaival.

Az EUMeTrain projekt tevékenysége

Putsay Mária*, Kocsis Zsófia

Az EUMeTrain project több európai ország meteorológiai szolgálatának együttműködésével jött létre 2004-ben az EUMETSAT támogatásával és finanszírozásával. A projekt célja, hogy bárki számára könnyen elérhető (főleg) online oktató anyagokat állítsanak elő, online tanfolyamok szervezzenek műhold-meteorológia témakörben az EUMETSAT műholdas programjairól, vagy azokhoz kapcsolódóan. A fő feladat a műholdadatok használatának népszerűsítése. Az OMSZ 2014-ben csatlakozott hivatalosan a projekthez.
Az előadásban részletesen ismertetjük az EUMeTrain munkáját. Évente legalább két, nagyobb részt online, kisebb részt 'osztálytermi' tanfolyamot és legalább két egyhetes online előadó sorozatot szervez. Előadás sorozat esetén egy-egy témakörben délelőtt és délután 1-2 online előadás hangzik el. Az online előadásokat rögzítik, és utólag is meg lehet hallgatni képpel, hanggal együtt.

10 éves az Alkalmazott Mérnöki Tudományok Versenye

Magyarok a Marson - Mars Rover Modell Verseny
Sipos Attila, Vizi Pál Gábor*

Bevezetés: Az alábbiakban röviden beszámolunk a Szimulált Mars Rover Modell Verseny tíz évéről 2006-tól 2015-ig. 2006-ban az induló Alkalmazott Mérnöki Tudományok Versenye megvalósításához egy motiváló témát és környezetet kellett találni és Sipos Attila alapító az akkor épp sikeres Mars roverek kapcsán elindította a Magyarok a Marson versenyt.
Ötletek: A kihívás a fejlődés motorja. A valaha fiatal megöregszik és az utánpótlásra szükség van, mert a tudás és tapasztalat nem velünk született adomány. A képességek kiteljesedését a versenyek felgyorsítva segítik elő. A kérdés az, hogy a mai fiatalok hol kapják meg azt a kis szikrát, ami elindíthatja őket a nehéz, de szép természettudományos pályán.
Minden évben jelentős erőfeszítéseket teszünk, hogy megszervezzük és megvalósítsuk ezt a hagyományt teremtő mérnöki versenyt. 10 sikeres év – www.magyarokamarson.hu. Korábbi munkáinkban több helyen publikáltuk, hazai és nemzetközi robotikai konferenciákon előadtuk a verseny beszámolóinkat, mint például a 40. - 46. Lunar and Planetary Science Konferencián. [1,2,3,4,5]
Szimuláció és megvalósítás: A szervezők, akik a cikkek szerzői, a versenyek lebonyolítása előtt számítógépen és valóságban szimulálják, valamint elkészítik a pályát, robotokat és bemutatják a verseny előtt. A kutatás és fejlesztés fontossága az, hogy képes legyen előállítani egy emulációs környezetet bármely küldetés előtt. Erre előbb a versenyeken van lehetőség, majd később az iparban és a kutatásban, az űr és planetáris helyszínek széles spektrumán. A versenyről bemutató kisfilmet készítünk, mely szórakoztatva oktató jellegű, hogy felkeltse a lehetséges fiatal versenyzők érdeklődését. Továbbá ezek a rövidfilmek sci-fi trailerekhez hasonlítanak.
Küldetések: Minden évben a legfontosabb feladat a robotok automatikus irányítása. A győzelmet csak egy automata eszköz képes elnyerni a mezőnyben.
2006.: Az első versenyen anyagmintát kellett hozni az alfa Mars bázisra. Ezt egy mozgó, manipulátorokkal ellátott eszközzel (célszerűen rover) lehetett elérni
2007.: A második küldetésben minél több energiakockát kellett kitermelni.
2008.: A „terra formálás következtében létrejött 'marsi' tavakat” kellett végiglátogatni a 8x8 méteres pályán a rovereknek és közben vizet gyűjteni.

2009.: 9600 liter „óceánnal és jéghegyekkel meg egy nagy jégmezővel” kellett megbirkózni, hogy a lehető legtöbb „űrhajóst” sikerüljön megmenteni.
2010.: A célterület elérése, ahol egy ‘élőlény’ ‘DNS’ mintáját kell leolvasni, majd talajmintát gyűjteni, és az űrliften az ‘űrállomásra’ juttatni.
2011.: Piramist kellett elfoglalni a saját területen és a másikén. Ehhez a pályák közti „csillagkapukon” kell átjutni. Egy „elbitorolt” piramist újra el lehetett foglalni.
2012.: Olyan rovarszerű robotot kellett építeni, mely képes a zord 'marsi' körülmények között minimális emberi beavatkozással navigálni. A cél minél több területet benépesíteni és megvédeni a többi robottól az értékes 'utódokat'.
2013.: Építeni kellett egy kisméretű kétkerekű robotot, mely képes akár autonóm módon mozogni ‘Mars City’ utcáin. Igazi kihívás volt az instabil kétkerekű mechanika irányítása valamint a megvalósításra rendelkezésre állt rövid 3 hónap.
2014.: Magyar Alkalmazott Mérnöki Tudományok Versenye MSSM Micro Sized Space-Mothership és NPSDR mérő-érzékelő raj. Az MSSM eljuttat és begyűjt: emberi elnagyolt pozíció kijelöléssel - helybeli autonómiával. Redundancia biztosítása: azonos feladat, de eltérő gyártókkal és eltérő megoldásokkal.
2015.: MaM9.5 Feladat – robot evolúció – megmérettetés Egy feladat, de több emberi intelligencia kiegészítve eszközökkel. Hozott és helyi: hozott vezérlés, terv, hosszabb idő az elképzelt és szimulált megoldásokra. Helyben rövid idő, a lokális anyagok kötelező felhasználása, amely analógia egy távoli célterületen a hozott ismeretekkel és eszközökkel a helyi anyagok és adottságok fel és kihasználására! Olyan, mint egy terepi kivonulás, expedíció a Földön, vagy űrbeli célpont, kőzetplanéta felszín, bolygó, hold, aszteroida, üstökös, stb. A helyi feltételrendszernek legalkalmasabban megfelelő a nyerő. A verseny tanulsága, ha nem sík a pálya, hanem egyenetlen, például egy mező, akkor másik megoldás nyert volna.
Konklúzió: A versenyzőknek megtervezni, kifejleszteni és megépíteni kell egy összetett önműködő robotot, mozgatni kerékkel, lánctalppal, lábakkal, dupla kerekekkel vagy légpárnával és manipulátorokkal elvégezni a célterületen a feladatokat.

INDEX

Almár, Iván: 3
Apáthy, István: 45
Bacsárdi, László: 6, 33, 37, 51
57, 63, 67
Balázs, László: 31
Bálint, Tibor: 15
Barta, Veronika: 27, 47
Bencze, Pál: 27
Berényi, Kitti: 27, 47
Darvas, Ferenc: 18
Deme, Sándor: 45
Dudás, Levente: 29
Földváry, Lóránt: 35
Frey, Sándor: 51, 63
Ehmann, Bea: 31
Gócz, Éva: 53, 64
Gschwindt, András: 29
Hirn, Attila: 45
Horváth, Gyula: 45
Horváth, Zsuzsa: 53, 64
Huszák, Árpád: 33
Jones, Richard: 18
Kalmár, János: 27
Kemény, Márton István: 35
Kereszturi, Ákos: 55, 66
Kis, Árpád: 27, 47
Kiss, András: 37
Kiss, Gábor: 39
Kocsis, Zsófia: 59, 68
Kovács, Kálmán: 6
Kovács, Károly: 27
Milánkovich, Dorottya: 57, 67
Nagy, Tamás: 27
Ongaro, Franco: 20
Pázmándi, Tamás: 45
Pieler, Gergely: 27
Putsay, Mária: 59, 68
Sandau, Rainer: 21
Sátori, Gabriella: 27
Sipos, Attila: 61, 69
Tari, Fruzsina: 3
Varga, Gábor István: 41
Várhegyi, Zsolt: 45
Vicsi, Klára: 39
Vizi, Pál Gábor: 43, 61, 69
Zábori, Balázs: 45

Post conference workshop

The first European Space Generation Workshop (E-SGW) will be held on 26–27 February, 2016 in Budapest, Hungary. The two-day regional workshop is organised by the Space Generation Advisory Council, and hosted by the Hungarian Astronautical Society.

The Space Generation Advisory Council (SGAC) organises its first European Space Generation Workshop (E-SGW 2016) in Budapest. The event is intended for university students and young professionals, between the ages of 18 and 35, primarily from the European region. With the workshop theme "Approaches to promoting European regional collaboration in the space sector – the next generation perspective," about 50 young European space enthusiasts will discuss the most relevant and up-and-coming space topics in the region. The participants will work in three Working Groups during the workshop and make recommendations that help shape and provide insight into the future of the European space sector. The topics are the following:

• European collaborations in small satellites
• Knowledge sharing between young professionals and experts at the European level
• Young Entrepreneurship in Europe - the Space Perspective

The results will be presented at high-level scientific conferences and submitted to different European stakeholders. Furthermore, the report of the workshop will be included in the annual report of SGAC and submitted to the United Nations Committee on Peaceful Uses of Outer Space (UN COPUOS).

The workshop will welcome speakers from the DLR, ESA, HESpace, University of Applied Sciences Wiener Neustadt, BHE Bonn Hungary Ltd., Budapest University of Technology and Economics, and the Hungarian Space Office in the Ministry of National Development.

The E-SGW 2016 will be held in conjunction with the H-SPACE 2016, the 2nd International Conference on Research, Technology and Education of Space held on 25–26 February. The E-SGW 2016 takes place at the conclusion of UN COPUOS Technical Subcommittee meeting in Vienna, Austria.

About the Space Generation Advisory Council (SGAC)

The SGAC is a global non-governmental and non-profit organization and network, which aims to represent university students and young space professionals to the United Nations, space agencies, industry and academia. SGAC was established as a recommendation from the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) held in Vienna in 1999. SGAC has Permanent Observer Status in the UN COPUOS and is regularly present at its annual meeting and its two subcommittee meetings. These presentations cover the outcomes of SGAC's annual conferences and projects throughout the year. This includes the reporting the recommendations and outcomes gathered at the annual Space Generation Congress (SGC) and the annual Space Generation Fusion Forum (SGFF), bringing together top young minds from around world to focus on key space topics

Promoted and organized by

Federated Innovation and Knowledge Centre of Budapest University of Technology and Economics

Magyar Asztronautikai Társaság

Hungarian Astronautical Society

Sponsors

MŰEGYETEM 1782

Budapest University of Technology and Economics

BME VILLAMOSMÉRNÖKI ÉS INFORMATIKAI KAR

BME Faculty of Electrical Engineering and Informatics

Partners

IEEE youngprofessionals

IEEE Young Professionals

nhit NATIONAL COUNCIL FOR TELECOMMUNICATIONS AND INFORMATION TECHNOLOGY

National Council for Telecommunications and Information Technology

H-SPACE 2017

The 1st International Conference on Research, Technology and Education of Space was the opening event of the conference series. It was held on February 13, 2015.
The 2nd International Conference on Research, Technology and Education of Space was held on February 25-26, 2016.

H-SPACE 2017, the 3rd International Conference on Research, Technology and Education of Space' is planned to be organized in February, 2017 in Budapest, Hungary.

The Call for Papers will be available from 20 May on the http://space.bme.hu website.