

**3rd International
Space Science and Technology Conference**

Conference Materials

Kraków, 28-29 November 2015

Organizers:

Astronomia Nova Association
Museum of Polish Aviation

Co-organizers:

AGH Space Systems
forScience Foundation
Polish Space Professional Association
Polskie Towarzystwo Miłośników Astronomii
Wroclaw Space and Aviation Group

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Sponsors/Supporting organizations:

Polish Amateur Astronomers Society
Oprogramowanie Naukowo-Techniczne sp. z.o.o. sp. k.
Polish Rocket Society
WObit

Contact:

fichbio@gmail.com

WELCOME

It is my pleasure to welcome you, on behalf of the scientific and organizing committees, to the Third International Space Science and Technology Conference. This year, thanks to generosity of the Director of the Museum of Polish Aviation, Krzysztof Radwan, we meet in a very special venue, which highlights the power of human dreams about space travels. With a strong background in science and technology, our dreams come true and we become empowered to enable the future. We cannot learn everything, but we can work in teams, where we share our talents and specializations. Specialized multicellular organism like a human being can do much more and more efficient than a single cell like a bacteria. But team work can be difficult, if we are not focused, if we have diverse goals. In order to „callibrate” a common focus we should consider what does space mean for us?

The main aim of this conference is to enable the future. We would like to provide you an effective platform for dialog between experienced professionals and young ambitious people, who want to work in space sector. But in order to make it real, not only in theory, we need your help by your active contribution. Use this time and talk with people, especially who are new here. Talk about your space dreams, about your projects. Share your passion, knowledge and experience. Discuss, what would you want to do during the next year. If you feel tired, visit the Max Planck Science Tunnel, which adresses the megatrends of the 21st century. Catch inspiration and creativity! If you don't feel comfortable with conference atmosphere, we offer you Kraków by night informal meetings. Enjoy!

We are proud to host so many active and open-minded students, scientists, engineers and businessmen from Poland and other countries. Particularly we are happy to share the top good news from LISA Pathfinder mission and locally from the Polish national synchrotron. This year we would like to award teachers, scientists, associations, organizations, and companies for their significant contribution in development of the space sector in Poland in 2015. We are also happy to host very talented school students from Słupsk realizing the second edition of the educational project „Pan Stanisław” - a school in space. Polish Rocket Society and WObit Company will perform educational workshops for them. If you think about working for space for 100% or more, come to our workshop about working with the European Space Agency.

Finally, I would like to express huge gratitude for generous financial support from the Polish Amateur Astronomers Society, from the Company Oprogramowanie Naukowo-Techniczne Sp. z.o.o. sp.k., who prepared valuable students awards, for AGH Space Systems, for Science Foundation, and all other coorganizers, who contributed in making this meeting real.

I wish you on behalf of organizing committees, an exciting and productive meeting!

Let's MEET THE SPACE, here and now!



Agata Kołodziejczyk, coordinator of the conference

CONFERENCE PROGRAMME

DAY I

Saturday, 28 November 2015,
Polish Aviation Museum, al. Jana Pawła II, 39 / 31-864 Kraków

09.00 – 09.15 Welcome

SESSION I

09.15 – 09.30 *Humanization of space education* – Mikołaj Karawacki

09.30 – 09.45 *Polish Space Professionals Association* – Marcin Wygachiewicz

09.45 – 10.00 *Autonomization of astronomical observatories* – Mariusz Słonina

10.00 – 10.15 *Vision systems on board of flying objects – practical tips* – Jędrzej Kowalewski

10.15 – 10.45 Networking break

SESSION II

10.45 – 11.15 *MATLAB and Simulink for science and space industry* – Rafał Płatek

11.15 – 11.45 *SOLARIS – the Polish national synchrotron* – Marek Stankiewicz

11.45 – 12.15 *LISA Pathfinder: countdown to launch* – Michele Armano

12.15 – 12.30 Photo session

12.30 – 14.00 Lunch break

SESSION III

14.00 – 15.30 **Awarded winners of international space challenges 2015' – short presentations:**

14.00 – 14.15 *Legendary Rover Team- Winners of the University Rover Challenge 2015*

14.15 – 14.30 *AGH Space Systems – Winners of the CanSat Competition 2015*

14.30 – 14.45 *JADE – Winners of the Global Space Balloon Challenge 2015,*

Stratosphere biomonitoring – what can mosses tell us – Oldřich Motyka

14.45 – 15.00 *Project Dragonfly - Interstellar Laser-sail mission* - Nikolaos Perakis

15.00 – 15.15 *SPACE IS MORE: Finalists of the NASA 3D Printed Habitat Challenge*

15.15 – 15.30 *The European Rover Challenge as a motivator and integrator for young robotics*

teams on their paths to conduct research and commercialize technological solutions

– Łukasz Wilczyński

15.30 – 15.40 Surprise from our sponsor, ONT Company

15.40 – 16.00 Networking break

SESSION IV

16.00 – 16.45 *W objęciach Uranii i Polyhymnii* – Przemysław Rudź

16.45 – 17.30 Photo session, Visiting Max Planck Exhibition and Museum of Polish Aviation

19.00 – 22.00 Gala Dinner at Sławkowska 1 (70 PLN/person)

in parallel: educational workshops for school students:

11.00-13.00 Rocket workshop (Polish Rocket Society)

14.00-15.45 Robotic workshop (WObit)

DAY II
Sunday, 28 November 2014, Campus UJ P1.1
Polish Aviation Museum, al. Jana Pawła II, 39 / 31-864 Kraków

09.00 – 09.30 Networking break

SESSION I

09.30 – 09.45 *The Legal Aspects of Space Settlement* – Kamil Muzyka

09.45 – 10.05 *Why the Polar Regions are important for space research?* – Adam Nawrot

10.05 – 10.20 *WObit robotic company. Development potential in space industry* - Joanna Sławińska

10.20 – 10.40 *Polish astrobiological nanosatellite* – Jakub Mielczarek

10.40 – 11.00 *Atmospheres of exoplanets* – Milena Ratajczak

11.00 – 12.00 Panel discussion: *Habitat architecture for analog missions and scientific research* – Anna Łosiak, Michał Czapski, Szymon Gryś, Adam Nawrot and Łukasz Wilczyński

12.00 – 13.00 Lunch

SESSION II

13.00 – 13.15 *Are water bears able to survive in hipomagnetic conditions?* – Weronika Erdmann

13.15 – 13.30 *Tethered balloon study of fugitive emissions over the industrial agglomeration in Moravian-Silesian Region, Czech Republic* – Kristína Štrbová

13.30 – 14.00 *Meet The Space III movie* – Michał Czapski

14.00 – 14.15 **Closing ceremony**

14.00 – 16.00 Poster session (available during two days of the conference)

in parallel: educational workshop for students:

13.00 – 14.00 *Writing ESA Proposals* – Jędrzej Górski

18.00 – 22.00 Kraków by Night

Awarded Polish teachers, scientists, teams, associations and organizations:

1. category: scientific and technological projects

- **AGH Space Systems** - 2015 winners of the CanSat Competition
- **JADE Team** - 2015 winners of the Global Space Balloon Challenge
- **Legendary Rover** - 2015 winners of the University Rover Challenge
- **Space is More** - finalists of the 3D-Printed Habitat Challenge
- **Copernicus Project** - significant support in scientific balloon missions
- **Polish Rocket Society** - significant support in rocket launches
- **SKA Polska** - a novel software for space debris removal

2. category: education and popularization

- **Anna Rzepa** - project: Pan Stanisław - a school in space
- **Paweł Grochowalski** - „Orion” portal editor, cyclic popularizing picnics
- **Przemysław Rudź** - writer, composer

3. category - events and workshops

- **Planet PR** - European Rover Challenge
- **BlueDot Solutions** - Galileo Masters, Startup Weekend Space
- **WObit** - event „Polskie roboty na ziemi i w kosmosie”
- **Fundacja Wspierania Polskiej Astronautyki** - Polska w Kosmosie

POSTERS

1. *Global Astrophysical Telescope System* - Patrycja Bagińska
2. *Mars fly-by mission architecture* – Aleksander Gorgolewski
3. *Space is More: NASA 3D printed habitat challenge finalist* - Aleksander Gorgolewski
4. *To Mars with GMO: designing escape stage and „genetically engineered” trajectory for manned free-return fly-by mission* - Aleksander Tuzik
5. *Obserwacje śmieci kosmicznych przy użyciu robotycznego teleskopu spektroskopowego RBT* - Mikołaj Krużyński
6. *Students' Space Association* - Aleksander Masłowski, Tadeusz Górnicki, Mariusz Krasnodębski, Emilia Węgrzyn

ABSTRACTS

LISA Pathfinder: countdown to launch

Michele Armano

European Space Agency

Abstract: Rapidly approaching the takeoff date of 2nd December 2015, the free-fall explorer LISA Pathfinder (LPF) is already awaiting launch in the European Space-port of Kourou, in French Guiana. A thrilling mission by design, LPF flies key technology for gravitational waves observation in space, including reference sensors, interferometers, precision rockets and a high-performance control system to tie them all. Based on the analysis of time series and closer to a seismometer than to a telescope, the science of the top geodesy ESA mission of our days shall qualify the technology to enable gravitational astronomy and cosmology beyond ground detectors. We will browse the science of gravitational waves and show its impact on the mission design, both for eLISA and LPF and explain our scientific plans for the first three months of operations.

About the Author: LISA Pathfinder Operations and Archive Scientist SRE-SD ESAC Aurora Technology for European Space Agency

Global Astrophysical Telescope System

Patrycja Bagińska

Global Astrophysical Telescope System

Abstract: Poznań Spectroscopic Telescope 2 (PST2) is the second spectroscopic telescope constructed in Astronomical Observatory of Adam Mickiewicz University in Poznań (Poland). The first one (PST1) is operational since 2007 in Borowiec observing station (near Poznań, Poland). The PST2 is located over 120 deg away in longitude from the PST1. The telescope has been installed in Winer Observatory in October 2013 and is fully operational since then. Since both telescopes are equipped with similar echelle spectrographs, they are perfectly suited for monitoring spectroscopic variations of pulsating and binary stars in nearly continuous way, up to 21h per day.

Mars fly-by mission architecture

Dorota Budzyń, Konrad Cyprych, Szymon Gryś, Aleksander Gorgolewski, Radosław Groński, Olaf Kowalski, Leszek Orzechowski, Aleksander Tuzik
Space is More, Wrocław University of Technology

Abstract: We have elaborated mission architecture for Mars fly-by in 2018. Our design was based on Wet Workshop idea developed by Werner von Braun for the mission Skylab, which assumed usage of fuel tank for living purpose. For this mission we have found new 500 days trajectory for the mission optimized for Earth reentry velocity. NASA's Space Launch System with a DUUS/LUS class upper stage was chosen as launch vehicle, we suppose that it would be possible to scale-up Boeing Large Upper Stage to adopt it as a wet workshop. Second launch of Falcon 9 Heavy would carry to LEO Earth Reentry Pod, Crew, Launch Abort System, modified Cygnus Service Module and Dry Workshop. In Dry Workshop there would be stored main systems like life support system, communication systems and tanks. In our design we had concerned issues of communication, radiation and life support system.

There have been planned docking on LEO, in which ERP and Cygnus SM are performing 180o turn and are connecting to Dry Workshop, after that vehicle is docking to Ext-LUS and crew is utilizing Wet Workshop. Crew accommodation in Wet Workshop was dictated with human needs for such a long period of time and that was the main aim that we concerned. There have been designed sleeping compartment, place for science experiments, G-bike and treadmill to keep crew in fit.

SPACE IS MORE: NASA 3D Printed Habitat Challenge Finalist

Dorota Budzyń, Konrad Cyprych, Szymon Gryś, Agata Mintus, Konrad Gruber, Piotr Gruber, Michał Olejarczyk, Leszek Orzechowski, Aleksander Tuzik
Space is More, Wrocław University of Technology

Abstract: Space is More design team had qualified for NASA 3D Printed Habitat Challenge top 30 designs out of 180 submitted entries. Our project was showcased during World Maker Faire New York in September 2015. Our goal was to propose a 3d printing technology of erecting building from in situ resources using CNC Cladding. Our project is a complete proposal of 3d printing technology and architecture that, we believe, will meet all requirements of manned Mars mission and also could provide affordable 3d-printed housing here on Earth. Our goal was to create feasible and utility solutions both in terms of 3d printing technology and habitat design. In space exploration there is no room for waste of space and every solution must consider payloads restrictions when landing on Mars. This is one of the reasons we located our mission site in the Gale Crater.

Gale Crater is located at the Mars equator which benefits mission in several ways, including amount of solar energy, low elevation (thicker atmosphere) and relatively robust data from Curiosity rover for precise site selection and resource evaluation.

Proposed 3d-printing technology can help construct habitat that is not only safe, but also comfortable to live in. Rover based printer is a feasible solution and a great opportunity for a human/agent cooperation. Thanks to the unlimited range of Y-end rovers habitat can be expanded and evolve into first Martian colony. Proposed technology could also create habitats insulation by creating layers of aerogel in low pressure environment.

Same technology could be used to create eco-friendly terraced housing on Earth in any location using sand and local resources. Thanks to simple 3d printing process such architecture could be

perfect for places leveled with natural disasters, and undeveloped regions being at the same time attractive for customers in well developed communities.

Presented habitat design uses different technologies and combines them with 3d-printing to create truly feasible design. We are certain that all technologies needed could be ready in a couple of years and perfected before first manned Mars mission.

Outside the field: Are water bears (Tardigrada) able to survive in hipomagnetic conditions?

Weronika Erdmann

A. Mickiewicz University

Abstract: Astrobiologists who consider the possibility of the spread of terrestrial organisms on other celestial bodies of the Solar System, are bothering question: Is it possible that Earth's organisms could survive drifting in space and successfully colonize other space object? Outer space is characterized by many disadvantages for the life of factors: extremely low pressure, low temperature and high doses of different kinds of radiation. Also, the magnetic field in space (outside the Earth's magnetosphere) is very weak, and the nearest planets have magnetic fields much weaker than geomagnetic field. The greatest chance of survival in such adverse conditions, have various extremophilic organisms. Including Water bears (Tardigrada). Tardigrades are small invertebrates which have a high resistance to stress factors, including those associated with space travels. Water bears owe this remarkable resistance to adverse conditions their ability to enter into cryptobiosis. During its term reproduction, growth, and even metabolism are significantly slowed or even stopped. But enter into cryptobiosis and return to an active life requires preparation in the form of specific metabolic processes.

That the geomagnetic field has a significant effect on the metabolism of living organisms, was confirmed by numerous studies, conducted both on animals and plants. Research on the impact, which hipomagnetic conditions have on living organisms, have shown that isolation from the geomagnetic field interferes with many important metabolic processes, like transport of ions and function of certain enzymes. However, the most common subject of studies were single cells or plants and animal tissue cultures, and only few animals (mostly vertebrates). But, so far, the measure of sensitivity of extremophilic organisms, such as Tardigrades, on long-term isolation from the geomagnetic field has not been tested. As a result of our experiments, we found that although Tardigrades in cryptobiotic state are able to survive isolation from the Earth's magnetic field, however, active individuals or in the process of preparation for the cryptobiotic state and during the process of return to active state, water bears are particularly sensitive to lack the geomagnetic field.

Ionizing radiation issue in Space

Aleksander Gorgolewski

Space is More, Wroclaw University of Technology

Abstract: Ionizing radiation problem was studied and analyzed for the purposes of Inspiration Mars “Fly-by Mars Mission in 2018 Student Design Contest”. Over the duration of a manned space missions, it is necessary to take care of the crew’s health. A huge hazard for human life is space radiation, which can be divided into two groups: constant (in approximation) galactic cosmic rays (GCR) and persisting from a few hours to a couple of days Solar Particle Events (SPE) usually strictly correlated with Solar CMEs and Flares. GCR is characterized by low flux and high-energy particles, while SPE has high flux and low-energy particles (protons mainly). Because of their

different reactions for shielding, there have to be used two different strategies. Effectiveness of shielding materials is several times weaker for GCR in comparison with SPE. There hasn't been developed any structural material more effective than polyethylene, so far. Additionally, mission will be taken during the solar minimum, which means that the crew will be exposed to bigger doses than during solar maximum, because the Sun generates Interplanetary Magnetic Field, therefore an effective dose in solar minimum can reach 300% value of the effective dose in solar minimum.

About the author: Ionizing radiation and the Sun activity specialist. Power Engineering Student on Wrocław University of Technology.

Humanization of space education

Mikołaj Karawacki

Abstract: The continuation and proliferation of space exploration heavily depends on one key element that cannot and will not be produced neither in a laboratory nor in a factory: dedicated personnel. Meanwhile, all our education system is successful in doing is mass production of poorly educated young people, anesthetized to the wonders of the world and devoid of their innate creativity and curiosity. Without changing the way we teach and learn, there will be no future generations of scientists, explorers, engineers – or any generations whatsoever. This talk will present a number of possible steps as well as tools needed for the education system's makeover from the 18th-century Enlightenment industrial model to the more humane one.

The cameras we sent to space

Jędrzej Kowalewski

Siviso - Simple Vision Solutions

Abstract: One picture is worth a thousand of words. Because of that cameras are an inseparable components used in almost all of the modern interplanetary missions. This two-dimensional arrays of light-sensitive sensors provides crucial data about geophysical features, composition, terrain formation or even micro-structure of rocks on distant worlds. Very often, vision modules become a separate auto control systems for the spacecraft, used for checking the level of degradation of mechanical components (like the state of Martian rover wheels), general orientation (low-gravity body landers), or to define the dust layer on the crucial components (dust on the solar panels). The commonness, miniaturization and low cost of the lightweight cameras, also resulted in a mass use of vision systems in the RC-aircraft, drones and low-budget sounding balloons and rockets. Despite the wide variety of cameras, considerable number of missions provides a poor quality images or even leads to a destruction of imaging device. This is caused mainly by the design of camera or housing not adjusted for stratospheric or space conditions.

This article shows the technologies and basics of vision systems design for interplanetary missions, based on current and past space flights. The article focuses also on crucial information about optics, construction and thermal aspects that should be considered during design of vision system. This clues and tips are based on polish stratospheric sounding balloon missions: JADE-1 and FREDE2015. Information in this article can be useful for both professional and amateur designers of stratospheric and space flights.

About the author: Jędrzej Kowalewski, M.Sc.Eng, is an vision system designer, CEO and founder of Siviso - Simple Vision Solutions company which implemented imaging modules in polish stratospheric missions - FREDE2015 and JADE-1. Designer and leader of industrial machine vision projects for many European institutes and companies, mainly in automotive and aviation branches. Author of articles: " Coaxial vision calibration system for remote laser processing scanners" and "Vision of elasticity and innovation. About the cameras that change industry".

Stratosphere biomonitoring - what can mosses tell us

Oldřich Motyka

VŠB - Technical University of Ostrava

Abstract: Three moss species (*Orthotrichum anomalum*, *Physcomitrella patens* and *Atrichum undulatum*) were chosen as the best representatives of their eco-physiological strategy groups and subjected to a series of stratospheric balloon experiments in order to assess their biomonitoring potential. Overall cell conditions, chloroplast/chlorophyll degradation and ascorbic acid content were monitored in both the moss material subjected to stratospheric conditions and the ground controls. Under the stratospheric conditions, cells of the moss samples displayed the tendency to lose water, shrink and rupture, damage of chloroplasts was also recorded. Nevertheless, the response was distinctly species-specific. Ruderal species *P. patens* showed the lowest resilience, whilst stress-tolerator *O. anomalum* and mixed-strategist *A. undulatum* were significantly less affected by the harmful conditions. Results obtained suggest that the choice of the species for the biomonitoring purposes should be affected by its eco-physiological life strategy and that, after a well-informed selection, mosses may serve as a complex monitor of ozone concentrations as well as general conditions of the stratosphere. However, particular environmental factors affecting the moss survival under such conditions has to be yet assessed.

About the author: Biologist working among nanotechnologists. With interest in stress ecology, mosses and pollution.

Why the Polar Regions are important for space research?

Adam Nawrot

forScience Foundation, Poland; Institute of Geophysics Polish Academy

Abstract: Every space mission is unique, gives limited time for sampling and can be done once per few years. Space research needs a very specific technology and methods, where is no place for mistakes. To avoid technical problems in a new created devices is necessary to verify applied solutions. Laboratory can help to fix different technical problems but not all. To make tests as good as possible we need to find similar conditions like those where devices will work. The Outer Space is dark, cold and still is unknown.

Arctic or Antarctic give us a harsh unpredictable climate conditions, with low air temperatures, strong winds and with a long periods with or without light. This region is covered by ice and permafrost – frozen soils. Glaciers create moraine ridges with mix of stones, soils and gravels.

The Polar Regions are on Earth, are quite close to us and is much easier to get there and come back. Thus, this northern and southern parts of Earth hemisphere seems to be a very good laboratory for Space technology testing.

About the author: President of the forScience Foundation. In my research work I'm interested in polar regions. Polar Expedition Leader in 2011/2012. I'm working in Department of Polar and Marine Research, Institute of Geophysics Polish Academy of Sciences.

Project Dragonfly: Interstellar Laser-sail mission

Nikolaos Perakis

Technical University of Munich (TUM)

Abstract: Project Dragonfly is a feasibility study for an interstellar mission, conducted by small, distributed spacecraft, propelled primarily by laser sails. The spacecraft shall be capable of reaching the target star system within a century and be able to decelerate. Such a mission can be conducted with technology available by 2024-2034 as well as a space infrastructure, available by 2050. Within the frame of this competition, the WARR ISF group from the Technical University of Munich submitted a design based on a graphene sandwich multiple-layer sail and proposed a new deceleration scheme. The results of this study will be presented at the Meet the Space Conference 2015.

About the author: Aerospace Engineer and Physicist. Main interests: Propulsion systems, mission design, interplanetary and interstellar spaceflight, simulations.

Atmospheres of Exoplanets

Milena Ratajczak

University of Wrocław

Abstract: Since the discovery of the first planet outside the Solar System we have learned that exoplanets are extremely common in the Universe and much more diverse than originally predicted. With high quality data, we are able to study both the staggering diversity of exoplanetary compositions, as well as their atmospheric and interior processes. In particular, excellent photometric and spectroscopic observations lead us into tremendous progress in characterizing exoplanets' atmospheric signatures.

We shall describe the methods used for exoplanetary atmospheres investigation and review the most recent developments in the field.

About the author: Postdoctoral researcher at University of Wrocław, board member of New Space and Multiświat foundations. Milena holds PhD in astronomy and her scientific interests include binary stars and extrasolar planets. She has been responsible for the implementation of UNAWAWE program in Poland, an international project or outreach of astronomy among children. Milena has coordinated outreach activities during several events and organised dozen of educational camps for children. She is an author of many popular science articles.

Tethered balloon study of fugitive emissions over the industrial agglomeration in Moravian-Silesian Region, Czech Republic

Kristína Štrbová

VŠB - Technical University of Ostrava

Abstract: This study deals with the topic of fugitive emissions in the industrial agglomeration of Ostrava region. Fugitive dust is a major part of atmospheric aerosols, increased attention is given to it due to its significant impact on climate change, air quality and human health, and ecosystems.

Vertical distribution of PM₁ up to 500 m a. s. l. was monitored at selected locations during spring and summer seasons of 2014, using the balloon measuring method with the dust analyser GRIMM 1.108. Attention was given to the influence of the meteorological parameters on PM₁ concentrations. Furthermore, distribution of organic matter in the vertical profiles of the atmosphere in the most exposed places was studied using the Py-GC/MS and thus, using mathematical methods, contributions of the individual pollution sources were identified.

Measurements have shown that the contribution of PM₁ concentrations in the vertical profile of the atmosphere is significantly higher in the spring. The course of the concentration of PM₁ with the increasing height is more or less downward. Presence of inversion layers was observed in some locations. Accordingly, the measured values of the number of particles per litre for the selected particle size in the spring season showed more or less downward trend with the increasing height. Similar trend was observed in the particle size of 0.290 microns and 0.325 microns for majority of the sites. The highest number of particles was in the particle size 0.265 microns in all of the observed locations. The most commonly observes was strong correlation of the PM₁ concentration with height and pressure. The results of the correlation with the other factors – temperature and humidity were not so clear. The highest concentrations of PAHs and heavy metals were found in the upper layers (140-170 m), whereas it almost did not occur in the layers below 120 m. By the means of PM₁₀ air pollution analysis, material with fragments of organic matter usually originating from waste dumps was identified in the areas with old environmental burdens.

About the author: Mrs of Environmental Engineering, actually PhD student at Department of Energy. Fields of my interest: Air Quality, Air Pollution Studies, Air Sampling, Environment, Py-GC/MS, FT-IR Spectroscopy.

To Mars with GMO: designing escape stage and “genetically engineered“ trajectory for manned free-return fly-by mission

Aleksander Tuzik

Space is More, Wrocław University of Technology

Abstract: Space is More' Mars 2018 fly-by reference mission launch systems architecture and trajectory is described. The aim is to overcome the severe payload mass limitations of current and proposed launch systems, while keeping modifications and introduction of new systems to minimum. Existing know-how and experience in in-orbit operations is noted and focus is placed on maximizing upper stage capability. The feasibility of near-term serious improvements in that regard is demonstrated. A Boeing's Large Upper Stage is modeled and scaled-up through a simple tank stretch up to the mass limit imposed by Space Launch System, thereby dedicating a single SLS launch to the upper stage. An allowed payload mass growth of approximately 50% or more is reported for high-energy trajectories, greatly improving the trade-offs that can be made between the spacecraft's capability, design margins and overall feasibility, at the cost of introducing the simplest

form of on-orbit assembly: rendezvous and docking.

The project uses both literature data analysis and independent deep-space simulations using genetic algorithms under PyGMO framework for finding trajectory solutions, as well as numerical Trans Mars Injection simulation to determine stage performance on a number of free-return Mars flyby trajectories.

About the author: Aleksander Tuzik, "Space is More" research group member, space and Python programming language fan. Currently intern at Polish Academy of Sciences Space Research Center (CBK PAN) and Air Force Institute of Technology (ITWL).

The European Rover Challenge as a motivator and integrator for young robotics teams on their paths to conduct research and commercialize technological solutions.

Łukasz Wilczyński
European Space Foundation

Abstract: The European Rover Challenge is the biggest space-robotics event popularizing science and new technologies in the East-Central Europe, which since 2014 has been taking place in Poland. The ERC is an event analogous to the University Rover Challenge in the United States, although takes place at a venue widely available to the public and is accompanied by a science-tech picnic. This makes it possible for anyone interested in the STEM fields to watch the efforts of young robotics teams. The first and second edition brought together more than 45,000 visitors and almost 40 teams from 4 continents. The competition was also observed by an international assembly of space experts with whom the students had a chance to talk about their future plans. Moreover, we played host to 54 accredited journalists, thanks to whom we've enjoyed over 2,000 publications in 14 languages, and the communication efforts have reached nearly 30,000,000 media consumers.

Thus, an event like the ERC is a proven method of scouting ideas and people, who are about to enter the job market and are trying to define their position in it. So, if they will not be able to find education-related work after leaving university, there is a risk they will change their profession. Thanks to the ERC, as well as the large-scale promotion I have discussed earlier and cooperation with the industry, we have an opportunity to keep these young people in the space sector, and thus boosting resources needed to build it, most of all in the developing countries. This, indeed, is the basic conclusion stemming both, from the ERC and the URC, where the number of teams from the developing countries is growing every year. This allows for putting forward an assumption that their potential is significantly greater because of their stronger motivation - they want to catch up with the Western world. The main lesson learned from the ERC 2014 is the need to provide mentor support to young robotics teams, who often do not know how to utilize their success. Thus, during the 2015 edition of the ERC, special workshops were held for the previous winners of the URC/ERC. They were lead by representatives of space sector, financial sector and representatives of government agencies. This will help young robotics teams find their professional path and will enrich their knowledge of financing tools and promoting their ideas on the international stage.

About the author: Historian by education (with publications on space exploration) and a PR specialist. Spokesman for the Mars Society for many years, supporting various space-related projects in Poland and abroad. President of Planet PR, part of the GlobalCom PR Network. Space science writer and populariser.

Polish Space Professionals Association
Marcin Wygachiewicz
SENER / Polish Space Professionals Association

Abstract: Main purpose of PSPA is to create a common platform - point of contact between Polish space professionals. Moreover we would like to actively participate in development of the Polish space sector through various projects.

One of our basic activities covers providing support to students and graduates in order to help them gaining a necessary professional experience through easy access to our community and the space industry.

During Meet the Space conference in Kraków, our representative will introduce the association, its history, currently realised projects, achievements and our plans for the future.

We will be also glad to hear new brilliant ideas from the audience as well as find partners for our future activities.

About the author: Graduate of Robotics and Mechatronics at AGH University of Science and Technology in Kraków and Digital Signal & Image Processing at Cranfield University (UK). Former YGT in the Structures and Mechanisms Division at the European Space Agency (ESTEC). Currently Design Engineer at SENER (Warsaw), specialised in mechanisms for spacecrafts. Co-founder of the Polish Space Professionals Association.

LIST OF PARTICIPANTS

Name	Last	Affiliations	E-mail
Dominika	Achtel	The Jagiellonian University	dnk.achtel@gmail.com
Michele	Armano	European Space Agency	michele.armano@esa.int
Konrad	Babiuch	AGH University of Science and Technology	konrad.babiuch@gmail.com
Patrycja	Bagińska	Astronomical Observatory, Adam Mickiewicz University	patibag@gmail.com
Wojciech	Balon	Jagiellonian University	wojbal3@gmail.com
Stefanos Alexandros	Bamopoulos	Ludwig Maximilian University of Munich	S.Bamopoulos@campus.lmu.de
Łukasz	Bereś	Rzeszów University of Technology	bereslukasz@gmail.com
Adam	Bortnowski	Wrocław University of Technology	bortnowski.adam@gmail.com
Henryk	Brancewicz	Polish Amateur Astronomers Association	zgptma@gmail.com
Dorota	Budzyń	Wrocław University of Technology	budzyn92@gmail.com
Weronika	Erdmann	Department of Animal Taxonomy and Ecology, A. Mickiewicz University	weronika.erdmann@gmail.com
Anna	Fogtman	Institute of Biochemistry and Biophysics, Polish Academy of Sciences	annafogtman@ibb.waw.pl

Michał	Gocyła	Neuronator	mgocyła@gmail.com
Marta	Goli	Students' Space Association	marta.goli@yahoo.com
Wojciech	Gołębiowski	SKA Polska Sp. z o.o.	w.golebiowski@ska-polska.pl
Aleksander	Gorgolewski	Space is More	agorgolewski@gmail.com
Aleksander	Gorgolewski	Space is More	agorgolewski@gmail.com
Aleksander	Gorgolewski	Space is More	agorgolewski@gmail.com
Grzegorz	Grzegorz	AGH University of Science and Technology	grzegorz@gajoch.pl
Aleksander	Guzik	AGH Space Systems	amf.guzik@gmail.com
Mieczysław	Jagła	Polish Amateur Astronomers Association	janusz@moa.edu.pl
Maciej	Jakimiec	Copernicus Project Foundation	maciej@copernicus-project.org
Marzena	Jakimiec	Copernicus Project Foundation	marzena.jakimiec@icloud.com
Marian	Jeż	Institute of Aviation	ochota02020@gmail.com
Mikołaj	Karawacki	private	mapkarawacki@gmail.com
Agata	Kołodziejczyk	European Space Agency	fichbio@gmail.com
Jędrzej	Kowalewski	Siviso - Simple Vision Solutions	jedrzej.kowalewski@siviso.com
Marek	Kowaluk	Students' Space Association	kowaluk.marek@gmail.com
Jan	Krowiranda	Rzeszów University of Technology	jankrowiranda@gmail.com
Adam	Kurzak	AGH Space Systems	amkurzak@gmail.com
Robert	Lubanski	Mars Society Poland	ronert.lubanski@marsociety.pl
Dariusz	Marchewka	Oprogramowanie Naukowo-Techniczne Sp. z o.o. sp. k.	dariusz.marchewka@ont.com.pl
Aleksander	Masłowski	Students' Space Association	maslowski.aleksander@gmail.com
Anka	Mizerska	Students' Space Association	ankadzanka@gmail.com
Maciej	Mogilski	private	viarel123@gmail.com
Oldřich	Motyka	VŠB - Technical University of Ostrava	oldrich.motyka@vsb.cz
Katarzyna	Mura	Atlas Tours	kasia.mura@gmail.com
Kamil	Muzyka	The Institute for Legal Studies of the Polish Academy of Sciences	muzykakamil@wp.pl
Adam	Nawrot	forScience Foundation, Institute of Geophysics Polish Academy of Sciences	a.nawrot@forscience.pl
Agnieszka	Nowak	Polish Amateur Astronomers Association	a-en@wp.pl
Nikolaos	Perakis	Technical University of Munich (TUM)	nikolaos.perakis@tum.de
Tomasz	Perenc	Kompania Węglowa S.A. - IT Department	t.perenc@gmail.com
Aleksandra	Piotrowska	University of Social Sciences and Humanities	erdwadedwa@gmail.com
Edyta	Pióro	Jagiellonian University	edyta.pioro@student.uj.edu.pl
Marcin	Piwowarczyk	Oprogramowanie Naukowo-Techniczne sp. z o.o. sp.k.	marcin.piwowarczyk@ont.com.pl

Mikołaj	Podgórski	IASE sp. z o.o.	mikpod822@gmail.com
Anna	Radzik	private	anna.radzik@gmail.com
Milena	Ratajczak	University of Wrocław	milena.ratajczak@gmail.com
Paweł	Rzońca	AGH University of Science and Technology	addinpoczta@gmail.com
Adam	Serafin	AGH University of Science and Technology	serafadam@gmail.com
Kamil	Sieciński	Wrocław University of Technology	siecinski.kamil@gmail.com
Mariusz	Słonina	Sybilla Technologies	mariusz.slonina@sybillatechnologies.com
Kristína	Štrbová	VŠB - Technical University of Ostrava	kristina.strbova.st@vsb.cz
Marek	Substyk	Polish Amateur Astronomers Association	astrocd@astrocd.pl
Tomasz	Szelągowski	Fundacja Ochrony Zdrowia Publicznego	tom.szlagowski@gmail.com
Aneta	Szotek	Uniwersytet Jagielloński	szotek.aneta@gmail.com
Grzegorz	Szpyra	Rzeszów University of Technology	gszpyra@borgwarner.com
Tymoteusz	Topa	Rzeszów University of Technology	tymoteusz.topa@gmail.com
Karolina	Tran	AGH Space Systems	karolina.tran@gmail.com
Aleksander	Tuzik	Space is More, Wrocław University of Technology	aleksander.tuzik@gmail.com
Jakub	Węgrecki		krolikbuks@poczta.fm
Emilia	Węgrzyn	Students' Space Association	e.o.wegrzyn@gmail.com
Lukasz	Wilczynski	European Space Foundation	lukasz@spacefdn.com
Agata	Winkler		gatawinkler@gmail.com
Michał	Wiśniewski	University of Technology in Gdańsk	michal.wisniewski147@gmail.com
Elzbieta	Witkowska		ela.v@vp.pl
Paula	Wojciechowska		wojciechowska.fran@gmail.com
Magdalena	Wszolek	Queen Jadwiga Astronomical Observatory	magdagemini@gmail.com
Bogdan	Wszolek	Jana Długosz Academy in Częstochowa, Queen Jadwiga Astronomical Observatory	bogdan@ajd.czyst.pl
Marcin	Wygachiewicz	SENER / Polish Space Professionals Association	marcin.wygachiewicz@pspa.pl
Ewelina	Zaremba	Students' Space Association	ewezar12@gmail.com
Elzbieta	Zocłowska	CAMK	ela@camk.edu.pl
Maksymilian	Żurman	Wrocław University of Technology	makzur@gmail.com