

Highlights 2018

INNOspace
MASTERS

Space Moves! New ideas for the next space generation

The competition is embedded in DLR Space Administration's INNOspace® initiative,
which promotes innovation and new markets.

Operator



Partners



Organiser





INTRO

Aerospace enriches our digital and increasingly automated everyday lives with innovative key technologies. Ground-breaking developments have been achieved in a number of areas, especially in microelectronics, software, and smart materials. Meanwhile, global stakeholders are emerging in new constellations that present innovative business ideas and commercialisation concepts for the space sector. In doing so, they are helping to promote the development of integrated value chains that are capable of manufacturing versatile subsystems and components in cost-effective ways. This is resulting in compelling opportunities to expand into new markets, not only for aerospace companies, but also for non-space industries and midsize supplier firms as well.

Under the theme “Space Moves!”, the third INNOspace Masters competition embarked on a search for new ideas and concepts designed to address the aerospace industry’s current problems and challenges from various industries by offering a mutual transfer of technology and knowledge. The INNOspace Masters is organised by the Space Administration of the



Dr Walther Pelzer
Member of the DLR Executive Board
German Aerospace Center (DLR), Space Administration

German Aerospace Centre (DLR). In the third year of the competition, it has once again been possible to build on the success achieved in the previous year. The relevance of the competition is underscored by both the quality of the ideas and concepts entered as well as the wide range of topics covered. I am thrilled with this positive response and look forward to advancing the ideas received along with the other INNOspace Masters partners.

I congratulate all of this year’s finalists. At the same time, my sincere thanks go out to Airbus, OHB and Germany’s ESA Business Incubation Centres (BICs) in Bavaria and Hesse & Baden-Württemberg for their collaboration in the competition. Furthermore, I want to thank AZO Anwendungszentrum GmbH Oberpfaffenhofen for doing such an excellent job of organising the INNOspace Masters competition 2018.



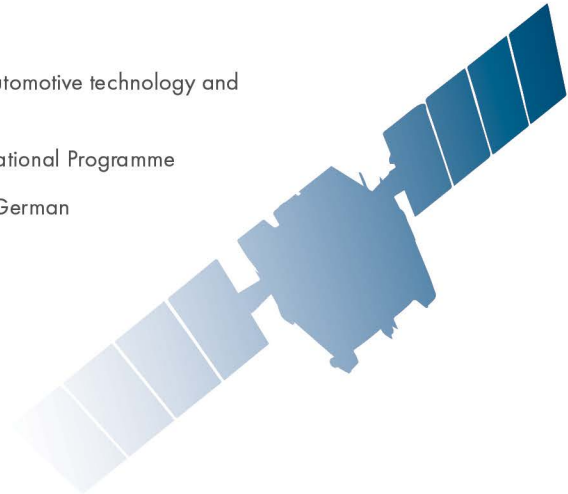
INNOSPACE INITIATIVE



Space is an important driver of innovation for Germany and a key to open new markets. In order to use and exploit the innovation potential and cross-industry technology synergies more goal-oriented and efficiently, the Space Administration of the German Aerospace Center (DLR) has launched the INNOspace® initiative in 2013.

INNOspace® is an initiative in the framework of the Federal Ministry for Economic Affairs and Energy (BMWi)s “National Programme for Space and Innovation” and part of the German government’s new high-tech strategy since 2014. In close coordination with the BMWI as well as with various federal states, INNOspace® comprises the following instruments:

- › Interdisciplinary symposia to initiate cooperation projects
- › Expert and user workshops on “new markets”
- › Networking like exemplary the founding of the first space and automotive technology and cooperation network “Space2Motion”
- › Promoting innovation and transfer projects with funds from the National Programme
- › Ideas competition INNOspace Masters in cooperation with the German ESA BICs, Airbus and OHB
- › The mobile INNOspaceEXPO “ALL.täglich!” for efficient public presentation of space applications in everyday life
- › Website www.dlr-innospace.de





PRIZE CATEGORIES

Materials, Components & Production

Sensor Technology & Miniaturisation

Communication & Networks

Propulsion Technology, E-Mobility & Energy Storage

Simulation & Testing

spin-in



DLR
Space Administration



AIRBUS



Business
Models for
User Needs

Pre-competition phase
Research, development, demonstrators

Initial phase
Proof of market, near-to-market prototypes

Innovation and integration phase
Technologies, systems, services & solutions

Target group:

Companies (especially SMEs), universities, and non-university research institutions

Target group:

SMEs, startups, research teams, students

Target group:

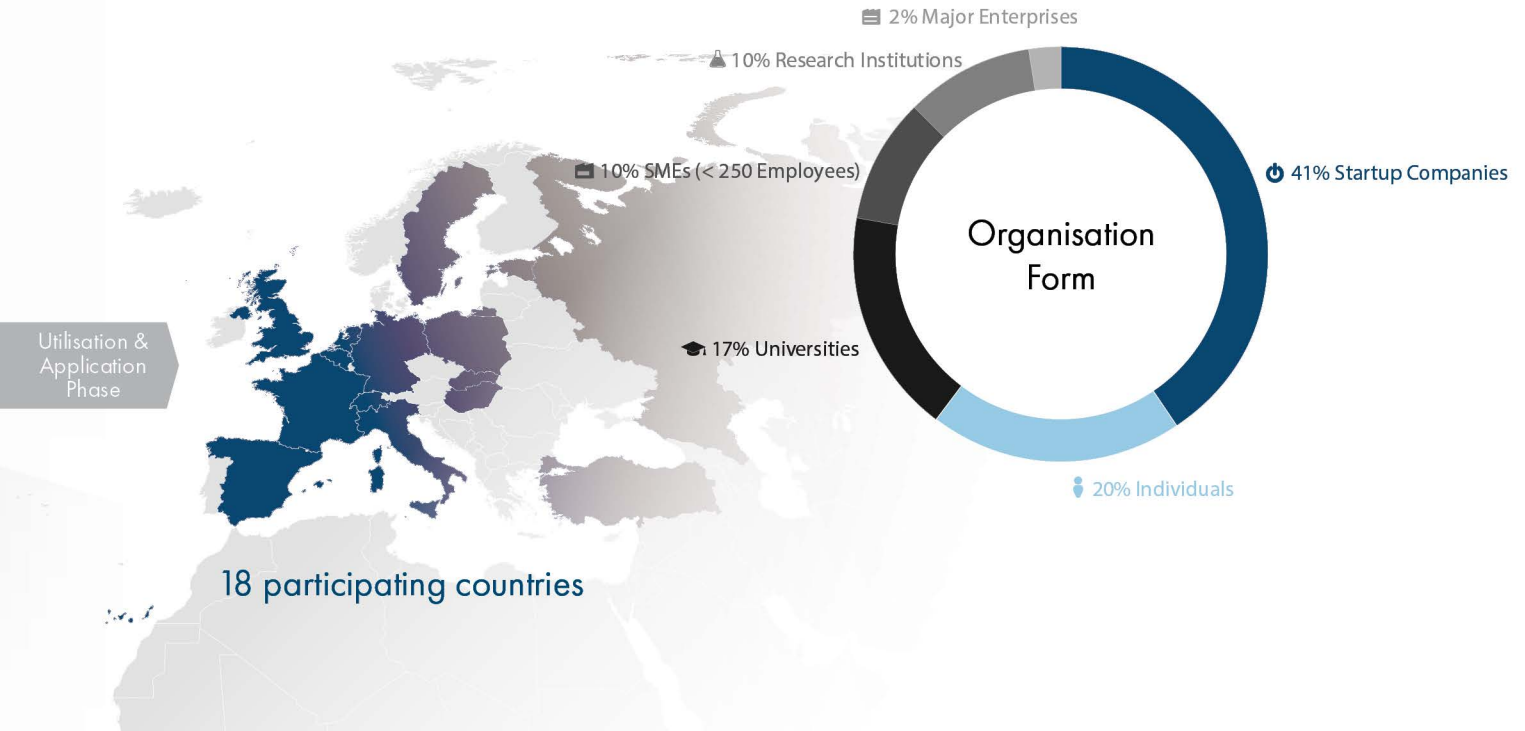
Science and industry, startups and individualists



spin-off

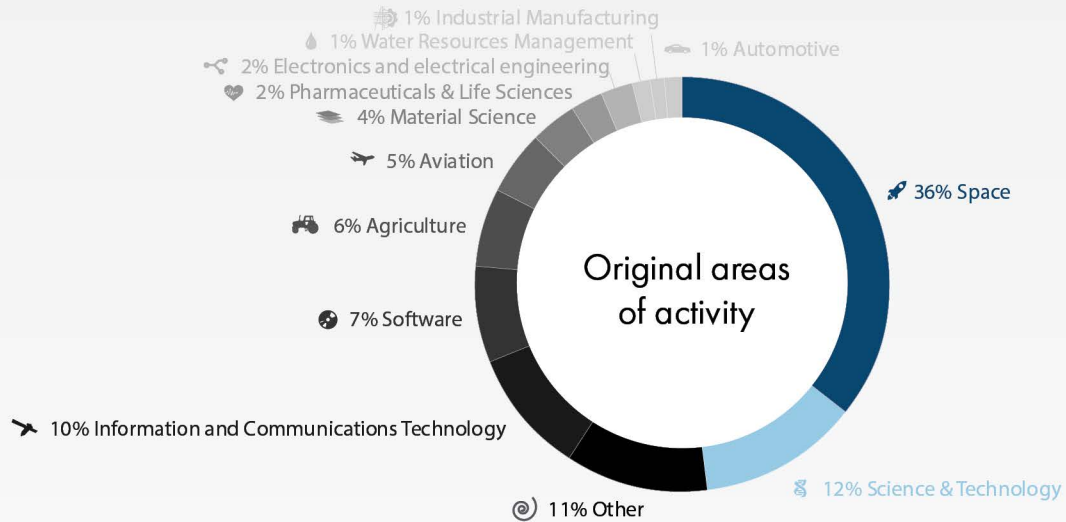
STATISTICS

The INNOspace Masters 2018 addressed companies, startups, universities and non-university research institutions worldwide. Overall, 125 participants from 18 different countries submitted 81 ideas. The ideas competition was looking for future-oriented ideas and solutions that can be transferred with know-how and technology transfer from non-space sectors into space ("spin-in") and vice versa ("spin-off").



STATISTICS

The third INNOspace Masters tackled current user challenges with the objective of finding innovative concepts and solutions related to the space industry. The finalists developed specific research methods, innovative business models and new technology and communication solutions for aerospace systems.



„Space Moves!“ Challenge by the DLR Space Administration

The space industry and the mobility sector are currently undergoing a period of transition. Increasing digitisation, complex and networked production processes, higher degree of automation and autonomous systems are seriously challenging established manufacturers.

CHALLENGE

This challenge was looking for innovative ideas and concepts for technologies as well as processes and applications that deal with current problems of the space sector or the requirements of the two industries through a mutual exchange of technology in the following categories:

- › Materials, Components & Production
- › Sensor Technology & Miniaturisation
 - › Communication & Networks
- › Propulsion Technology, E-Mobility & Energy Storage
 - › Simulation & Testing



DLR

Space Administration

PRIZE

- › Verifiable applications involving individual or joint proposals are eligible for funding from Germany's National Programme for Space and Innovation
- › Up to 400,000 Euro in possible funding for each project. This funding is subject to the general funding guidelines of the German federal government



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Infused Thermal Solutions

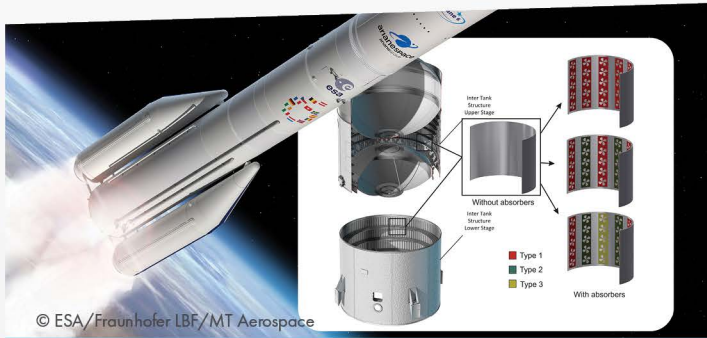
Technical components in space are often exposed to fluctuating temperatures, which can lead to degraded performances or reduced lifetimes. Infused Thermal Solutions (ITS) is an innovative concept to passively stabilize the temperature of thermo-elastic spacecraft components. This idea combines known concepts of phase change materials (PCM) with modern manufacturing techniques (3D printing). The phase change materials are embedded inside custom-printed, double-walled component structures, offering a standalone solution.

Benefits:

- › Temperature stabilisation
- › Reduced thermo-elastic deformations
- › Increased component lifetimes
- › Creation of complex lightweight “bionic” structures
- › Cost reduction
- › Technology transfer (spin-off), e.g. in the automotive industry



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 **MT AEROSPACE**
An OHB Company



Silent Running – Intrinsic Structural Vibration Reduction for Carrier Rockets Using Metamaterials

When launching and flying a rocket, vibrations must be reduced to such an extent that they do not cause damage to the payload and structure. In the “Silent Running” project, MT Aerospace and Fraunhofer LBF are using carbon-fibre-reinforced plastics (CFRP) with metamaterials, in order to reduce the vibrations that affect on the payload and structure during acceleration. Metamaterials combine the benefits of active and passive vibration reduction and are used, in the automotive industry, amongst others. “Silent Running” specifically targets to minimise vibrations in the upper stages of future Ariane carrier rockets. The innovative vibration dampers should be integrated into the load-bearing structure of the carrier rockets, so that the heavy damping elements conventionally used are no longer required.

Benefits:

- › Efficient rocket stages and complex payloads with longer service lives by minimising vibrations in the stage structures
- › Competitive new carrier rockets thanks to a reduction in weight and costs
- › Transporting of satellites with effective payloads and thus improved payload/cost ratio per launch
- › Spin-off into the automotive, aerospace and shipping industries



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 **INVENT**

UBiMAX
wear IT at work



SUMSENS – Structure-Borne Ultrasonic Multi-Hop Sensor Network for the Temperature Monitoring of Satellites

The mechanical and thermal integrity of spacecraft will be crucial for future space missions lasting months, years, or even longer. Traditionally, wired sensors are used to measure all relevant parameters. SUMSENS offers the integration of a holistic wireless sensor network using the satellite structure itself for communication, in order to provide in-situ monitoring of the mechanical and thermal subsystem status. The SUMSENS sensor network consists of smart temperature sensor nodes, communicating among themselves via structure-borne ultrasonic waves. The core of each sensor node is a microcontroller platform providing all required data operations. SUMSENS integrates Augmented Reality (AR) to support visual system integration, monitoring and maintenance. The technology can be transferred from space to ground transportation.

Benefits:

- › Wireless sensor network instead of heavy, space-consuming network infrastructure consisting of cable clutter
- › Cost reduction due to flexible installation, easy expandability, low energy consumption and reduction of communication traffic
- › Reliable, fail-safe network architectures
- › Modularity, allowing flexible installation
- › High-level structural integration



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ESA BIC Startup Challenge

Space creates innovations that are used in many industries and in everyday life – the universe is your marketplace of the future. The ESA BICs (Bavaria, Hesse & Baden-Württemberg) have already supported more than 200 startups, thereby fostering technology transfer from space to a wide variety of commercial applications.



**business
incubation
centre**

CHALLENGE

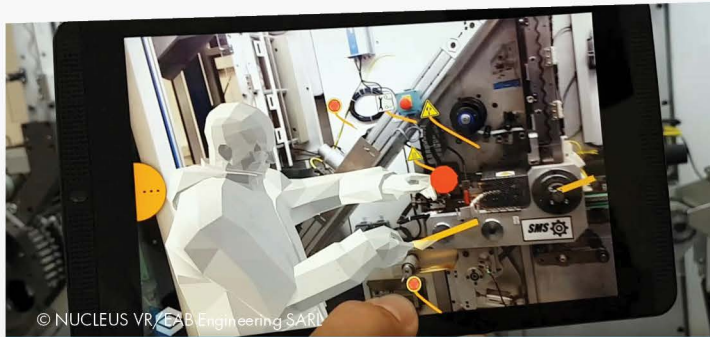
The ESA BIC Startup Challenge by the INNOspace Masters was looking for the best new business ideas and models. Possible ideas for a technology transfer from Earth into space and vice versa include:

- › Mobility applications/solutions
- › Innovative optimisation solutions
- › Increased efficiency and customer orientation solutions
 - › Components or subsystems
 - › Or any other ideas in the space sector

PRIZE

The winning proposal will be awarded with a support package tailored to the requirements of its realisation:

- › Assistance in transforming the business concept into a viable business plan
- › Support of the application in one of Germany's ESA BIC facilities. If accepted, the startup will benefit from 50,000 Euro in funding
- › Access to the Europe-wide network of experts, which can assist in technological and business-related matters
- › 5,000 Euro cash prize sponsored by Telespazio VEGA Deutschland or development contract worth at least 5,000 Euro for the realisation of the product or service idea



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NUCLEUSVR

UNITE PEOPLE AND INFORMATION
WORLDWIDE IN REALTIME

Cooperation Partners:

GRAND LYON
LA MÉTROPOLE

Communauté
UR Ouest Rhodanien

La Région
Auvergne-Rhône-Alpes

bprfrance

Initiative

CONF LUEN
CE

imaginove

TJBA



Nucleus VR – Connecting People and Information Worldwide in Real-Time

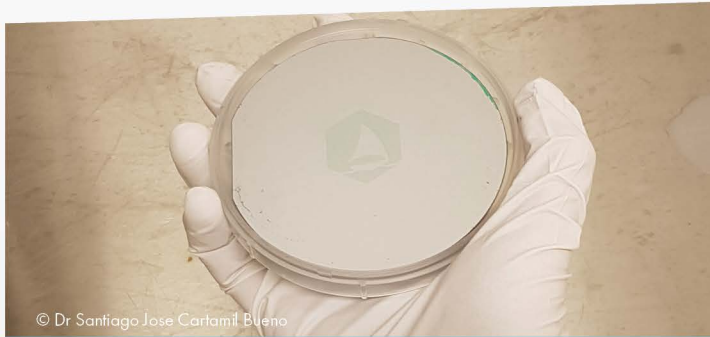
Human survival in space is highly dependent on life support systems, computers and equipment. Maintaining these complex systems requires support of hundreds of earth-based experts. Nucleus VR is removing the distance barrier, by allowing astronauts and experts to work simultaneously, as if they were together in the same place. Experts simply connect to the digital twin of the spacecraft and appear in the real spacecraft as a holographic companion. Data can also be placed on the digital twin and displayed in the real spaceship with Augmented Reality (AR). Thereby, challenges can be solved faster, and in a natural, intuitive and less stressful way.

Benefits:

- › Connecting astronauts and experts all over the world in the digital twin
- › The digital twin is built from existing CAD data using a simple drag-and-drop process
- › Many kinds of data can be pinned to the digital twin (live telemetry streams, PDF, video, 360° video)
- › Increase astronauts' well-being through meetings with family and friends in relaxing virtual worlds
- › Compatible with most existing AR/VR (Virtual Reality) hardware: HTC VIVE, OCCULUS, Android AR, castAR, PC, HOLOLENS



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GIMOD – Graphene Interferometric Modulation Displays for VR/AR

Future displays in astronaut helmets will need to integrate Virtual/Augmented Reality (VR/AR) capabilities for training and operation purposes. The screens of electronic devices with standard technologies consume the most power. Reflective-type displays (e.g. e-book readers) consume little power although current technologies cannot provide colourful images nor fast refresh rates to reproduce videos. Graphene Interferometric Modulation Displays (GIMOD) unite the advantages of the reflective-type technology (low power consumption) with those of standard technologies (video capability), in order to cater to the display requirements in future VR/AR visors. The SCALE project, implemented jointly with Gesellschaft für Angewandte Mikro- und Optoelektronik mbH (AMO) and Graphenea S.A., will commercialise the graphene technology to lead the new semiconductor industry of 2D materials.

Benefits:

- › Reflective-type display technology with high contrast in bright environments
- › Ultra-high resolution (>2500 ppi) with low power consumption
- › Ultimate refresh time (>1000 Hz)
- › Caters to the requirements of portable VR/AR visors



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Shapecomm – Shaping the Future of Satellite Communication

Current communication systems are experiencing great technical changes but do not fully reach the theoretical data rate limits. Satellite communication, in particular, requires flexibility and higher transmission rates to cope with current demands, e.g., for inflight entertainment systems or high throughput satellites. Shapecomm showcased the innovative technology of “Probabilistic Amplitude Shaping” (PAS) and “Distribution Matching” (DM), which achieved a 2.5-fold rate increase in an optical transmission experiment over the Atlantic Ocean conducted by Facebook and Nokia Bell Labs. Based on the patented technology, the company’s objective is to develop a transceiver architecture building upon the DVB-S2X standard, which could support new standardisation endeavours, possibly culminating in DVB-S3.

Benefits:

- › Increase the data rate limits of current communication systems, e.g. satellite communication links
- › Efficient use of existing resources (e.g. bandwidth), helping to serve and accommodate more users and provide a better experience to end users
- › Important enabler and pioneer for future applications that require high data rates
- › Transceiver modems can be designed and produced more flexibly and with lower costs
- › Economically efficient provision of reliable connections and high data rates in remote areas



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Airbus Challenge

Exceptional applications that – using aerospace – are capable of having a lasting positive influence on our daily lives?

CHALLENGE

Airbus was looking for exceptional ideas (technical solutions, products, services & business models) that – using aerospace (satellites, ISS, HAPS) – are capable of having a lasting positive influence on our daily lives.

This includes topics such as:

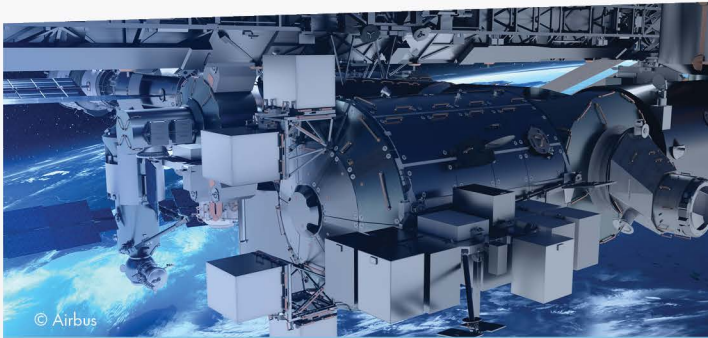
- › Autonomous driving
- › 5G connectivity and IoT/M2M
 - › Life sciences
 - › Material research
- › New technologies and service

AIRBUS

PRIZE

The winning idea receives a customised Airbus support package with elements from the following components:

- › Access to the global Airbus expert network
- › A place on the shortlist for the Airbus BizLab accelerator
 - › Possibility of pitching to Airbus Ventures
 - › Consulting for a mission proposal
- › Development of a crowd-investing campaign for a space experiment



Cloud Computing on the ISS Using Bartolomeo

Modern satellites, especially micro and nano satellites, have little in-orbit processing capabilities and data storage capacities. The satellites are dependent on sending their data regularly to a ground station. Golbriak Space OÜ is developing a cloud computing infrastructure on the International Space Station (ISS) using the Bartolomeo platform, to serve other spacecraft that would not be able to afford on-orbit processing otherwise. The “Bartolomeo cloud” could be realised through a compact high-performance computing data centre installed on the ISS, interfaced to customer spacecraft through an optical and a radio frequency (RF) antenna terminal installed on the ISS. Potential ISS cloud services could reduce the time between data acquisition and availability, in order to introduce new capabilities such as automated feature detector for Earth observing spacecraft, enhanced spacecraft autonomy (cognitive satellites) and real-time machine learning on space data.

Benefits:

- › Reduction in time between data acquisition and availability
- › In-orbit spacecraft have the ability to use machine learning services
- › Opportunity to extend missions
- › Complementary services e.g. data storage and high-bandwidth data downlink



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FISHinSPACE – Zebrafish Larvae to Study Vertebrate Physiology in Space

The Zebrafish larvae are the ideal model to study vertebrate physiology in space and to transfer the results to humans. In the “FISHinSPACE” project, the GIGA – Université de Liège will send a platform for microscopic observation of such zebrafish larvae into space. The device for automatic observation of individual larvae is a cheap and highly efficient system model for studying an entire living organism in space conditions. The biggest benefits of this model are the optimisation of human life in an extreme environment, and the exploitation of the space environment to research common health issues.

Benefits:

- › Zebrafish larvae are highly suitable to study vertebrate physiology under space conditions
- › Exploiting the space environment as a proxy for researching common health issues, such as aging, osteoporosis, or blood circulatory problems
- › Space flight market will benefit as life in extreme environments becomes easier
- › Pharmaceutical industry will benefit from an adaptable platform to develop and test new medicines



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Golden Fleece – In-Space Nanometal 2D Printing Demonstration

Golden Fleece is an intelligent solar sail concept used for spacecraft propulsion. ABM Space and AMEPOX Microelectronics developed a production process with a 2D-printing technology, allowing the solar sail to be covered with in-situ nanometal ink to place electronic circuits on the sail substrate. Nanometal has outstanding and diversified mechanical, thermal and electrical properties which can be used for various applications in the field of space materials. The development of this 2D-printing method will facilitate in-orbit production and utilisation of metals gained in the future, particularly in-situ from the Moon and asteroids. The technology enables flexible production in space, spare parts production from lightweight material and mass production from future in-situ resources.

Benefits:

- › Flexibility of electronics production in space
- › Flexibility of production of lightweight structures in space
- › Nanosilver as a biocide allows sterile structures and reductions in cleanroom costs



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OHB Challenge

The first OHB Challenge was the perfect opportunity for anyone who wants to give new impulses to tomorrow's space industry, foster creativity within interdisciplinary work in order to come up with forward-looking ideas, and also wants to get these ideas off the ground!



We. Create. Space.

CHALLENGE

OHB was looking for promising ideas for the future space sector, which interacts closely with other branches of industry. Space could benefit even more from non-space technologies and processes!

OHB would like to create new scope for realising and implementing space solutions. The OHB Challenge also required lower costs and faster availability with improved performance.

PRIZE

- › Access to relevant expert knowledge from the OHB Group
- › Cooperation opportunities at a European level through the companies in the OHB Group
- › Possibility of joint technology development programmes
- › Pitch opportunity at OHB Venture Capital
- › Support for the winner in terms of exhibition appearance during the IAC 2018 in Bremen



Biocontroller – Platform Technology for the Improvement of Microbes Applied in Space Missions

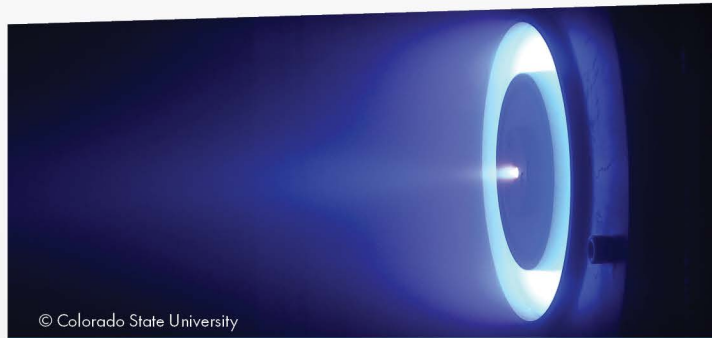
Microbes are a ticking time bomb for long-term space missions. Microbes evolve thousands of times faster than humans and, in space, they are no longer kept in check by the inexhaustible diversity of the Earth's biosphere. Regulating the evolution of microbes is crucial to prevent microbes from evolving in undesired directions and becoming tremendous threats to human health. The OPE Group's expertise lies in controlling the evolution of microbes. For this purpose, OPE designed innovative bioreactors and developed IoT-enabled hardware and software to train microbes to be beneficial to space travellers. The technology allows in-situ resource utilisation and resource recovery during deep space missions.

Benefits:

- › Cost-effective support of human life on spacecraft
- › In-situ resource utilisation and resource recovery during deep space missions to produce clean water, food, fuel, soil fertilisers, chemicals, medicines and a large variety of other materials
- › Stable and robust foundation for new ecosystems on celestial bodies to foster population
- › Reinforcing the space travellers' microbiome for disease prevention and well-being



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PVT-GAMERS – “Improved Pressure-Volume-Temperature Gauging” Method for Electric Propulsion Systems

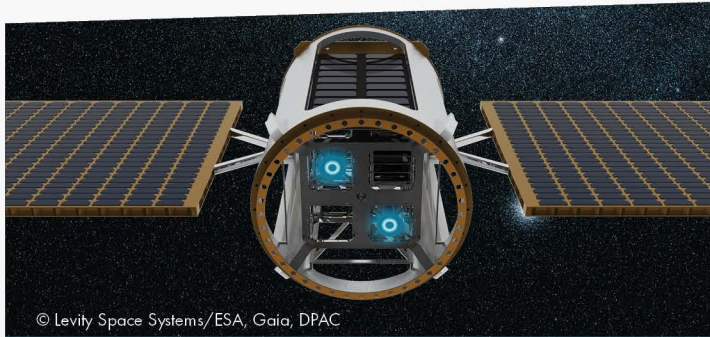
In the new era of electric propulsion, where propellant tanks are larger and missions are longer, the accuracy of classic mass retrieval methods has become obsolete. The knowledge of the exact amount of remaining propellant is critical for optimising a spacecraft’s lifespan. A team from Luleå University of Technology has developed the “Improved Pressure-Volume-Temperature Gauging” Method. This method uses existing technology readiness levels (TRL 9) sensing technologies and it improves the physical modelling of the available propellant as well as the accuracy of the classic Pressure-Volume-Temperature (PVT) retrieval techniques. Thanks to smart use of the spacecraft’s telemetry, its implementation will help spacecraft propulsion systems providers, spacecraft operators, telecommunication companies, and space agencies to increase the lifespan of space missions.

Benefits:

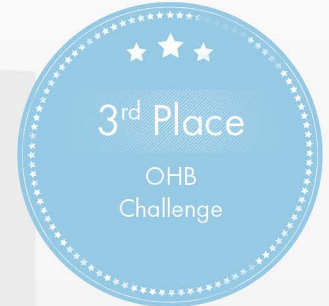
- › More accurate gauging of spacecraft propellant mass
- › Technology scalable to any propellant tank size
- › Extension of the lifespan of space missions and their profitability
- › Low-cost implementation using the existing spacecraft telemetry systems
- › Propellant control system as a transferable technology to any one-phase pressurised vessel in any sector



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ESKIMO – The Next Generation Kickstage

The launch capacity of launch providers is not always sufficient to meet the increasing demands on the flexibility of microsatellite operators. Levity Space Systems is developing an electrically propelled microlauncher kickstage, to transport small satellites into higher orbits beyond the microlauncher capabilities. The additional stage establishes a new alternative for satellite operators, by expanding mission capabilities and reducing launch costs, while increasing the launch performance of the microlauncher. The goal is to provide satellite operators with the opportunity to use microlaunchers as a viable alternative to conventional rockets, as they are able to reach low Earth and lunar orbits, reducing launch times, as well as reliable satellite constellation maintenance by specifically replacing defective satellites.

Benefits:

- › Transport of small satellites into higher orbits (access to lunar orbit using microlaunchers)
- › Reduction of the launch interval from 24 to 3 months
- › Reduction of launch- and opportunity costs
- › Deployment and maintenance of microsatellite constellations
- › Avoidance of secondary payload restrictions
- › Increasing number of possible satellite concepts and applications



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Airbus Challenge

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Autumn 2018**

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