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3rd International Conference and Exhibition on

Satellite & Space Missions

May 11-13, 2017 Barcelona, Spain

Scientific Tracks & Abstracts

Day 1

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Nicolas H Younan
Mississippi State University, USA

Session Co-Chair
Joseph Seckbach
The Hebrew University of Jerusalem, Israel

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Benjamin K Malphrus, J Aeronaut Aerospace Eng 2017, 6:2(Suppl)
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Lunar IceCube: Pioneering technologies for interplanetary small satellite exploration

Benjamin K Malphrus
Morehead State University, USA

Lunar IceCube, a 6U CubeSat designed to prospect for water in solid, liquid and vapor forms and other volatiles from a low-perigee, highly inclined lunar orbit, has been selected by NASA to fly on Exploration Mission-1 (EM-1). The mission is a partnership between Morehead State University, NASA Goddard Spaceflight Center, JPL, the Busek Company, and Vermont Tech. Lunar IceCube will be deployed during lunar trajectory by the Space Launch System (SLS) and use an innovative RF ion engine to achieve lunar capture and the science orbit (inertially locked, highly elliptical, 100 km periapsis) to investigate the distribution of water as a function of time of day, latitude and regolith composition in the context of lunar mineralogy. IceCube will include the Broadband InfraRed Compact High Resolution Exploration Spectrometer (BIRCHES), developed by GSFC- a compact version of the successful New Horizons instrument designed with the high spectral resolution (5 nm) and wavelength range (1 to 4 μm) needed to distinguish forms of water, including ice. The mission will complement the scientific work of other missions by focusing on the abundance, location and transportation physics of water ice on the lunar surface at a variety of latitudes. Lunar IceCube, while primarily a science mission, will demonstrate technologies that will enable future interplanetary exploration with small satellite platforms including radiation-hardened subsystems, a precise ranging transponder/transceiver, a capable attitude determination and control system, a high power solar array and an innovative electric propulsion system (EP). The EP (Busek BIT-3 Iodine engine) generates 1.2 km-1 of delta-v and, combined with an innovative low energy manifold trajectory, allows the spacecraft to reach lunar orbit from Earth escape with minimal energy. The 13 secondary payloads to be deployed on EM-1, including Lunar IceCube, will usher in a new era of solar system exploration with small satellite platforms.

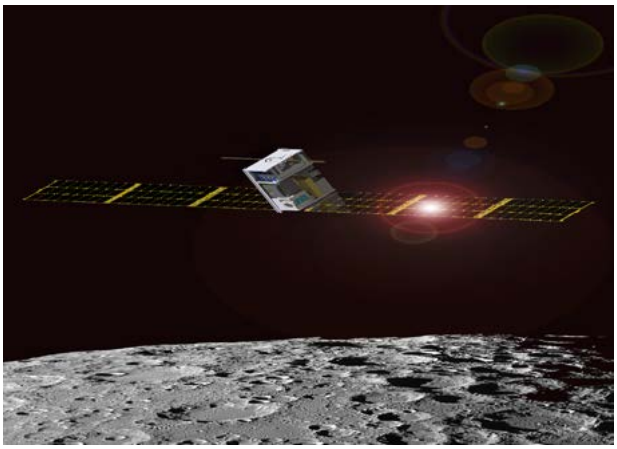

Figure 1: The Lunar IceCube mission is designed to prospect for water ice and other lunar volatiles from lunar orbit. Morehead State University is leading the mission in partnership with NASA Goddard Spaceflight Center, JPL, Busek and Vermont Tech. It was selected under NASA's Next STEP program and will fly on Exploration Mission-1 in 2018.

Biography

Benjamin K Malphrus is a Professor of Space Science at Morehead State University. He has served as Scientific Staff of the National Radio Astronomy Observatory, NASA's Wallops Flight Facility, the University of South Carolina and West Virginia University. He served as Principle Investigator (PI) on nanosatellite missions including KySat-2, the Cosmic X-ray Background Nanosatellite (CXBN), and CXBN-2, and had various roles on other small satellite missions. He is currently PI of the Lunar IceCube Mission- a $15 M NASA project designed to investigate the transport physics of water ice on the Moon. He has published papers on topics ranging from "Extragalactic astrophysics to instrumentation in radio astronomy, to nanosatellite systems development" and was awarded over $18 million R&D grants funding. In the late 1990s, he developed a theory of galaxy formation that has gained wide acceptance among the astronomical community.

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Electron photoavalanche diode arrays: A new technology for noiseless high speed near infrared sensors

Gert Finger, Derek Ives, Leander Mehrgan and **Joerg Stegmeier**
European Southern Observatory, Germany

To conduct high angular resolution observations of astronomical objects from ground based observatories, adaptive optics is needed to correct the images distorted by atmospheric turbulence. For the adaptive optics (AO) systems, low noise high speeds near infrared sensors are needed for wave front sensing and fringe tracking. Until now the performance of those sensors was based on CMOS detectors. Due to the high analog bandwidth needed for achieving frame rates of 1 KHz the readout noise severely limited the sensitivity. The only way to overcome the CMOS noise barrier is the amplification of the photoelectron signal directly at the point of absorption inside the infrared pixel by means of the noiseless avalanche gain. A breakthrough has been achieved with the development of the near infrared SAPHIRA 320x256 pixel electron avalanche photodiode arrays (e-APD) which have already been deployed in the wave front sensors and in the fringe tracker of the instrument Gravity at the Very Large Telescope Interferometer (VLTI) located on Cerro Paranal in Chile. Results obtained with this new technology will be presented. The detectors now show flat response with high quantum efficiency in the wavelength range from 0.8 µm to 2.5 um. Sub electron readout noise at frame rates of 1 KHz has been demonstrated. The dark current is as low as 0.02 e/s/pixel for an APD gain up to 8. With this performance, e-APD arrays also have the potential to outperform conventional large format NIR science focal planes. For AO systems of extremely large telescopes and for co-phasing segmented mirror telescopes larger formats are needed. Therefore, a 512x512 pixel SAPHIRA array optimized for AO applications will be developed, which has 64 outputs operating at 10 Mpixel/s/output. This corresponds to frame rates of 2 K frames/s for full single frame readout. The design of this large format SAPHIRA array will be discussed.

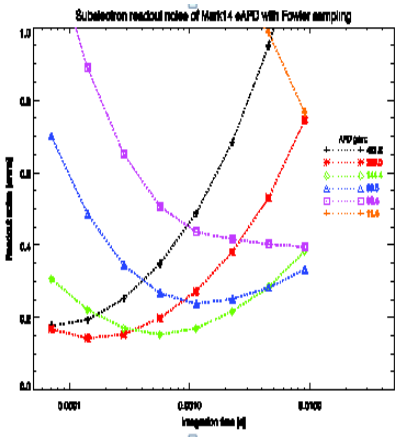

Figure 1: Sub-electron readout noise of Mark14 eAPD at a detector temperature of T=90K for different APD gains. Number of Fowler pairs is proportional to detector integration time and increase by a factor of 2 for each data point. Number of Fowler pairs from left to right: 2, 4, 8, 16, 32, 64 and 128.

Biography

Gert Finger has developed infrared arrays for astronomy and deployed them in many instruments at European Southern Observatory. He was leading the detector group at ESO. Since his retirement, he holds an emeritus position at ESO and is still actively pushing the development of eAPD technology which has been recently deployed in the Gravity instrument at the VLTI.

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Nano-satellites, the tool for a new economy of space: Opening space frontiers to a wider audience

Gloria Garcia Cuadrado
Celestia Aerospace, Spain

Space is still a frontier. The advantages of research in microgravity conditions are still somehow a private niche of the big aerospace contractors and main space agencies. But the landscape is changing and an incipient effort is being pursued to open space frontiers to small and medium-sized companies, universities, under-developed countries and non-profits. We will revise the advantages of microgravity research and a tool to conduct it at low-cost, rapid response and flexibility through the use of nano-satellites opening thus space frontiers to a wide audience. These highly capable satellites can support a wide range of mission objectives from pure research to technology demonstrators and space qualification tests. The small satellites market is valued 600 M USD to 1.000 M USD yearly with an estimated 2.200 to 2.700 needed launches in the 2015-2020 timeframe. We will also introduce a new launcher under development to serve specifically the nano-satellite incipient market to help solve the scarce launching opportunities served today by conventional launchers.

Biography

Gloria Garcia Cuadrado is a President and CEO at Celestia Aerospace, a company devoted to the opening of space access to SMEs and research groups through the use of nano-satellites. She firmly believes a new economy of space has to be developed for the benefit of all. She is Theoretical Physicist. She completed her Graduation in Physics department at University of Barcelona; Master in Theoretical Physics and; Diploma in Space Studies. She has specialization in Space Business and Management from International Space University, California, USA. She has been a Researcher at Institute of Space Studies of Catalonia; Head of Human Space Flight and Advanced Concepts at Aerospace Research & Technology Centre; and General Director of Aerospace Cluster of Catalonia, gathering more than 80 enterprises, university, technology centers and government devoted to enhance the aerospace industry. She is also a passionate Advocate for scientific education and communication.

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Research methodology in mechanical systems and bionics from Plato to contemporary science

Simona-Mariana Cretu
University of Craiova, Romania

Statement of the Problem: During the process of scientific creation, innovators can apply creativity techniques either intuitively or by using the most appropriate research methodology. A research methodology can use present or historical knowledge. Many scientific matters of current interest are described in Plato's work, and some contradictory topics from his work are still debated. A short overview referring to the methodological rules from Plato's work which has not been exceeded is considered to be necessary.

Aim: The aim of this paper is to promote the utilization of the appropriate research methodology in the process of scientific creation in the field of mechanical systems and bionics, to present some applications, as well as focusing our attention on new historical research with useful results in the present.

Methodology & Theoretical Orientation: Some of the streams used in solving difficult problems are: Experimental analysis, thought experiments, visual analogy, inventive principles recommended by TRIZ method (the theory of inventive problem solving), and maintenance of the idea in long-term-memory.

Results: The paper presents the author's point of view referring to the interpretations of Plato's books. Some new applications of Plato's ideas in mechanical systems are included. The author's strategy utilized in the process of scientific creation in bionics was applied to obtain several biological robots and models of mechanical systems inspired from nature, e.g., viruses. The applications of TRIZ method in the field of mechanisms and robots, even for the calculus, e.g., global mobility, are obtained.

Conclusion & Significance: The author aims for the paper to be useful to other young researchers who strive to improve their strategy in the process of scientific creation. In addition to that, the paper encourages researchers from different fields to collaborate together for solving the contradictions from Plato's work.

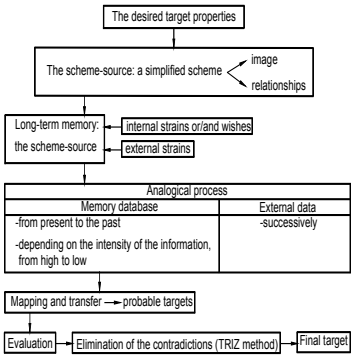

Figure 1: Algorithm for creative thinking

Biography

Simona-Mariana Cretu completed her BSc in Mechanical Engineering in 1984, and PhD in Mechanisms in 1999 at University of Craiova. From 1984 to 1992, she was a Research Engineer at Research Laboratory for CAD Systems, ICMET and Craiova. Since 1992, she has been working in Department of Applied Mechanics and Civil Engineering, Faculty of Mechanics, Craiova, where she is currently a Professor. She wrote scientific papers and books in the fields of "Mechanisms, biological robots, creative techniques, philosophy and history of science". She realized new models for legged robots and viruses inspired from nature, and proposed a new interpretation of Plato's books.

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SUCHAI 2 and 3: Scientific grounds and challenges of the new space mission of the University of Chile

Marcos A Diaz
University of Chile, Chile

Developing countries and their educational institutions are taking advantage of the CubeSat standard in order to either accelerate or even start space programs. Chile, and in particular the University of Chile, has started a space program based on CubeSats. The first university CubeSat, the Satellite of the University of Chile for Aerospace Investigation 1 (SUCHAI-1), is awaiting launch in a Falcon 9 (Space X). SUCHAI-1 was a proof of concept with simple payloads and experiments. We present the learned lessons of SUCHAI-1 and the process of starting neither a university program funded by sources external to the university in a country without a space agency nor a space program. We also present the university new space mission, which continues the efforts of the first one. The new mission under development involves the construction of 2 3U CubeSat, SUCHAI 2 and 3. The main payloads under design for this mission, and eventually for future more dedicated missions, are: magnetometers, Langmuir probes, dual frequencies GPS receivers and radio beacons. These payloads expect to gather information of the ionosphere. In particular, we will show the current status of the payloads, paying attention to the first designs of them together with the current performance. We analyze the type of physics; we might obtain with these instruments and with the fusion of data among them as well as with ground based instruments such as GNSS receivers, magnetometers networks, ionosondes and Incoherent Scatter Radars (ISRs).

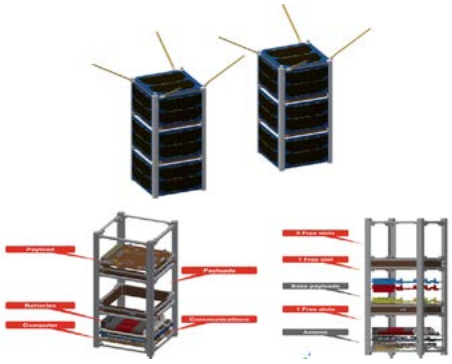

Figure: SUCHAI 2 and 3 buses. They will carry ionospheric/magnetospheric experiments.

Biography

Marcos A Diaz is a Professor in Electrical Engineering department at University of Chile, Santiago, Chile. He completed his Electrical Engineering Degree in 2001 at University of Chile; MS and PhD degrees in Electrical Engineering in 2004 and 2009, respectively at Boston University. His research interests are related to the study of ionospheric turbulent plasma, incoherent scatter radar techniques, and low-frequency-radio-astronomy/space instrumentation and nano-satellite technologies.

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Valentine A Yankovsky, J Aeronaut Aerospace Eng 2017, 6:2(Suppl)
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Proposals on multi-channel methods for the simultaneous remote sensing of [$O(^3P)$], [O_3] and [CO_2] altitude profiles in the mesosphere and lower thermosphere in daytime

Valentine A Yankovsky
St. Petersburg State University, Russia

Three small components of $O(^3P)$, O_3 and CO_2 in the daytime mesosphere and lower thermosphere (MLT) of the Earth are responsible for the thermal regime of the atmosphere. Among these components, only the altitude profile of ozone concentration can be measured by a direct method for absorbing radiation from the Sun or the stars in the UV range of the spectrum. However, this method is most often realized in the conditions of twilight, so cannot give an exhaustive presentation of the altitude profile of [O_3] throughout the daytime hours. Height profile of the atomic oxygen is usually restored on the assumption that it is looped with ozone. Despite the attractiveness of this approach, it cannot explain the altitude profile of atomic oxygen above 96-98 Km, where the ozone concentration decreases by catastrophic style. The CO_2 concentration in the MLT region is usually retrieved indirectly by solving complicated kinetic problem for the non- LTE radioactive transfer. The analogous difficulties of [O_3] retrieval from the observation of emission in 9.6 μm band are explained by the complexity of the vibrational kinetics of O_3 molecule. Retrieved values of both CO_2 and O_3 to some extent depend on a prior information about the $O(^3P)$ altitude profile. The problem can be solved by using individual proxy for each of the target component. Using a sensitivity study and uncertainty analysis of the contemporary model of O_3 and O_2 photolysis in the MLT, YM2011, we have tested three excited components; namely the electronic-vibrational excited molecules, $O_2(b1_g+, v=0, 1, 2)$, as [$O(^3P)$], [O_3] and [CO_2] proxies. We conclude that in the altitude range of 50-85 km, simultaneously independent retrievals of [O_3] and [CO_2] are possible (see figure 1); and in the range of 85-100 Km, the emissions in three channels from the $O_2(b1_g+, v=0, 1, 2)$ molecules make it possible to retrieve the [O_3], [CO_2] and [$O(^3P)$] simultaneously.

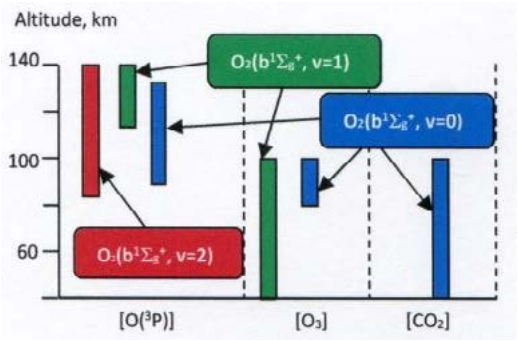

Figure 1: The types of proxy are recommended for retrieval of altitude profiles of the [$O(^3P)$], [O_3] and [CO_2] in the MLT region.

Biography

Valentine A Yankovsky is an Associate Professor of Atmospheric Physics at St. Petersburg State University. In 1986, he completed his PhD at St. Petersburg University. His main research fields are "The atmospheric photochemistry in the MLT region, the sensitivity and uncertainty study of complex photochemical systems and the retrieval of ozone and atomic oxygen in the MLT". He has published more than 25 papers in reputed journals.

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Single-satellite global positioning system

Alexander V Bagrov[1], **Vladislav A Leonov**[1] and **Valentin K Sysoev**[2]
[1]Institute of Astronomy of the Russian Academy of Sciences (INASAN), Russia
[2]Lavochkin Association, Russia

The earth global positioning systems are based on numerous set of geodetic space probes that send special signals to receiver on the earth surface. These systems need simultaneous earth-based precision astrometrical observations of every satellite spatial position, and even so the accuracy of instant positioning is only few meters. As for the moon as well for the Mars, there is no global positioning system of this kind and it seems that it never will be build. On the other hand, we need to determine instant coordinates of points of interest on the lunar surface and coordinates of space probes near the moon or landing to target point. To get it, the Russian mission "Luna-25" will deliver to the moon light beacons that will become referent points for precision selenodetic coordinate frame. The brightness of these light beacons will be enough for observation by any on-board TV-camera from near-moon orbit and by earth-based telescopes. In the case of from-orbit observations the angular position of the beacon relative to referent stars will be measured with support of onboard orientation system. Row of such angular measurements will provide us to calculate selenodetic coordinate (latitude) of the light beacon and instant coordinates of lunar satellite with accuracy about few meters by geodetic equalization methods. The "Luna-25" will be landed near lunar pole, so its beacon will be very good for latitudes measurements, but not suitable for longitudes. This problem will be solved by "Luna-26" mission, which will be a satellite on low polar lunar orbit. It will be supplied with laser projector to illuminate existing on lunar surface retro-reflectors and observe them as point-like sources. As existing retro-reflectors are not far from lunar equator, they will be good for longitudes determination.

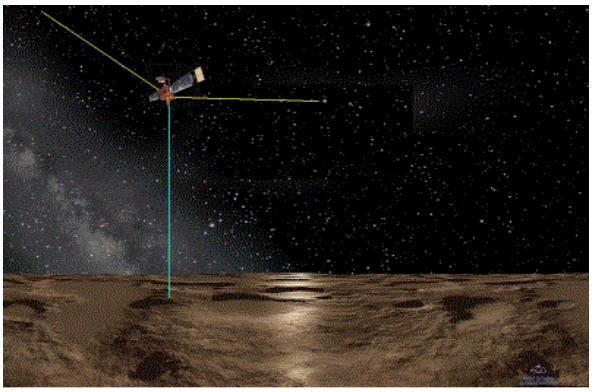

Figure 1. Angular position of lunar light beacon relative to stars can be determined from orbite by on-board TV camera and satellite's

Biography

Alexander V Bagrov as Astronomer studies minor bodies of our solar system. Besides that, he was Leader of Russian team that worked out space optical interferometer for precision measurements of stellar coordinates. In the field of Space Technique, he proposed interstellar spaceship with super-conductive magnet mirror, lunar elevator and method of non-rocket launch from mars, solar 3-D printer for lunar building. He was honored by the Russian Cosmonautic Federation to be "Space Technique Constructor". He has completed Doctor of Philosophy and Doctor of Science in Astronomy at Moscow State University. His major achievements include "Research in theory of the origin of the solar system and its planets, meteors study, asteroid-comet hazard, project of space probes OSIRIS, LIDA and STAR PATROL".

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Optimal detection of changes in real-time data: Applications in satellites

Peter Johnson
University of Manchester, UK

Detecting changes in random processes as quickly and accurately as possible is important for many scenarios. Examples include: detecting a plane using radar; identifying nuclear material at ports; reacting to breakages in atomic clocks on satellites and; determining when is the best time to buy/sell stocks and shares. Using advanced applied probability, it is possible to provide an optimal time to stop and declare that a change has occurred (optimal in the sense of minimizing the delay after the change) with a fixed probability of error. This collaborative work looks at problems of this type applied to issues in detecting breakages in clocks on board satellites. The sophisticated solutions of these optimal stopping problems show that the first hitting time of a test statistic to a defined boundary is the quickest possible decision time for a given level of accuracy (see figure). This means that no other method can outperform the algorithms used, which is a valuable asset in high performance systems. This research has two high profile satellite applications: The New Horizons mission, and The Galileo Project. Most recently solutions of this type have been involved in helping engineers from NASA detect an unusual change in the two on-board quartz clocks (which are replied upon to beam accurate data back to earth) as its satellite passed Pluto. These methods are also helping resolve similar problems in detecting the breakages in the atomic clocks used in the Galileo project; the first global navigation system primarily for civilian use is being developed by the European Union. The accuracy of these clocks is critical to accurate positioning with a 100 nanosecond error meaning positioning could be out by up to 30 meters on the ground.

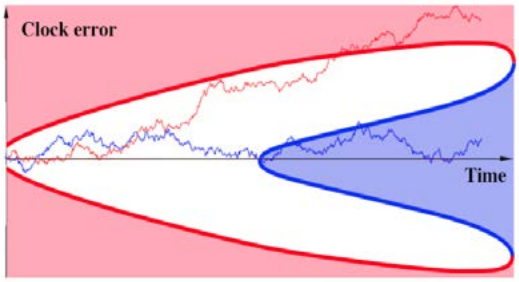

Figure. This boomerang shape is the optimal stopping boundary when the the possible clock error has a Gaussian distribution. If the clock error hits the red region then it is determined that a drift is present and the satellite temporarily stops transmissions until the clock can be recalibrated. If it hits the blue region, however, then it is determined that the clock is still working correctly and the satellite continues transmitting subject to further monitoring.

Biography

Peter Johnson is currently pursuing his Post-doctorate studies at University of Manchester, Manchester. He has mainly worked with optimal stopping and free boundary problems in the area of sequential analysis. However, he also has a keen interest in “HMM tracking algorithms, filtering theory and non-linear optimal stopping problems”. His research area is Applied Probability.

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Using object based image analysis to monitor soil aggregate breakdown under natural conditions

Irena Ymeti
University of Twente, Netherlands

Statement of the Problem: Monitoring of soil aggregate breakdown still remains a challenge. Using remote sensing approach changes on soil surface such as soil aggregate breakdown that occur over a short period of time can be detected in a fast and non-destructive way. To understand these changes, it is important to monitor the interaction between soil surface and the surrounding environment at high temporal resolution.

Methodology & Theoretical Orientation: We designed an outdoor experiment to monitor soil aggregate breakdown under natural conditions at a micro-plot scale using a regular digital camera. Five soils susceptible to detachment (silty loam with various organic matter content, loam and sandy loam) were photographed each day. We collected images and weather data from November 2014 until February 2015. When an image has a sufficient high spatial resolution, pixels are smaller than the object so grouping of pixels is possible in order to obtain real-world homogeneous features. Object-based image analysis (OBIA) approach, which allows estimation of the image area occupied by soil aggregate, was used. OBIA consider not only the spectral reflectance and neighbor relations, but also the shape and the size of objects.

Findings: Our results show that the image area covered with soil aggregate decreases over time. The trigger that initiates the decrease of area covered with aggregate is freezing-thawing followed by the rain events.

Conclusion & Significance: This research concludes that when dealing with images with very high spatial resolution object based approach should be considered for monitoring soil aggregate breakdown. The OBIA approach allows quantifying the image area covered with soil aggregate.

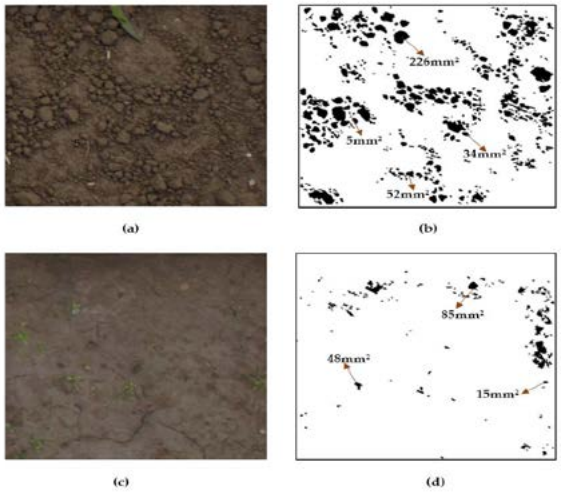

Figure: On the left side are original images (a) and (c) of silty loam soil. Using a thresholding technique soil aggregate (black color) on the right side (b) and (d) are defined. While the images (a) and (b) show the results at the beginning of the experiment, the images (c) and (d) show the results at end of the experiment). The area of some aggregates calculated in mm2 is shown as an example.

Biography

Irena Ymeti is pursuing her PhD in Earth Systems Analysis department at University of Twente, Netherlands and working on monitoring soil aggregate breakdown using Remote Sensing Technology. She started to work in Geosciences, Energy, Water and Environment at Polytechnic University of Tirana, Albania. Building a Geo-Information (GIS) and RS laboratory for processing and analyzing data for earth science applications was the focus of her work.

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Space exploration: A matter for governments or for private operators

Giancarlo Genta
Polytechnic University of Turin, Italy

Initially space exploration was based on a direct involvement of governments. The main reasons were the general cold war climate, the programmatic non-existence of a private sector in one of the main actors (the Soviet Union) and perhaps also the novelty of this enterprise, allows forecasting its cost beyond the possibilities of any private organization. Consequently, the main international treaties dealing with this subject were heavily influenced by the belief that states were the actors in space and that exploration could be peaceful only if everything of value existing beyond earth was considered as belonging to humankind in general, and could be exploited, if at all, in the interest of all. Space activity allowed the development of a space industry. The governmental agencies (and the military) were the customers of these companies, and managed the missions directly. Slowly, a new model started emerging with space agencies not dealing with all kinds of space activities, leaving all the industrial ones, in particular telecommunication, meteorological and earth resources satellites, to private companies, concentrating on their main business, namely science and exploration. Later, starting with 2000, the idea that also in science and exploration missions' space agencies should buy many services from private companies emerged, with transportation to LEO operated by privates. The launchers for scientific and exploration missions should not only be built, but also studied, designed and operated by privates. Exploration missions could be completely run by private enterprises that decide their goals, recruit the crew (if any), build the equipment, operate the mission and finally own the outcome, of whichever nature it is. Private exploration is possible only if the outcome of the mission is lucrative enough to justify the investments and the risks, like it was the case of the sea exploration journeys of the sixteenth century.

The SpaceX Red Dragon lander arriving on Mars: An emblem for private space exploration.

Biography

Giancarlo Genta is a Professor of Construction Machines at Polytechnic University of Turin. He is a member of Academy of Sciences of Torino and International Academy of Astronautics. In 2013, he received the Yangel Medal for outstanding contributions to the development of the international space sciences and technologies and the Engineering Science Award of the International Academy of Astronautics for outstanding achievement in Engineering Science. He authored 90 papers, published in Italian, American and English journals, 268 papers presented to symposia and 25 books. He is also the Author of two science fiction novels, published in Italian, English and Ukrainian.

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Leonid V Ksanfomality et al., J Aeronaut Aerospace Eng 2017, 6:2(Suppl)
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Hypothetical discovery of life on Venus

Leonid V Ksanfomality, Arnold S Selivanov and **Yuryi M Gektin**
Space Research Institute, Russia

Some of exoplanets possess physical conditions close to those of Venus. Therefore, the planet Venus, with its dense and hot (735 K) oxygen-free atmosphere of CO_2, having a high pressure of 9.2 MPa at the surface, can be a natural laboratory for this kind of studies. The only existing data on the planet's surface are still the results obtained by the Soviet VENERA landers in 1975-82. The VENERA TV experiments returned 41 panoramas of Venus surface (or their fragments). The experiments were of extreme technical complexity. They have not been repeated by any space agency in the subsequent 40 years. The VENERA panoramas have been treated as new by modern processing codes. Relatively large objects from a decimeter to half a meter in size with an unusual morphology have been found which moved very slowly or changed slightly their shape. Certain unusual findings that have a structure similar to the Earth' fauna and flora were found in different areas of the planet. Analysis of treated VENERA panoramic images revealed objects that might indicate the presence of about 11 or 12 hypothetical items of Venusian flora and fauna. Among them is 'amisada' that stands out with its unusual lizard shape climbing up at stone plates surrounding it.

Biography

Leonid V Ksanfomality completed his PhD at Abastumany Astrophysical Observatory and Post-doctoral studies at Space Research Institute, Moscow. He has published more than 300 papers in reputed journals and has been serving as an Editorial Board Member of scientific journals.

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Notes:

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AURORA project: A challenge for synergistic exploitation of Sentinel-4/-5 ozone operational products

Ugo Cortesi
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An unprecedented quantity and quality of data on the Earth's atmosphere will become available with the launch of the Sentinel-4 and Sentinel-5 operational missions of the Copernicus Program by the early 2020. The extraordinary amount of information associated to the geostationary (S-4) and Low Earth Orbit (S-5) measurements will shed new light into our understanding of air quality, climate, ozone and solar radiation. The envisaged advancement in atmospheric monitoring capability and the need to manage the volume and complexity of the data stimulated the investigation of an innovative approach to synergistic exploitation of measurement products. The AURORA H2020 project (2016-2019) is currently developing, implementing and testing a new concept based on combined use of data fusion techniques and data assimilation models to derive advanced quality products for vertical profiling of ozone from the surface to the top of the atmosphere. The ultimate goal of the scientific and technological effort of the project is to demonstrate the comparative advantages of the assimilation of fused products versus assimilation of standard operational products. Advanced quality ozone profiles will then be used to calculate tropospheric partial columns and UV surface radiation products, which might foster the development of pre-market applications, for instance in the health sector. Along with the scientific background and core elements of AURORA, a synthetic insight will be offered into the technological infrastructure constituting at the same time the set of tools for building the system and the overall assembly as final product of the project in itself. The focus on applications will aim to describe their relevance for demonstration purposes, as well as in the perspective to possible follow-up of the concept extended to a variety of atmospheric targets and application sectors.

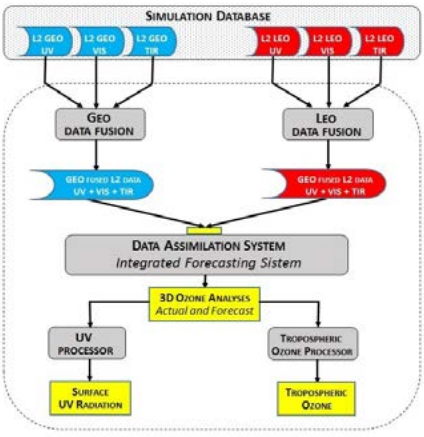

Figure 1 – The AURORA data processing chain

Biography

Ugo Cortesi is a Research Scientist with 25-years of experience in the field of Earth Observation and, in particular, in Remote Sounding of the Earth's Atmosphere. His activity is focused on a variety of subjects: "From design and development of atmospheric emission sounders, to engineering and scientific campaigns on-board high altitude platforms, to atmospheric data validation, to radiative transfer applied to forward and inverse modeling, to development and application of data fusion techniques". He is currently a member of the Mission Advisory Group of Sentinel-4 and Sentinel-5 and is acting as the Scientific Coordinator of the AURORA project funded by the European Commission in the Horizon 2020 Framework Program.

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Micro-satellite hosted laser-gated system for space debris tracking, forest fires and plants' health monitoring and underground facilities location

Yavor Yossifov Shopov[1], **Ognyan Ognyanov**[2] and **Plamen Dankov**[1]
[1]Sofia University, Bulgaria
[2]O & K Co., Bulgaria

Here, we propose a space platform integrating telescope with an interchangeable head holding five receptors: NIR, MIR, FIR and VIS cameras and laser range meter. Such construction is very appropriate for using on micro satellites and space probes because it is much more compact and light than conventional payload with separate optics for each receptor. It allows high resolution imaging for Normalized Difference Vegetation Index (NDVI) estimation of the wilting (water loss) of the vegetation to determine the degree of drying of plant, for monitoring the state of health of the vegetation, for early tracing of illness of plants, and to determine fire hazardous areas of dry vegetation in order to prevent forest fires. It is very useful for: prediction of forest fires; natural disaster warning; accurate determination of the area of the forest fire-affected areas and to monitor fire hazard areas of dry vegetation. Most effective and precise method for remote localization of forest fires is with mid-IR (MIR) camera, mounted on board of an unmanned aerial vehicle (UAV) or high resolution satellite. MIR camera sees clearly the hot spot of the fire even through dense smoke which is impossible for observations in the visible range of the spectra. Therefore, they are particularly useful for localization of the hot spots of forest fires and their extension. FIR camera allows location of entrances of underground facilities due to temperature difference of the ambient air and this coming from the facility. At the same time laser ranging is very useful for space surveillance and tracking of space debris, etc. Laser-gated imaging for debris observation/detection use common telescope with other cameras.

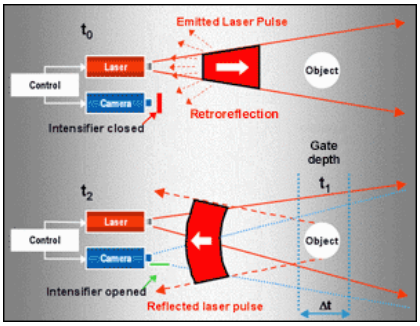

Figure 1: Principle of laser-gated scan camera object detection. The imaging sensor or "global-shutter" scan-gated camera "opens the gate" (i.e., starts the exposure) after a certain time (gate) delay for a very short period of time (gate width). Therefore, the sensor is not influenced by scattered photons or parasitic light sources. Only the photons that arrive within the gate width contribute to the resulting image. The gate delay determines the position of the detection debris object, and the camera gating time (exposure time) will define the depth of view (range depth). Therefore, the resulting image consists of information only from reflected light at the distance of interest. Changing the gate delay by a selected step, the camera can perform quite informative 3-D imaging of the possible space debris object at different distances along a given direction.

Biography

Yavor Yossifov Shopov has completed his PhD at Sofia University, Bulgaria and Post-doctoral studies at McMaster University, Canada. He is Head of University Centre for Space Research & Technologies, Sofia University. He is a Supervisor of Master Programme on aerospace engineering of small satellites at Sofia University. He has published more than 100 papers in reputed journals and has been serving as an Editorial Board Member of repute. His research interest includes "Applications of satellites in applied and fundamental research, space physics and solar-terrestrial physics, design and development of optical and spectral equipment for photographic observations and photometry in different regions of the spectrum".

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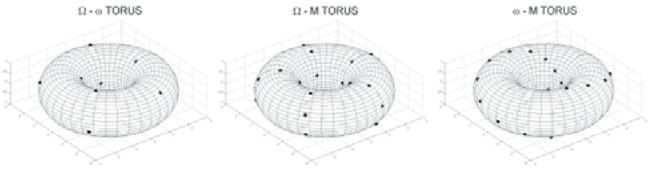
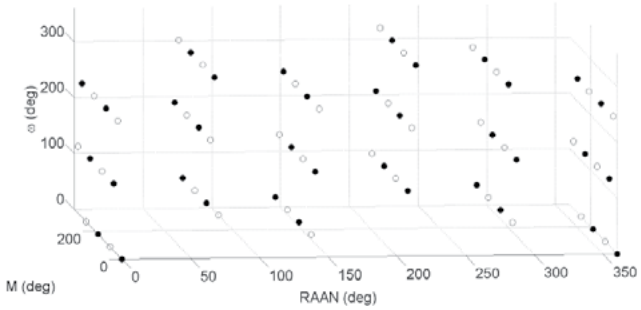
Necklaces theory applied to satellite constellation design

Eva Tresaco
University of Zaragoza, Spain

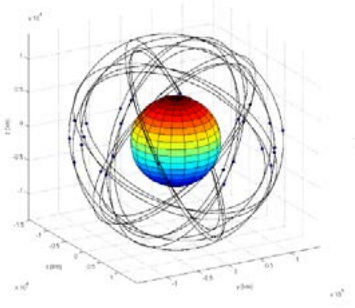
Satellite constellations are groups of satellites working cooperatively and following the same goal. In this work, we recall different ways to design satellite constellations. Satellite constellation design has been since its beginning a process that required a high number of iterations due to the lack of established models for the generation and study of constellations. This situation resulted in the necessity of specific studies for each particular mission, being unable of extrapolate the results from one mission to another. Fortunately, in the last decade, new theoretical models were developed that include in their formulation all the former configurations. One of these models is the flower constellations. In this work, we present these constellations along with the 2D-lattice flower constellation theory, which represents an improvement of the original theory since its formulation is simpler and has a physical meaning. We focus on the application of the theory of necklaces to the determination of the reference orbit of the constellation. This approach opens new design possibilities and brings what we named necklace flower constellations. Finally, we introduce a time distribution methodology to generate constellations whose satellites share a set of relative trajectories and maintain that property over time without orbit corrections. This distribution methodology is able to generate all kinds of satellites configurations including equally spaced time distributions (as the Flower Constellations Theory does) but also formation flying. To sum up, we will present examples of missions in which the satellites present the ground-track repetition property, constellations based on high eccentricity orbits and formation flying designs.



Torus representation of the constellation distribution



(Ω,ω,M)-space representation of the constellation



Inertial orbits of the constellation

Biography

Eva Tresaco completed her PhD in 2010 at University of Zaragoza. She has experience in Research, Teaching and Administration both at aerospace companies and institutions of higher education. Currently, she works as an Associate Professor at Centro Universitario de la Defensa Zaragoza (Spain). Her main research interests include “Celestial Mechanics and Dynamical Systems” where she has co-authored over 20 scientific papers and she has participated in many research projects. She is a senior member of American Institute of Aeronautics and Astronautics.

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Spatial technology: Hydrological perspectives

Imran Ahmad
Debre Tabor University, Ethiopia

State-of-the-art geospatial technologies for imaging the earth and its subsurface are invaluable tools; especially when direct measurements are sparse or even impossible. Geospatial technology with their advantages of spatial, spectral and temporal availability and manipulation of data covering large and inaccessible areas within a short time have become very handy tools in accessing, monitoring and conserving groundwater resources. In hard rock terrain such as the Palar basin (South India), interpretation of satellite data for delineation of lithological units, weathered zones, mapping of lineament density and their trends as well as intensity, are discriminatory features and form a valuable aid for the location of groundwater areas..This paper mainly deals with the approach of geospatial technology to delineate groundwater potential zones in Palar basin, South India. Digitized vector maps pertaining to chosen parameters, viz. geomorphology, geology, land use/land cover, lineament, relief, and drainage, were converted to raster data using 23 m × 23 m grid cell size. The raster maps of these parameters were assigned to their respective theme weight and class weights. The individual theme weight was multiplied by its respective class weight and then all the raster thematic layers were aggregated in a linear combination equation in Arc Map GIS Raster Calculator module.

Biography

Imran Ahmad has completed his Ph.D. in Environmental sciences from Tamil University, India in 2013. He received his B.Sc. degree from the University of Kashmir, India, in January 2004, followed by a M.Sc. degree in Environmental sciences from the University of Kashmir, India, in January 2008. He is an excellent researcher in the field of earth and environmental sciences. His research work has been published in various international journals such as Journal of Hydrology (Elsevier) and Environmental Monitoring and Assessment (Springer). Imran Ahmad is an editorial board member in several international journals, also acting as a scientific reviewer in many others. He is listed in the committee of the International Association of Management Science and Engineering Technology, Hong Kong, and he is the founding editor of a journal International Journal of Water Sciences, InTech (Croatia).

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Future intelligent earth observing satellites

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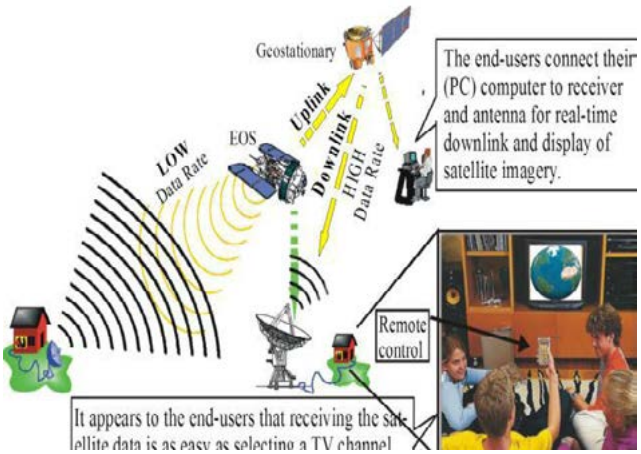
This invited paper presents the future intelligent earth observing system (FIEOS) and event-driven earth observation concepts as well as their connections to societal benefits for both decision-makers and the general public. The elucidated linkage and flow of information from FIEOS to societal benefits is interoperable. With the envisioned FIEOS, this paper focuses on: How to apply the FIEOS to increase the efficiency of monitoring natural disaster, to improve the natural disaster management, and to mitigate disasters through providing highly accurate, and reliable surveillance data for experts, analysts, and decision-makers; How to significantly increase and extend societal benefits to the future US Earth observation application strategy in, for example, real-time response to time-critical events, and disastrous environmental monitoring. Therefore, this paper presents the analysis of FIEOS to society benefit in the realms: Reducing loss of life and property from natural and human-induced disasters; improving human health and well-being; improving wealth forecasting; supporting sustainable agriculture and; serving lay people.



Biography

George Zhou completed his PhD at Wuhan University, Wuhan, China, with expertise in Earth Observing. He was a Visiting Scholar in Department of Computer Science and Technology at Tsinghua University, Beijing, China. He continued his research as an Alexander von Humboldt Fellow at Technical University of Berlin, Berlin, Germany from 1997-1998, and then became a Researcher at Ohio State University, USA from 1998 to 2000. He has published two books and more than 300 peer-reviewed papers, and has worked on 48 research grants as a Principal Investigator or a Co-principal Investigator.

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Scientific Tracks & Abstracts

Day 2

Sessions

Remote Sensing Satellites and GIS | Aerospace and Mechanical Engineering | Asteroid Impact Mission (AIM) | Earthquake and Structural Dynamics | Space Weather | Military Satellites | Orbital Mechanics | Materials Science in Space

Session Chair
Gloria Garcia-Cuadrado
Celestia Aerospace, Spain

Session Co-Chair
Dorian Gorgan
Technical University of Cluj-Napoca, Romania

Session Introduction

Title: **Engaging the user community in developing Earth observing remote sensing data products**
Vanessa M Escobar, NASA Goddard Space Flight Center, USA

Title: **Is there life on planets and satellites? Examples from extremophilic candidates on earth**
Joseph Seckbach, Hebrew University of Jerusalem, Israel

Title: **Modeling the space environment and its effects on spacecraft and astronauts using SPENVIS**
Stijn Calders, Royal Belgian Institute for Space Aeronomy, Belgium

Title: **New technologies applied to environmental remote sensing**
Emilio Ramírez-Juidías, University of Seville, Spain

Title: **Mars the harbinger of human survival**
Donald C Barker, MAXD Inc., USA

Title: **Application of remote sensing in mapping potential gold mineralization in Muteh gold mining area, Iran**
Hooshang Asadi Haroni, The University of Western Australia, Australia

Title: **The panorama of European launchers and their evolution**
Jean-Marc Astorg, National Center for Space Studies (CNES), France

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Title: **Using of thermal vision cameras for remote location of caves on Mars for immediate shelters for astronauts and storage chambers**
Yavor Yossifov Shopov, Sofia University, Bulgaria

Title: **Flying Vehicles (FV) for air and space medium, which reactive force is generated by acceleration of electrically charged particles in a constant electric field implemented both inside and outside of the FV**
Gennady Semenovich Luk'yanchikov, Prokhorov General Physics Institute-RAS, Russia

Title: **The evolvement of the university orbital constellation of small satellites series AIST for scientific, educational and applied tasks in the field of remote sensing**
Ivan S Tkachenko, Samara University, Russia

Title: **Forcing of sunspot number oscillations on North Atlantic oscillations**
Shahinaz Yousef, Cairo University, Egypt

Title: **Evolution of mission, design and utilization trends of small and miniaturized satellites in developing countries**
Mohamed B Argoun, Cairo University, Egypt

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Engaging the user community in developing Earth observing remote sensing data products

Vanessa M Escobar[1] and **Molly E Brown**[2]
[1]NASA Goddard Space Flight Center, USA
[2]University of Maryland, USA

Satellite remote sensing technology has contributed to the transformation of multiple earth science domains, putting space observations at the forefront of innovation in Earth science. With new satellite missions being launched every year, new types of Earth science data are being incorporated into science models and decision-making systems in a broad array of organizations. These applications help hazard mitigation and decision-making in government, private, and civic institutions working to reduce its impact on human wellbeing. Policy guidance and knowledge of product maturity can influence mission design as well as development of product applications in user organizations. Ensuring that satellite missions serve both the scientific and user communities without becoming unfocused and overly expensive is a critical outcome from engagement of user communities. Tracking the applications and product maturity help improve the use of data. NASA's Applications Readiness Levels (ARLs) reduce cost and increase the confidence in applications. ARLs help identify areas where NASA products are most useful while allowing the user to leverage products in early development as well as those ready for operational uses. By considering the needs of the user community early in the mission-design process, agencies can use ARLs to ensure that satellites meet the needs of multiple constituencies and the development of products is integrated into user organizations organically. ARLs and user integration provide a perspective on the maturity and readiness of a products ability to influence policy and decision-making. This paper describes the mission application development process at NASA and within the Earth Science Directorate. We present the successes and challenges faced by NASA data users and explain how ARLs helps link NASA science to the appropriate policies and decision frameworks. The methods presented here can be adapted to other programs and institutions seeking to rapidly move scientific research to applications that have societal impact.

Biography

Vanessa M Escobar is NASA's Deputy Applications Coordinator for the recently launched SMAP (Soil Moisture Active Passive) mission and for the ICESat-2 mission. She leads the science and stakeholder applications for NASA's Carbon Monitoring Systems Initiative at Goddard Space Flight Center. She facilitates and translates discussions across scientific and political boundaries related to water resource management, risk, and hydrology, remote sensing, public policy, carbon science and decision support frameworks. Her research is geared towards analyzing the sensitivity of earth science data in operational modeling systems, evaluating the value of information in decision support structures and applying that knowledge to areas of societal benefit. She works closely with the emergency response community, the reinsurance community and the wine/viticulture industry to help scale and improve the use of remote sensing observations for efficient use of resources and business management practices.

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Is there life on planets and satellites? Examples from extremophilic candidates on earth

Joseph Seckbach
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Normally life occurs everywhere; however, there are some habitats of life that have very severe environmental conditions that host microorganisms can tolerate these harsh conditions. The organisms living and thriving in these habitats are termed extremophiles and polyextremophiles (under more than one category of stress). Among the microbial extremophiles who live in stress conditions are prokaryotes (archaea, bacteria and cyanobacteria) and eukaryotes (algae protozoa, and micro-animal such as, tardigrades). Among these harsh conditions are high salt media (halophiles), high and low level of temperatures (thermophiles 45-1220C vs. cryophiles of -150C and lower, various pH levels (acidophilic vs. alkalophilic members), thermoacidophiles (growing at 45->800C with pH of below 3), high-deep pressure (barophiles or piezophiles) in deep ocean trenches or deep terrestrial subsurface, anaerobes (without oxygen), cryptoendoliths (living in microscopic spaces with in rocks, hypoliths (living under rocks in cold deserts), xerophiles (in extreme dry desiccated conditions as in Atacama desert), metallotolerant (tolerating toxic heavy levels of heavy metals), osmophiles (growing in environment of high sugar concentration), radio-resistant microorganisms, hyper gravity of tolerant bacteria; lichen survived adaptation to condition of Mars, and other organisms tolerate space conditions. In our presentation, we will cover only part of the above factors. While these environments are considered severe habitats from our anthropocentric point of view, the extremophiles consider their own environments, as a 'Garden of Eden' and our 'normal' habitat may be lethal for them. We consider these extremophiles as models or analogues for extra-terrestrial life. We are aware that some Solar System planets and satellites may contain sub icy layers of large oceans of salty water, which may bear life. The above topic is currently of high interest with the recent discovery of an exo-solar system Sun with its seven planets. It is believed that among these planets some may bear life as in our planet.

Biography

Joseph Seckbach is the Founder and Editor-in-Chief of Cellular Origins, Life in Extreme Habitats and Astrobiology Seroes. He completed his PhD at University of Chicago and Post-doctorate at Caltech, and then headed a group at UCLA studying extraterrestrial life possibilities. Later, he was appointed to the Hebrew University and spent sabbaticals at UCLA and Harvard. During 1997-98, he served at LSU, Baton Rouge, as the first selected Chair for the Louisiana Sea Grant. He published ~140 scientific articles including Hebrew-language Chemistry Lexicon. His research interest is in "Enigmatic microorganisms, life in extreme environments and astrobiology". He has given seminars at numerous universities.

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Modeling the space environment and its effects on spacecraft and astronauts using SPENVIS

Stijn Calders
Royal Belgian Institute for Space Aeronomy, Belgium

Modeling the Space Environment: Being on earth, we are well shielded from the space weather environment by our planet's atmosphere and its magnetic field. However, satellites and astronauts are directly exposed to its hazardous effects. The danger becomes increasingly more substantial when moving away from Earth's protection e.g. a spacecraft mission through the harsh radiation environment of Jupiter and its Moons or future manned missions to Mars. SPENVIS (https://www.spenvis.oma.be) is a web application that allows someone to model the space environment (i.e. cosmic rays, radiation belts, solar energetic particles, plasmas, outgassing and micro-particles) around Mercury, Earth, Mars and Jupiter but also in the interplanetary medium. In addition, it enables to calculate the potential effects of these environments on spacecraft components and astronauts.

SPENVIS - A Long and Acclaimed History: Since its first development by the Royal Belgian Institute for Space Aeronomy (BIRA-IASB) in 1996, it has been successful ESA operational software for more than 15 years. In the recent years, SPENVIS has also been integrated in ESA's Space Situational Awareness (SSAhttp://www.esa.int/Our_Activities/Operations/Space_Situational_Awareness) Space Weather Service Network. As a result, SPENVIS has established a mature user community from all over the globe that is using the system for various purposes including mission analysis and planning, education and scientific research. Lately, a new system known as SPENVIS Next Generation (http://www.spenvis-ng.eu/) has been developed under ESA's GSTP-5 programme by an international consortium led by the space weather section of BIRA-IASB. The new system has a distributed architecture, uses standards to integrate models and supports the integration to other software by offering a web interface as well as an application programmer's interface (API).

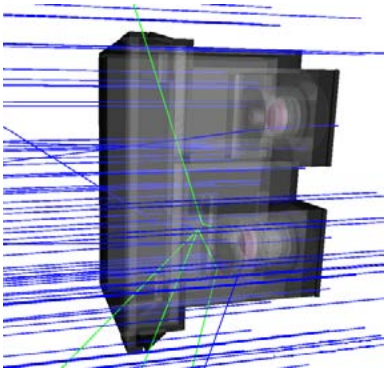

Figure 1: SPENVIS Geant4 simulation of trapped energetic proton interactions with the SREM instrument onboard PROBA-1 spacecraft.

Biography

Stijn Calders is a Project Manager with a strong expertise in IT engineering and Space Physics. He is employed at Royal Belgian Institute for Space Aeronomy to work on space weather services. Space weather is the influence of solar electromagnetic and particle radiation, galactic cosmic rays and the radiation belts on satellites, technology and human health on Earth and in space (e.g. GPS navigation, communication and astronauts). His main duty today is the technical project management of ESA's "SPENVIS Next Generation" (SPENVIS-NG) project. The key objective of the project is to upgrade the current SPENVIS system into a new web-based, service-oriented & distributed framework supporting plug-in of models related to the hazardous space environment, and including both a user friendly interface for rapid analysis and a machine-to-machine interface for interoperability with other software tools (e.g., SEISOP).

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3rd International Conference and Exhibition on

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New technologies applied to environmental remote sensing

Emilio Ramírez-Juidías
University of Seville, Spain

Both climatic factors and the dynamics of pollutants in the atmosphere are two important factors in studying the possible causes of increased rates of atmospheric pollutants in relation to the moisture of the canopy, as well as with the industrial activities existing in the study area. The city of Almadén (Ciudad Real, Spain) declared a world heritage site on June 30, 2012, is a good example of mutual relationship of sustainability existing between the eco-design of its urban design and its historical and industrial heritage, giving rise to a very peculiar landscape evolution. In this city, historical mining activity has caused a strong impact on the environment. With the development of image processing techniques, and use of a new procedure patented by the author, applied to the high resolution aerial images of the National Geographic Institute of Spain from 2004 to 2013, it is possible to obtain different results that show how the environmental sustainability of the city allows recognizing and evaluating the phenomena responsible for the increase or decrease of the atmospheric mercury concentration in Almadén. In conclusion, it can be considered that although atmospheric mercury rates are low throughout the Almadén district, it is necessary to consider the cumulative effect of both temperature and precipitation in the system since, through the relative humidity; they are responsible for the increase or decrease in atmospheric mercury concentration.

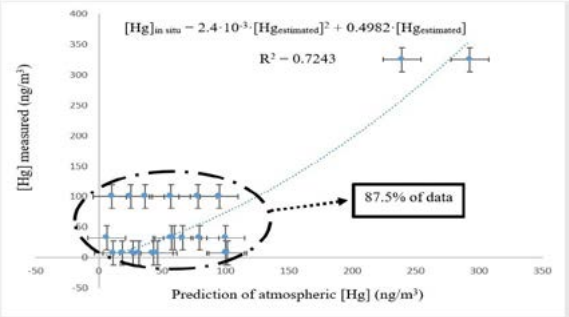

Figure 1: Prediction of atmospheric mercury concentration using the new procedure patented by the author.

Biography

Emilio Ramírez-Juidías completed his Graduation in Agricultural Engineering in 1998. He is tenured Lecturer in Graphic Engineering department at University of Seville. He completed his MSc in Water Engineering; MSc in Astronomy & Astrophysics and; PhD in Engineering in 2010. The main subject of his investigations is "Remote sensing applied to environmental sciences and solar physics". He is an Author of more than 40 books, more than 30 articles and holds six patents in different topics (Remote Sensing and Engineering). He is member of Spanish Royal Physics Society and member of editorial board of several indexed journals

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Mars the harbinger of human survival

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For the first time in the history, life on Earth has crossed a unique technological threshold enabling self-guided survival. Humanity, bound to an ever-shrinking Earth, needs a resolute, rigorous, and inspirational goal that will bind consciousness, ideals, and nations by putting humanity on a positive path for the future. Life has existed on Earth for eons for the simple reason that it has diversified into every niche possible. From a human perspective the Earth acts as single interconnected ecosystem that is ever threatened by both natural events and human behavior, and which, in the extreme portends our extinction. Given our tenuous understanding and control over the environment as well as our own behaviors and ever-increasing chances of social collapse, now is the time for humanity to think beyond its short term wants by enacting immediate off-world diversification and self- preservation efforts. Mars, for many reasons, is the most tenable and sustainable location in which to initiate such permanent diversification. Scientific curiosity alone will not initiate nor drive such off-world settlement and concerted public support for such an endeavor is shown to be constrained by human nature and attention- span. Lastly, the initial act of settlement uniquely serves as humanities greatest globally inspiring self-initiated endeavor, with tangible benefits capable of inspiring generations, connecting cultures and motivating and inspiring education in science, technology, engineering and math (STEM) in a manner similar to the dawn of human space exploration.

Biography

Donald C Barker, holds Master's degrees in Physics, Mathematics, Psychology and Space Architecture, and is currently pursuing a PhD in Planetary Geology from the University of Houston. He has held several positions over the past 20 years supporting the U.S. space program at Johnson Space Center including: Biomedical Engineer, Flight Controller, Systems Engineer (ISS Robotics, Crew Health Care, GNC-Propulsion & Operations Planning) and ISS Program Scientist. He is a certified Flight Instructor and avid mountaineer (Colorado 14'ers, Mt. Fuji, Mt. Aconcagua, and Kilimanjaro). His research interests include lunar and Mars science and exploration mission design and architectures.

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Application of remote sensing in mapping potential gold mineralization in Muteh gold mining area, Iran

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Muteh gold mining area is located in 160 km NW of Isfahan town in the Sanandaj-Sirjan metamorphic zone of central Tethyan belt in Iran. Muteh is the oldest active gold mine in Iran. Gold mineralization at Muteh is orogenic type in origin and is associated with fractured metamorphosed rocks such as metarhyolites showing hydrothermal clay alterations, silicification, carbonatization as well as iron oxides such as hematite and goethite. Image processing and interpretation were applied on the ASTER satellite imagery data of about 400 km2 at the Muteh gold mining area to identify important hydrothermal alteration minerals and iron oxides associated with gold mineralization. After applying preprocessing methods such as radiometric and geometric corrections, image processing methods such as false colored composite (FCC), principal components analysis (PCA), least square-Fit (Ls-Fit) and spectral angle mapper (SAM) were applied on the ASTER imagery data to identify hydrothermal alteration minerals and iron oxides. In this research, reference spectra of important minerals such as chlorite, hematite, goethite, quartz and clay minerals such as kaolinite, illite, smectite and phengite, identified from laboratory spectral analyses of collected samples of the Muteh gold mining area measured at Geosense company in the Netherlands, were resampled to ASTER band position, and then used to map several zones the known and unknown hydrothermal clay alterations, silicification and iron oxides in the Muteh and surrounding Muteh gold mining areas. This study identified four known gold mineralized areas of Senjedeh, Cheh Khatun, Chah Allameh and Chah Ghorom in the Muteh gold mining area. In addition, several other important targets showing similar important minerals were identified in the surrounding Muteh gold mining area. Finally, identified zones of the hydrothermal alteration minerals and iron oxides were validated by visiting and sampling them in field, and three targets, showing gold and associated arsenic and antimony mineralization, were suggested for future exploration.

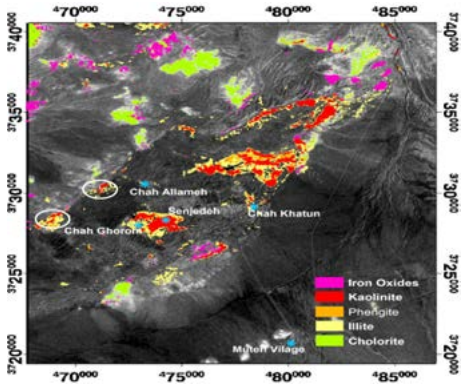

Figure 1: Processed Aster satellite image of the Muteh gold mining area

Biography

Hooshang Asadi Haroni completed his BSc in Geology; MSc and PhD in Mineral Exploration at ITC and Delft University of Technology, Netherlands. He worked for three years as Exploration Geologist and GIS Database Analyst at Rio Tinto Mining and Exploration Limited. He is now an Assistant Professor in Mining department at Isfahan University of Technology in Iran. In addition, he has been appointed as Adjunct Senior Researcher at Centre for Exploration targeting (CET), University of Western Australia (UWA) since 2013.

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Jean-Marc Astorg, J Aeronaut Aerospace Eng 2017, 6:2(Suppl)
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The panorama of European launchers and their evolution

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Currently, Arianespace operates three launch vehicles from the Guiana Space Centre: The heavy-lift launcher Ariane 5, which entered into service in 1996, has so far achieved 77 successful launches in a row since 2002. It is designed to place two heavy telecommunications satellites into geostationary transfer orbit; the medium-lift launcher Soyuz ST, for which Europe built a launch complex in French Guiana following the cooperation agreement signed with Russia in 2003. Operational since 2011, it has performed 16 launches from the Guiana Space Centre, and is fundamentally purposed to launch the Galileo satellite navigation constellation and other European institutional satellites (Earth observation, science) and; the lightweight Vega, whose development in 1997 was strongly advocated by Italy, realized its maiden flight in 2012 and has had nine successful launches since then. The Vega rocket is specifically designed to launch commercial or scientific missions with a mass lower than 1.5 tons in Low Earth Orbit. With this array of launch vehicles, Arianespace currently enjoys the availability of a fleet covering almost the full spectrum of the launch market in terms of both mass and orbits. The company remains the leading service provider on the open commercial market. However, owing to the development of new launch vehicles throughout the world, in recent years the launch service sector has indeed witnessed a hardening of competition. Therefore, the ESA Ministerial Conference of December 2014 eventually took some important decisions intended to provide Arianespace with the necessary tools to better cope with the increasing global competition: An upgraded launcher - Ariane 6 - that will be twice cheap (50% cheaper than Ariane 5), and a guaranteed market of five institutional launches per year at European level. At the Ministerial, ESA Member States also decided to proceed with the development of a new version of the Vega rocket: named Vega-C, it will be more efficient and will better meet the market needs of European small satellites. Ariane 6 and Vega C will make use of a common engine to reduce costs. The Ariane 6 programme is under development with a scheduled maiden flight in 2020. Although with Ariane 6 and Vega C, Europe will possess a range of advanced and cost-effective launch vehicles; the current pressures to reduce costs for accessing space are likely to remain a major trend in the long run. Therefore, the ESA Ministerial Conference of December 2016 also decided to fund the development of a low cost engine dubbed Prometheus that could equip the Ariane 6 evolutions either in an expandable or reusable mode.

Biography

Jean-Marc Astorg completed his Graduation at École Centrale des Arts et Manufactures in 1985. He joined the CNES Launch Vehicles Directorate and held various managerial positions in the field of European launchers, responsible alternately for programmes that were preparing the future or for developing launchers. From 1991 to 1998, he supervised the studies for the new version Ariane 5ECA, and the small Vega launcher. In 1998, he became Project Leader for development of the new ESC-A upper stage of Ariane 5. He also directed the 'Soyuz in French Guiana' project, from 2003 to the successful first launch in 2011. In 2011, he was appointed as CNES Director of Procurement, Sales and Legal Affairs. He was also CNES Director in charge of Intellectual Property, and CNES Mediator for relations with SMEs. Since 2015, he has been the Head of the CNES Launch Vehicles Directorate.

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An online batch-based fusion filter for navigation in Mars final approach phase

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Statement of the Problem: An accurate knowledge of Mars entry condition is significant for a successful aerocapture and pinpoint landing. However, the traditional navigation scheme during the final approaching phase based on the Deep Space Network cannot achieve an accurate result because of the severe time delay. Navigation based on the X-ray pulsars has been proposed to improve the navigation performance. But highly nonlinear dynamic model and relatively low updating rate of measurement may result in filter divergence.

Aim: The purpose of this study is to develop a novel online Batch-based Fusion Filter (BFF) dealing with the difficulties in Mars final approaching phase.

Methodology & Theoretical Orientation: In the algorithm, a batch-based estimation method with fixed batch length is developed to optimally determine the state of spacecraft. Unlike the traditional moving horizon estimation, only the cost function of previous measurements is used so that the differential correction method can be used. The computation cost is also reduced. To incorporate a priori information of state, a data fusion process is also employed. The stability and accuracy of batch-based estimation method is discussed, and the factors affecting the position and velocity estimation accuracy are also investigated.

Findings: The configuration of X-ray pulsars is a main contribution to the estimation error. The navigation pulsars should be carefully chosen to guarantee an accurate estimation. If three pulsars are used the direction of three pulsars should be orthogonal, which is identical to the analysis result using Fisher information matrix.

Conclusion & Significance: The proposed online Batch-based Fusion Filter gives a potential solution to the navigation for Mars final approaching phase. If the configurations of pulsars are carefully chosen, the navigation performance can also be further improved. The accuracy analysis method can also be extended to other navigation schemes based on relative position measurements.

Biography

Zhengshi Yu completed his PhD at Beijing Institute of Technology. He was a Research Scholar at University at Buffalo and worked on “The guidance, navigation, and control technologies for deep space exploration”. Now, he is pursuing his Post-doctoral Degree at Beijing Institute of Technology. He has his expertise in “Optimal estimation, trajectory optimization, autonomous guidance, navigation and control system, and image processing”. Now, he is working on “The innovative navigation, guidance and control method for Mars EDL phase and small body exploration”. He is the Project Leader of National Natural Science Foundation of China and China Postdoctoral Science Foundation Project.

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Sequential quadratic programming and metaheuristic methods applied to low-thrust interplanetary transfers

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Using transcription methods, the trajectory optimization problem can be easily converted into a non-linear programming problem. Once a set of variables and constraints are defined, one of the most efficient methods to optimize the objective function is the sequential quadratic programming. In this work, a tool that combines the SQP with two different types of metaheuristic methods (the particle swarm optimization and the differential evolution) has been developed. The results obtained with the SQP were validated using the MATLAB software FALCON.m developed at the Institute of Flight System Dynamics of Technische Universität of München. Since the PSO and the DE require converting the constrained optimization problem into an unconstrained one, a penalty function with static weights is also provided. In this work, low-thrust interplanetary transfers with electric propulsion are analyzed. The strong correlation between the weights of the penalty function, the number of generations and the accuracy of the solution is shown up with a large variety of examples. Then, the results will show if there is a real advantage using the combined method in terms of computational time and objective function.

Biography

Porzia Federica Maffione completed her Master's degree in Mechatronic Engineering at Polytechnic of Turin. Her project thesis was on Space Propulsion for human spaceflight with Variable Specific Impulse Magnetoplasma Rocket (VASIMR) and the aim of this project was to "Study the optimization problem with indirect method". Currently, she is pursuing PhD at Polytechnic of Turin and her research is about Interplanetary Missions Design for NEP and SEP.

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Yavor Yossifov Shopov, J Aeronaut Aerospace Eng 2017, 6:2(Suppl)
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Using thermal vision cameras for remote location of caves on Mars for immediate shelters for astronauts and storage chambers

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Sofia University, Bulgaria

Mars has much weaker magnetic field and lower density of atmosphere regarding the Earth. These results in very high cosmic radiation dose rate on the surface of Mars. Radiation measurements on the surface of Mars demonstrated that dose rate which will receive an astronaut there is around 15 times higher than dose limits for Radiation workers and 750 times higher than dose limits for general public. Therefore, manned exploration of Mars requires using of immediate shelters of astronauts during the initial stages of the planet exploration. Only natural shelters, which can be found there are caves. Daily variations of the surface temperature on Mars reach 110-120 degrees of Celcium. Temperature inside caves does not vary during day-and-night. It is constant (in the frames of one degree) even during the year. So location of caves on Mars can be of vital importance for future manned exploration of the planet, because such caves are appropriate for storage chambers and shelters of astronauts. We develop a new technique for remote location of cave entrances using thermal vision technique. It aims to locate new unknown caves using thermal vision camera, which visualize temperature difference on the air coming from the cave and that of the surrounding areas. During Martian nights temperature on the surface of the planet is tens of degrees of Celcium colder than that in the caves below. Therefore, cave entrances can be easily located by a thermal vision camera located on space probes or ROVs. We successfully performed preliminary remote locations of cave entrances on Earth to optimize this technique for work on Mars. So far, there are no any cave known on Mars, but there are sure indirect indicators of their existence.

Biography

Yavor Yossifov Shopov has completed his PhD at Sofia University, Bulgaria and Post-doctoral studies at McMaster University, Canada. He is the Head of University Centre for Space Research & Technologies, Sofia University. He is Supervisor of Master programme on Aerospace engineering of small satellites of Sofia University. He has published more than 100 papers in reputed journals and has been serving as an Editorial Board Member of repute. His field of research includes “Applications of satellites in applied and fundamental research, space physics and solar-terrestrial physics, design and development of optical and spectral equipment for photographic observations and photometry in different regions of the spectrum”.

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Gennady Semenovich Luk'yanchikov, J Aeronaut Aerospace Eng 2017, 6:2(Suppl)
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Flying Vehicles (FV) for air and space medium in which reactive force is generated by acceleration of electrically charged particles in a constant electric field implemented both inside and outside of the FV

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A new type of FV is proposed called ERELYOT. A special electrode system (the ERE system) is built into ERELYOT. The ERE system initiates the electrical discharge of a special type called the ERE discharge. When the ERE discharge is in outer space, there is a possibility of a mode in which all the emitted particles do not arrive at the electrodes of opposite polarity, but go away into space, thereby creating a reactive force. The power system of ERELYOT consists of the battery of fuel cells and devices, which convert the energy of electromagnetic radiation into the DC power. The purpose of this work is: to develop the design of the ERELYOT; to determine the required parameters of the power system of ERELYOT. A possible design of ERELYOT is presented. It is shown that the use of microwave and solar radiation is possible and extremely advantageous. The main task is the creation of high voltage (tens of kilovolts) battery, operating on oxygen and hydrogen with a minimal ratio of the weight of the battery to its power and low (~0°C) the temperature of the water coming out of the battery. An equally important task is to create the emitter of micro droplets of water with the maximum possible value of q/m (q, m – electric charge and mass of the droplets), and the maximum possible number of droplets emitted from a unit of surface per a unit of time. The greater is the value of q/m, the less the value of U is allowed to be.

Biography

Gennady Semenovich Luk'yanchikov is currently a Senior Researcher in Department of Plasma Physics at Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia. He completed his Graduation in Department of Electronics at Moscow Power Engineering Institute (National Research University) in 1962 and PhD in Physics-Mathematics in 1977. He has more than 50 publications. His research interests include "Plasma physics, interaction of microwave power with solids".

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The evolvement of the university orbital constellation of small satellites series AIST for scientific, educational and applied tasks in the field of remote sensing

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Launched on orbit in 2013 satellite constellation, consisting of two small spacecraft AIST is the result of joint work of students, postgraduates and young scientists of the Samara University and young professionals of Space Rocket Center Progress (Samara, Russia). Nowadays the satellites control, receiving and processing telemetry and scientific information are provided by young specialists of the university center for receiving and processing information. During three years of orbital working the unique information about the magnetic field of the earth and micrometeorite situation on two different orbits in which satellites operate were received. In addition, experience in the design, creation and operation of these satellites allowed significantly upgrading the educational process in Samara University. On 28th April 2016 during the first launch from Vostochny Cosmodrome, the new satellite of AIST constellation–Aist-2D was launched. The primary goal of Aist-2D is remote sensing with high resolution from an orbital altitude of 490 km; it provides resolution of 1.48 m in panchromatic mode and 4.5 m in multispectral mode in a 39.6 km-width band. The IR-range thermal equipment of Aist-2D which was the first to use micro-bolometric photo detectors without cooling, will not only produce night photographs, but also develop the technology for small fire foci detection. The special-purpose equipment includes an innovative radar set developed for passive earth location in a new R-range of frequencies (432-438 MHz). The scientists plan to use it for possible space observation not only of visible surfaces, but also sub-surfaces. The satellite holds six sets of scientific equipment created by scientists, students and post-graduate students of the Samara University. The article gives the first results of AIST-2D functioning and an analysis of space images and data from scientific equipment received from the satellite. Some variants of constellation evolvement are discussed also in the report.

Biography

Ivan S Tkachenko is currently an Assistant Professor in Space Engineering department at Samara University (Russia). He received his PhD at Samara University in 2011. In 2006, he organized the youth scientific-innovation center which is the main project of creation of small satellite “AIST”. In 2013, he became a Project Manager of AIST-2D satellite at Samara University. His research interests include “Space missions analysis, dynamics of flight of spacecraft with electric propulsion, methods of processing the telemetry data received from the satellites”. He has published over 50 papers.

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Forcing of sunspot number oscillations in North Atlantic oscillations

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We have found one to one correspondence of sunspot number SSN oscillation in North Atlantic Oscillation (NAO). This extremely important result can be explained by our early result that the density of solar wind is related to solar activity. We found co-evidence for oscillations in Earth's magnetopause altitude in response to variation of solar wind velocity & pressure. The variability of magnetosphere compression causes variability in atmospheric pressure with special emphasis on polar regions, in other word, oscillation in NAO.

Biography

Shahinaz Yousef completed her Graduation at Cairo University in 1966 and MSc in Nuclear Physics at London University in 1967. She completed her PhD in Solar Activity and XUV at University College London in 1971. She is a Professor in Astronomy and Space & Meteorology department, Faculty of Science, Cairo University, Egypt.

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Evolution of mission, design and utilization trends of small and miniaturized satellites in developing countries

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Over the past 25 years more than 50 countries have established space programs for building and acquisition of technology of small satellites. Small satellites are those weighting more than 20 Kg to less than 200 Kg. They are designed along the classical lines of design to perform typical missions like those of larger satellites. The first part of this paper focuses on the evolution of some of the most visible of these satellite programs in developing countries. Miniaturized satellites comprise various categories including microsatellites, nano-satellites and CubeSats. These are built to a much smaller sizes and weights through miniaturization of components and subsystems. This development has changed the focus of small satellite research from technology and operation to mission and utilization. The question now for satellite builders is not how to build, test and operate the satellite, but rather in what mission it could be employed? Since the emergence of this trend of building very small or miniaturized satellites, a large number of satellites have been launched and several categories and configurations were developed. However, a focus of the main mission of this group of satellites did not materialize. This paper attempts to trace the major design and utilization trends of this category of satellites in developing countries. This includes design trends centered on production of integrated miniaturized components and subsystems, mission trends focusing on fleet launches and satellite formation and utilization trends varying from classical uses such as remote sensing to rescue missions and education.

Biography

Mohamed B Argoun is a Professor of Dynamics and Control of Aerospace Vehicles in Department of Aerospace Engineering at Cairo University, Egypt. From 1999 to 2008, he was Director of the Egyptian Space Program and Manager of Egyptsat-1 satellite project. During the period 1998-2003, he was General Secretary of the Space Research Council in Egypt and the Head of the Space Sciences Division at National Authority of Remote Sensing and Space Sciences. From 1983-1988, he was a Professor of Mechanical Engineering at University of Wisconsin Milwaukee and worked at Atomic Energy of Canada Ltd. His research interest includes Systems Control Theory.

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