Measurement and Instrumentation Systems

National Space Institute
Short name: Measurement and Instrumentation Systems

Addresses
Type of address: Postal address
Street: Elektrovej
Building: 327
Postal code: DK-2800
City: Kgs. Lyngby
Country: Denmark

Phone numbers
Phone: (+45) 4525 2525
Fax: (+45) 4588 7133

Web addresses
Web: http://www.space.dtu.dk/English
Web: http://www.space.dtu.dk/english/Research/Research_divisions/Measurement_and_Instrumentation

E-mails
E-mail: office@space.dtu.dk

Organisation profile
Head of division: John Leif Jørgensen
Main research areas: Development of concepts, designs, implementations and verifications of the advanced high performance instruments for use on board spacecraft.
The Measurement and Instrumentation division develops high accuracy stellar reference units for spacecraft and science grade vector magnetometers for space and ground use. The division also works on optical detection and tracking sensors for space.
The division also develops optical formation flying sensors and autonomous sensor systems. These systems are refined by calibration techniques enabling full accuracy use. This calibration is done by the Measurement and Instrumentation division.

Research plan
Implementation of formation flying test lab and associated methods and techniques.
Inertial navigation techniques.
Sub-arcsecond techniques.
Interplanetary and planetary stellar magnetic measurement platforms
Planetary lander systems and autonomy

Applications of the technology
In parallel to these general instrument improvements, other applications and technology uses have been pursued. This research has led to several novel measurement principles, which encompass multi-sensor-head star trackers for improved maneuverability, sub-arcsecond accuracy instruments, astronomical telescope field determination, miniature magnetometer packages for planetary landers, autonomous radiation impact handling and guider and rendezvous docking systems.
Examples:
European Space Agency missions: SWARM, PROBA1, PROBA2, SMART1
NASA missions: IBEX, MMS, JUNO
A New Model of Jupiter's Magnetic Field from Juno's First Nine Orbits

A spherical harmonic model of the magnetic field of Jupiter is obtained from vector magnetic field observations acquired by the Juno spacecraft during its first nine polar orbits about the planet. Observations acquired during eight of these orbits provide the first truly global coverage of Jupiter's magnetic field with a coarse longitudinal separation of ~45° between perijoves. The magnetic field is represented with a degree 20 spherical harmonic model for the planetary ("internal") field, combined with a simple model of the magnetodisc for the field ("external") due to distributed magnetospheric currents. Partial solution of the underdetermined inverse problem using generalized inverse techniques yields a model ("Juno Reference Model through Perijove 9") of the planetary magnetic field with spherical harmonic coefficients well determined through degree and order 10, providing the first detailed view of a planetary dynamo beyond Earth.

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Characterization and compensation of thermo-elastic instability of SWARM optical bench on Micro Advanced Stellar Compass attitude observations

Launched into orbit on November 22, 2013, the Swarm constellation of three satellites precisely measures magnetic signal of the Earth. To ensure the high accuracy of magnetic observation by vector magnetometer (VFM), its inertial attitude is precisely determined by µASC (micro Advanced Stellar Compass). Each of the three Swarm satellites is equipped with three µASC Camera Head Units (CHU) mounted on a common optical bench (OB), which has a purpose of transference of the attitude from the star trackers to the magnetometer measurements. Although substantial pre-launch analyses were made to maximize thermal and mechanical stability of the OB, significant signal with thermal signature is discovered when comparing relative attitude between the three CHU's (Inter Boresight Angle, IBA). These misalignments between CHU's, and consequently geomagnetic reference frame, are found to be correlated with the period of angle between Swarm orbital plane and the Sun (ca. 267 days), which suggests sensitivity of optical bench system on temperature variation.

In this paper, we investigate the propagation of thermal effects into the µASC attitude observations and demonstrate how thermally induced attitude variation can be predicted and corrected in the Swarm data processing. The results after applying thermal corrections show decrease in IBA RMS from 6.41 to 2.58 arc-seconds. The model significantly improves attitude determination which, after correction, meets the requirements of Swarm satellite mission. This study demonstrates the importance of the OB pre-launch analysis to ensure minimum thermal gradient on satellite optical system and
therefore maximum attitude accuracy.

**General information**
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  - Web of Science (2015): Indexed yes
  - BFI (2014): BFI-level 1
  - Scopus rating (2014): SJR 0.908 SNIP 1.699 CiteScore 1.6
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  - Scopus rating (2012): SJR 0.475 SNIP 1.235 CiteScore 0.97
  - ISI indexed (2012): ISI indexed yes
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  - ISI indexed (2011): ISI indexed yes
  - Web of Science (2011): Indexed yes
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  - Scopus rating (2010): SJR 0.403 SNIP 1.149
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  - Scopus rating (2008): SJR 0.338 SNIP 0.755
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  - Web of Science (2006): Indexed yes
  - Scopus rating (2005): SJR 0.252 SNIP 0.651
  - Web of Science (2005): Indexed yes
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  - Scopus rating (2002): SJR 0.319 SNIP 0.806
  - Scopus rating (2001): SJR 0.23 SNIP 0.467
  - Scopus rating (2000): SJR 0.263 SNIP 0.548
  - Web of Science (2000): Indexed yes
Jupiter's interior and deep atmosphere: The initial pole-to-pole passes with the Juno spacecraft

On 27 August 2016, the Juno spacecraft acquired science observations of Jupiter, passing less than 5000 kilometers above the equatorial cloud tops. Images of Jupiter's poles show a chaotic scene, unlike Saturn's poles. Microwave sounding reveals weather features at pressures deeper than 100 bars, dominated by an ammonia-rich, narrow low-latitude plume resembling a deeper, wider version of Earth's Hadley cell. Near-infrared mapping reveals the relative humidity within prominent downwelling regions. Juno's measured gravity field differs substantially from the last available estimate and is one order of magnitude more precise. This has implications for the distribution of heavy elements in the interior, including the existence and mass of Jupiter's core. The observed magnetic field exhibits smaller spatial variations than expected, indicative of a rich harmonic content.
Jupiter's magnetosphere and aurorae observed by the Juno spacecraft during its first polar orbits

The Juno spacecraft acquired direct observations of the jovian magnetosphere and auroral emissions from a vantage point above the poles. Juno's capture orbit spanned the jovian magnetosphere from bow shock to the planet, providing magnetic field, charged particle, and wave phenomena context for Juno's passage over the poles and traverse of Jupiter's hazardous inner radiation belts. Juno's energetic particle and plasma detectors measured electrons precipitating in the polar regions, exciting intense aurorae, observed simultaneously by the ultraviolet and infrared imaging spectographs. Juno transited beneath the most intense parts of the radiation belts, passed about 4000 kilometers above the cloud tops at closest approach, well inside the jovian rings, and recorded the electrical signatures of high-velocity impacts with small particles as it traversed the equator.

General information
MICROSCOPE Mission: on-orbit assessment of the Drag-Free and Attitude Control System

Microscope successfully completed in November 2016 its on-orbit assessment. The paper begins with a brief description of the mission, the challenging performances the DFACS has to comply with and how they led to the hardware and software design. Then we go through the major phases of the commissioning months for DFACS, from the first switch-on of the scientific instrument, the star-trackers and the propulsion system until getting all of them in the same control loop and carrying out definitive tunings to reach full performance. At the end of the commissioning, we look over the most striking on-orbit observations: the linear and angular perturbations and the micro-perturbations. We finally point out the DFACS overall performances: the finest ever achieved on low earth orbit.

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Observations of interplanetary dust by the Juno magnetometer investigation

One of the Juno magnetometer investigation’s star cameras was configured to search for unidentified objects during Juno’s transit en route to Jupiter. This camera detects and registers luminous objects to magnitude 8. Objects persisting in more than five consecutive images and moving with an apparent angular rate of between 2 and 18,000 arcsec/s were recorded. Among the objects detected were a small group of objects tracked briefly in close proximity to the spacecraft. The trajectory of these objects demonstrates that they originated on the Juno spacecraft, evidently excavated by micrometeoroid impacts on the solar arrays. The majority of detections occurred just prior to and shortly after Juno’s transit of the asteroid belt. This rather novel detection technique utilizes the Juno spacecraft's prodigious 60 m² of solar array as a dust detector and provides valuable information on the distribution and motion of interplanetary (>μm sized) dust.

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Observations of MeV electrons in Jupiter’s innermost radiation belts and polar regions by the Juno radiation monitoring investigation: Perijoves 1 and 3

Juno’s “Perijove 1” (27 August 2016) and “Perijove 3” (11 December 2016) flybys through the innermost region of Jupiter’s magnetosphere (radial distances <2 Jovian radii, 1.06 RJ at closest approach) provided the first in situ look at this region’s radiation environment. Juno’s Radiation Monitoring Investigation collected particle counts and noise signatures from penetrating high-energy particle impacts in images acquired by the Stellar Reference Unit and Advanced Stellar Compass star trackers, and the Jupiter Infrared Auroral Mapper infrared imager. This coordinated observation campaign sampled radiation at the inner edges of the high-latitude lobes of the synchrotron emission region and more distant environments. Inferred omnidirectional >5 MeV and >10 MeV electron fluxes derived from these measurements provide valuable constraints for models of relativistic electron environments in the inner radiation belts. Several intense bursts of high-energy particle counts were also observed by the Advanced Stellar Compass in polar regions outside the radiation belts.

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Scopus rating (2009): SJR 2.742 SNIP 1.387
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Scopus rating (2008): SJR 2.573 SNIP 1.325
Web of Science (2008): Indexed yes
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Web of Science (2007): Indexed yes
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Web of Science (2003): Indexed yes
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Stellar aberration correction and thermoelastic compensation of Swarm μASC attitude observations: A comment to the Express Letter "Mysterious misalignments between geomagnetic and stellar reference frames seen in CHAMP and Swarm satellite measurements", by Stefan Maus

The Swarm constellation of three satellites measures the magnetic signal of the Earth using both a Vector Field Magnetometer and an Absolute Scalar Magnetometer. A Micro Advanced Stellar Compass (μASC) mounted on a common, supposedly stable, optical bench precisely determines its inertial attitude. However, comparison of the Inter Boresight Angle shows a relative attitude variation between the μASC Camera Head Units. These misalignments between Camera Head Units and a geomagnetic reference frame cannot be explained by incorrect aberration correction (as theorized by Maus). Herceg et al. found them to be caused by thermal gradient sensitivity of the optical bench system, opposing the underlying assumption of perfect platform stability. The results after applying thermal corrections show significant decrease in root mean square, with Inter Boresight Angle of thermally corrected data being nearly flat and clean from any variation caused by thermoelastic effects.
The analysis of initial Juno magnetometer data using a sparse magnetic field representation

The Juno spacecraft, now in polar orbit about Jupiter, passes much closer to Jupiter's surface than any previous spacecraft, presenting a unique opportunity to study the largest and most accessible planetary dynamo in the solar system. Here we present an analysis of magnetometer observations from Juno's first perijove pass (PJ1; to within 1.06 RJ of Jupiter's center). We calculate the residuals between the vector magnetic field observations and that calculated using the VIP4 spherical harmonic model and fit these residuals using an elastic net regression. The resulting model demonstrates how effective Juno's near-surface observations are in improving the spatial resolution of the magnetic field within the immediate vicinity of the orbit track. We identify two features resulting from our analyses: the presence of strong, oppositely signed pairs of flux patches near the equator and weak, possibly reversed-polarity patches of magnetic field over the polar regions. Additional orbits will be required to assess how robust these intriguing features are.

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The Juno Magnetic Field Investigation

The Juno Magnetic Field investigation (MAG) characterizes Jupiter’s planetary magnetic field and magnetosphere, providing the first globally distributed and proximate measurements of the magnetic field of Jupiter. The magnetic field instrumentation consists of two independent magnetometer sensor suites, each consisting of a tri-axial Fluxgate Magnetometer (FGM) sensor and a pair of co-located imaging sensors mounted on an ultra-stable optical bench. The imaging system sensors are part of a subsystem that provides accurate attitude information (to ∼20 arcsec on a spinning spacecraft) near the point of measurement of the magnetic field. The two sensor suites are accommodated at 10 and 12 m from the body of the spacecraft on a 4 m long magnetometer boom affixed to the outer end of one of three solar array assemblies. The magnetometer sensors are controlled by independent and functionally identical electronics boards within the magnetometer electronics package mounted inside Juno’s massive radiation shielded vault. The imaging sensors are controlled by a fully hardware redundant electronics package also mounted within the radiation vault. Each magnetometer sensor measures the vector magnetic field with 100 ppm absolute vector accuracy over a wide dynamic range (to 16 Gauss = 1.6 x 10^6 per axis) with a resolution of ∼0.05 nT in the most sensitive dynamic range (±1600 nT per axis). Both magnetometers sample the magnetic field simultaneously at an intrinsic sample rate of 64 vector samples per second. The magnetic field instrumentation may be reconfigured in flight to meet unanticipated needs and is fully hardware redundant. The attitude determination system compares images with an on-board star catalog to provide attitude solutions (quaternions) at a rate of up to 4 solutions per second, and may be configured to acquire images of selected targets for science and engineering analysis. The system tracks and catalogs objects that pass through the imager field of view and also provides a continuous record of radiation exposure. A spacecraft magnetic control program was implemented to provide a magnetically clean environment for the magnetic sensors, and residual spacecraft fields and/or sensor offsets are monitored in flight taking advantage of Juno’s spin (nominally 2 rpm) to separate environmental fields from those that rotate with the spacecraft.

General information

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The Juno Radiation Monitoring (RM) Investigation

The Radiation Monitoring Investigation of the Juno Mission will actively retrieve and analyze the noise signatures from penetrating radiation in the images of Juno’s star cameras and science instruments at Jupiter. The investigation’s objective is to profile Jupiter’s > 10-MeV electron environment in regions of the Jovian magnetosphere which today are still largely unexplored. This paper discusses the primary instruments on Juno which contribute to the investigation’s data suite, the measurements of camera noise from penetrating particles, spectral sensitivities and measurement ranges of the instruments, calibrations performed prior to Juno’s first science orbit, and how the measurements may be used to infer the external relativistic electron environment.
Doing Forensic on DTUsat-2 Using the Beacon Counter

DTUsat-2 was launched into a Polar LEO on a Dnepr rocket out of Yasny on 19th June 2014. After the first few days of beacon recording and precise orbit determination it became apparent that all was not nominal. One notable thing was the relatively low beacon count number. The beacon count reflects how many times the communication system has generated and transmitted a beacon. When nominal the number will reach 32767 in about 22.5 days before rolling over.

Not only did we observe a low beacon count number but most surprisingly the counter seemed the restart right before AOS when the satellite rises from the south. That observation is in direct conflict with our model for DTUsat-2 attitude. The electrical power subsystem became the primary suspect in the search for a cause for the frequent resets. However a fault in the power subsystem could not explain why the resets would occur just before AOS were the satellite should have maximum power.

A thorough investigation using modelling and beacon count mapping has been conducted in order to understand why the satellite does not operate nominally and why the beacon counter maps out contradictive to our initial understandings.

DTUsat the Ideal CDIO project

The CDIO concept was conceived by MIT, KTH, Linköping and Chalmers University to meet the changing demands of industries employing engineers. In real life engineering a theoretical model or a design is only half the picture, actual implementation and operation of a given design or technical solution is likewise challenging. The conceiving, designing, implementation and operation phases in the CDIO education aims to bring the student through a scenario simulating real life engineering. A satellite mission constitutes an ideal case for a CDIO project. Designing, building, launching and operating a satellite is not possible for any single individual nor for any single institute of expertise. Not only is interdisciplinary collaboration mandatory, but a tight control of system interfaces all the way from the conceptual phase to the operational phase is paramount. This calls for substantial documentation throughout the project that could drain valuable man-power resources from a student satellite project yielding the actual satellite construction impossible. From the very onset of the DTUsat-2 project we acknowledged this dilemma and chose a strategy in which we simplified and standardized both documentation and knowledge management. The engineering education brings the student skills within mathematics, physics, specific engineering disciplines and the ability to dissolve and analyze any technical challenge. This however is only half the picture of a real life engineering job. The other half; interdisciplinary collaboration and all the devils buried in the details of realizing any theoretical project is barely touched upon. The CDIO approach aims to simulate this and thereby prepare the students to meet the challenges of an engineering job. Whereas the standard student project at DTU involves one to three students and ends with a report or more rarely a prototype the DTUsat project involved +90 students over 9 years, achieving more than 1100 ECTS and ended with an orbiting satellite. In this paper I will go through the challenges faced and our solutions to the creation of the DTUsat-2 project.
MicroASC instrument onboard Juno spacecraft utilizing inertially controlled imaging

This contribution describes the post-processing of the raw image data acquired by the microASC instrument during the Earth-fly-by of the Juno spacecraft. The images show a unique view of the Earth and Moon system as seen from afar. The procedure utilizes attitude measurements and inter-calibration of the Camera Head Units of the microASC system to trigger the image capturing. The triggering is synchronized with the inertial attitude and rotational phase of the sensor acquiring the images. This is essentially works as inertially controlled imaging facilitating image acquisition from unexplored perspectives of moons, asteroids, icy rocks and planetary rings.
Performing High-Quality Science on CubeSats

January 2016 the International Space Science Institute in Berne, Switzerland, hosted a two-day Forum to focus on the rapid evolution of CubeSats as an enabling technology platform, with special emphasis on their promise to perform high-quality science. The Forum was initiated in coordination with a then ongoing, and recently published study performed by the US National Academies on the same topic (goo.gl/osCSQ3), and was focused on the international context of CubeSats-enabled science. This report summarizes the conclusions from this Forum to inform the growing international community of the activities in this area of research. Our discussions focused on four themes characteristic of CubeSats and their evolution: 1) identification of appropriate science in a variety of research disciplines, 2) technology development, 3) international vs. national approaches, and 4) educational benefits. These discussions will be followed by a few Appendices, each describing a concrete and illustrative example of a national or international engagement with science-focused CubeSats, or their enabling technologies.

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Scopus rating (2015): SNIP 0 SJR 0.111
Scopus rating (2014): SNIP 0 SJR 0.111
Scopus rating (2013): SNIP 0 SJR 0.122
Subduction zones seen by GOCE gravity gradients
In this study, the GOCE (Gravity field and steady state Ocean Circulation Explorer) gradiometry data were used to study geologic structures and mass variations within the lithosphere in areas of known subduction zones. The advantage of gravity gradiometry over other gravity methods is that gradients are extremely sensitive to localized density contrasts within regional geological settings, which makes it ideally suited for detecting subduction zones. Second order gravity gradients of disturbing potential were extracted from global geopotential model, the fifth release GOCE model ‘EGM_TIM_RL05’. In order to remove the signal which mainly corresponds to the gravity signal of the lower mantle, long wavelength part of the gravity signal was removed up to degree and order 60. Because the areas with notable topography differences coincide with subduction zones, topography correction was also performed. Few pattern recognition methods were tested on all 6 gravity gradient tensor components represented as global scale maps with resolution of 100km (corresponds to the resolution of the GOCE satellite data). By adjusting pattern recognition methods’ features and optimizing various input patterns, the best method was applied. That is a combination of methods based on SURF (Speeded Up Robust Features) and MSER (Maximally Stable Extremal Regions) algorithms provided in MATLAB’s Computer Vision System Toolbox. Based on 6 gravity gradient components, the global gradient anomaly maps were produced and used as starting point for analysis based on image processing. On obtained maps, locations of known subduction zones were represented with characteristic elongated patterns and cross-sections. Cross sections of well-known subduction zones were used as input patterns for pattern recognition method on global maps. The search for discrete point correspondences between these images was divided into three main steps: Interest point detection, interest point description and matching between images. Resulting routine compares vertical gravity gradient anomaly signal in the areas with known subduction zones with all locations on the Earth (covered by GOCE gravity gradients). Searching, comparing and detecting the compatible signal lead to correct detection of all known subduction zones but also gave indications for locations of unknown subduction. Apart from subduction zones, certain geological features were detected and studied. The method proved its advantages and should be easily adjusted and conducted on other datasets with similar representations.

Swarm: Recent Progress in Analysis of the Sun Induced Magnetic Disturbance
The ESA Earth Observation Magnetic Mission Swarm carries high precision vector and scalar magnetometers. Careful analyses have revealed a smaller, Sun driven magnetic disturbance of the vector magnetometer. This disturbance have empirically mapped and corrected since mid 2015. This work will show the recent developments in the modelling of this disturbance.

General information
State: Published
Organisations: National Space Institute, Geomagnetism, Measurement and Instrumentation Systems, Institut de Physique du Globe de Paris, ESRIN - ESA Centre for Earth Observation
Authors: Tesfner-Clausen, L. (Intern), Lesur, V. (Ekstern), Brauer, P. (Intern), Olsen, N. (Intern), Finlay, C. (Intern), Qamili, E. (Ekstern)
Number of pages: 1
Publication date: 2016
Event: Abstract from ESA Living Planet Symposium 2016, Prague, Czech Republic.
Main Research Area: Technical/natural sciences
Links: http://lps16.esa.int/page_session189.php#940p
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2016
The Neutron star Interior Composition Explorer (NICER): design and development

During 2014 and 2015, NASA's Neutron star Interior Composition Explorer (NICER) mission proceeded successfully through Phase C, Design and Development. An X-ray (0.2-12 keV) astrophysics payload destined for the International Space Station, NICER is manifested for launch in early 2017 on the Commercial Resupply Services SpaceX-11 flight. Its scientific objectives are to investigate the internal structure, dynamics, and energetics of neutron stars, the densest objects in the universe. During Phase C, flight components including optics, detectors, the optical bench, pointing actuators, electronics, and others were subjected to environmental testing and integrated to form the flight payload. A custom-built facility was used to co-align and integrate the X-ray "concentrator" optics and silicon-drift detectors. Ground calibration provided robust performance measures of the optical (at NASA's Goddard Space Flight Center) and detector (at the Massachusetts Institute of Technology) subsystems, while comprehensive functional tests prior to payload-level environmental testing met all instrument performance requirements. We describe here the implementation of NICER's major subsystems, summarize their performance and calibration, and outline the component-level testing that was successfully applied.

General information

State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems

Number of pages: 16
Publication date: 2016

Host publication information

Title of host publication: Proceedings of SPIE
Volume: 9905
Publisher: SPIE - International Society for Optical Engineering
Series: SPIE Proceedings - International Society for Optical Engineering
Volume: 9905
ISSN: 0277-786X
Main Research Area: Technical/natural sciences
Conference: Space Telescopes and Instrumentation 2016, Edinburgh, United Kingdom, 26/06/2016 - 26/06/2016
X-ray astrophysics, Neutron stars, Timing spectroscopy, International Space Station, X-ray pulsar-based navigation (XNAV), X-ray and gamma-ray telescopes, astronomical telescopes, Neutron star Interior Composition Explorer, Phase C, astrophysics payload, Electrical and Electronic Engineering, Environmental technology, Environmental testing, Instrument testing, NASA, Neutrons, Pulsars, Sextants, Silicon detectors, Space flight, Space stations, Space telescopes, Stars, Component level testing, Design and Development, Goddard Space Flight Center, International Space stations, X-ray pulsars, Gamma rays
Electronic versions:

The Neutron_star_Interior.pdf
A satellite based low power low volume receiver system for tracking of migrating birds

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Pages: 4430-4437
Publication date: 2015

Field-aligned currents' scale analysis performed with the Swarm constellation
We present a statistical study of the temporal- and spatial-scale characteristics of different field-aligned current (FAC) types derived with the Swarm satellite formation. We divide FACs into two classes: small-scale, up to some 10 km, which are carried predominantly by kinetic Alfvén waves, and large-scale FACs with sizes of more than 150 km. For determining temporal variability we consider measurements at the same point, the orbital crossovers near the poles, but at different times. From correlation analysis we obtain a persistent period of small-scale FACs of order 10 s, while large-scale FACs can be regarded stationary for more than 60 s. For the first time we investigate the longitudinal scales. Large-scale FACs are different on dayside and nightside. On the nightside the longitudinal extension is on average 4 times the latitudinal width, while on the dayside, particularly in the cusp region, latitudinal and longitudinal scales are comparable.

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems, German Research Centre for Geosciences, University of Bergen
Authors: Lühr, H. (Ekstern), Park, J. (Ekstern), Gjerløv, J. W. (Ekstern), Rauberg, J. (Ekstern), Michaelis, I. (Ekstern), Merayo, J. M. (Intern), Brauer, P. (Intern)
Number of pages: 8
Pages: 1-8
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: Geophysical Research Letters
Volume: 42
Issue number: 1
ISSN (Print): 0094-8276
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.429 SJR 2.657
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.35 SJR 2.819 SNIP 1.495
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 3.144 SNIP 1.496 CiteScore 4.27
Web of Science (2015): Indexed yes
Flight demonstration of formation flying capabilities for future missions (NEAT Pathfinder)

PRISMA is a demonstration mission for formation-flying and on-orbit-servicing critical technologies that involves two spacecraft launched in low Earth orbit in June 2010 and still in operation. Funded by the Swedish National Space Board, PRISMA mission has been developed by OHB Sweden with important contributions from the German Aerospace Centre (DLR/GSOC), the French Space Agency (CNES), and the Technical University of Denmark (DTU). The paper focuses on the last CNES experiment achieved in September 2012 that was devoted to the preparation of future astrometry missions illustrated by the NEAT and microNEAT mission concepts. The experiment consisted in performing the type of formation maneuvers required to point the two-satellite axis to a celestial target and maintain it fixed during the observation period.
Achieving inertial pointing for a LEO formation represented a new challenge given the numerous constraints from propellant usage to star tracker blinding. The paper presents the experiment objectives in relation with the NEAT/microNEAT mission concept, describes its main design features along with the guidance and control algorithms evolutions and discusses the results in terms of performances achieved during the two rehearsals.

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems, Centre National d’Etudes Spatiales, IPAG, OHB Sweden, Universite Paris-Sud
Authors: Delpech, M. (Ekstern), Malbet, F. (Ekstern), Karlsson, T. (Ekstern), Larsson, R. (Ekstern), Léger, A. (Ekstern), Jørgensen, J. L. (Intern)
Pages: 82-94
Publication date: 2015
Conference: 7th International Workshop on Satellite Constellation and Formation Flying, Lisbon, Portugal, 13/03/2013 - 13/03/2013
Main Research Area: Technical/natural sciences

Publication information
Journal: Acta Astronautica
Volume: 105
Issue number: 1
ISSN (Print): 0094-5765
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.49 SJR 0.758
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.08 SJR 1.009 SNIP 1.974
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.004 SNIP 1.676 CiteScore 1.49
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.998 SNIP 1.699 CiteScore 1.6
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.638 SNIP 1.411 CiteScore 1.24
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.475 SNIP 1.235 CiteScore 0.97
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.479 SNIP 1.22 CiteScore 0.88
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.403 SNIP 1.149
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.311 SNIP 0.878
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.338 SNIP 0.755
Scopus rating (2007): SJR 0.272 SNIP 0.786
Scopus rating (2006): SJR 0.332 SNIP 0.926
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.252 SNIP 0.651
Web of Science (2005): Indexed yes
High Accuracy Tracking of Space-Borne Non-Cooperative Targets
This dissertation is focused on the subject of tracking non-cooperative targets, by the use of a vision based sensor. With the main goal of navigating a spacecraft or a rover. The main objective of the dissertation is to apply image processing methods to facilitate accurate and robust measurements for the spacecraft to navigate safely and autonomously towards the target. These methods are applied on three distinct study cases, which are based on the platform of the microASC instrument.

In relation to the Mars2020 rover, a structured light system is used to navigate the PIXL instrument towards the Martian surface, whose objective is to seek evidence of ancient life in the form of chemical biosignatures. The structured light is a subsystem of the PIXL instrument consisting of two active lasers and an imager. The structured light makes use of active triangulation to support a safe approach towards the surface and to enhance the PIXL instrument's capabilities with highly accurate distance measurements. Optical observations of planetary bodies and satellites are utilized to determine the inertial position of a spacecraft. A software module is developed, tested and verified by both ground based and in-flight observations, where the performance over the complete operational envelope is characterized by simulations. The in-flight observations were captured onboard Juno, during the Earth flyby, by the microASC instrument, operating as an inertially controlled imager. The involvement in Juno's Earth Fly By operation and processing of the captured data was recognized with two Group Achievement Awards from the National Aeronautics and Space Administration.

With today's advancement in autonomy, the focus is set on in-flight tracking of a non-cooperative artificial satellite with the end goal of capturing the target. The objective is to facilitate a sensor technology that enables fully autonomous relative navigation between a target and chaser. A novel method is designed, tested and verified to comply with the requirements for the final phase of a rendezvous scenario, applicable to servicing and sample return missions.

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Pedersen, D. A. K. (Intern), Jørgensen, J. L. (Intern)
Number of pages: 208
Publication date: 2015

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
thesisDAKP.pdf

Relations
Projects:
High Accuracy Tracking of Space-Borne Non-Cooperative Targets
Source: PublicationPreSubmission
Source-ID: 134226528
Publication: Research › Ph.D. thesis – Annual report year: 2015

Stratospheric Air-Ships a Platform for Earth Observation
The interhemispheric and F region dynamo currents revisited with the Swarm constellation

Based on magnetic field data sampled by the Swarm satellite constellation it is possible for the first time to determine uniquely F region currents at low latitudes. Initial results are presented from the first 200 days of formation flight (17 April to 5 November 2014). Detailed results have been obtained for interhemispheric field-aligned currents connecting the solar quiet day magnetic variation (Sq) current systems in the two hemispheres. We obtain prominent currents from the Southern (winter) Hemisphere to the Northern around noon. Weaker currents in opposite direction are observed during morning and evening hours. Furthermore, we could confirm the existence of vertical currents above the dip equator, downward around noon and upward around sunset. For both current systems we present and discuss longitudinal variations.
Westward tilt of low-latitude plasma blobs as observed by the Swarm constellation

In this study we investigate the three-dimensional structure of low-latitude plasma blobs using multi-instrument and multisatellite observations of the Swarm constellation. During the early commissioning phase the Swarm satellites were flying at the same altitude with zonal separation of about 0.5 degrees in geographic longitude. Electron density data from the three satellites constrain the blob morphology projected onto the horizontal plane. Magnetic field deflections around blobs, which originate from field-aligned currents near the irregularity boundaries, constrain the blob structure projected onto the plane perpendicular to the ambient magnetic field. As the two constraints are given for two noncoplanar surfaces, we can get information on the three-dimensional structure of blobs. Combined observation results suggest that blobs are contained within tilted shells of geomagnetic flux tubes, which are similar to the shell structure of equatorial plasma bubbles suggested by previous studies.

General information
State: Published
Organisations: National Space Institute, IT-Department, Measurement and Instrumentation Systems, Korea Astronomy and Space Science Institute, German Research Centre for Geosciences, Uppsala University
Ingen hints i titlen

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 26 Nov 2014

Publication information
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links:
http://ing.dk/blog/ingen-hints-i-titlen-172522
Publication: Communication › Internet publication – Annual report year: 2014

DTUSAT 2 Close Approach Notification

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 3 Nov 2014

Publication information
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links:
http://ing.dk/blog/dtusat-2-close-approach-notification-171510
Publication: Communication › Internet publication – Annual report year: 2014

TLE’erne opdateret

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 24 Jun 2014

Publication information
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links:
Optical stimulator for vision-based sensors

We have developed an optical stimulator system for vision-based sensors. The stimulator is an efficient tool for stimulating a camera during on-ground testing with scenes representative of spacecraft flights. Such scenes include starry sky, planetary objects, and other spacecraft. The optical stimulator is used as a test bench to simulate high-precision navigation by different types of camera systems that are used onboard spacecraft, planetary rovers, and for spacecraft rendezvous and proximity maneuvers. Careful hardware design and preoperational calibration of the stimulator result in high precision and long-term stability. The system can be continuously used over several days. By facilitating a full camera including optics in the loop, the stimulator enables the more realistic simulation of flight maneuvers based on navigation cameras than pure computer simulations or camera stimulations without the involvement of the actual optics.

General information
Nedtælling til torsdag, fredag og 2014

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 18 Nov 2013

Publication information
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links:
http://ing.dk/blog/nedtaelling-til-torsdag-fredag-og-2014-164341
Publication: Communication › Internet publication – Annual report year: 2014

Lidt om satellitbaner

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 3 Sep 2013

Publication information
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links:
http://ing.dk/blog/lidt-om-satellitbaner-161427
Publication: Communication › Internet publication – Annual report year: 2014

Gæt et ben

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 26 Aug 2013

Publication information
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links:
http://ing.dk/blog/gaet-et-ben-161220
Publication: Communication › Internet publication – Annual report year: 2014

Fejlsøgning med varmesyn
Spændingen udløst

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 31 May 2013

Publication information
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links:
http://ing.dk/blog/spaendingen-udloest-159297
Publication: Communication › Internet publication – Annual report year: 2014

PPL Antennen

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 24 May 2013

Publication information
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links:
http://ing.dk/blog/ppl-antennen-159064
Publication: Communication › Internet publication – Annual report year: 2014

Spot en bøf

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 17 May 2013

Publication information
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links:
http://ing.dk/blog/spot-en-boef-158870
Publication: Communication › Internet publication – Annual report year: 2014
**Seeing is believing**

**General information**
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 6 May 2013

**Publication information**
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links: http://ing.dk/blog/seeing-believing-158509
Publication: Communication › Internet publication – Annual report year: 2014

**Vi går spændt og venter i øjeblikket**

**General information**
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Fléron, R. (Intern)
Publication date: 29 Apr 2013

**Publication information**
Type: Blog
Source/Publisher: Ingeniøren
Main Research Area: Technical/natural sciences
Links: http://ing.dk/blog/vi-gaar-spaendt-og-venter-i-oejeblikket-158307
Publication: Communication › Internet publication – Annual report year: 2014

**3-D velocity structure of upper crust beneath NW Bohemia/Vogtland**

We present preliminary results from a travel time tomography investigation of the upper crust beneath west Bohemia/Vogtland region which is characterized by a series of phenomena like occurrence of repeated earthquake swarms, surface exhalation, CO2 enriched fluids, mofettes, mineral springs and enhanced heat flow. This region is an excellent location for an ICDP drilling project targeted to a better understanding of the crust in an active magmatic environment.

The data set were taken from permanent and temporary seismic networks in Germany and Czech Republic from 2000 to 2010, as well as active seismic experiments like Celebration 2000 and quarry blasts. Seismic Handler was applied for picking P and S wave arrival times. Before travel time inversion, we selected 399 events which were recorded by 9 or more stations and azimuthal gap<160°. In the first step a simultaneous inversion of P and S wave 1-D velocity models together with relocations of hypocenters and station corrections was performed. To test the reliability of earthquake locations we performed two experiments: first relocation of randomly perturbed earthquakes in the preferred 1-D velocity model, second mislocations of shots to check the accuracy of the earthquake positions.

**General information**
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems, University of Leipzig, German Research Centre for Geosciences
Authors: Mousavi, S. S. (Ekstern), Korn, M. (Ekstern), Bauer, K. (Ekstern), Rössler, D. (Intern)
Number of pages: 1
Publication date: 2013
Main Research Area: Technical/natural sciences
Electronic versions: moussavietaldgg2013.pdf
Source: dtu
Source-ID: u::7178
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2013

**3D velocity structure of upper crust beneath NW Bohemia/Vogtland**
Comparison between the Juno Earth flyby magnetic measurements and the magnetometer package on the IRIS solar observatory

**General information**
State: Published
Organisations: National Space Institute, IT-Department, Measurement and Instrumentation Systems
Authors: Merayo, J. M. (Intern), Connerney, J. E. (Ekstern), Jørgensen, J. L. (Intern), Dougherty, B. (Ekstern)
Number of pages: 1
Publication date: 2013
Event: Poster session presented at AGU Fall Meeting 2013, San Francisco, United States.
Main Research Area: Technical/natural sciences

Earth's Radiation Belts: The View from Juno's Cameras

**General information**
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Number of pages: 1
Publication date: 2013
Event: Poster session presented at AGU Fall Meeting 2013, San Francisco, United States.
Main Research Area: Technical/natural sciences

Juno and Jupiter's Magnetic Field

**General information**
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Bloxham, J. (Ekstern), Connerney, J. E. (Ekstern), Jørgensen, J. L. (Intern)
Number of pages: 1
Publication date: 2013
Event: Poster session presented at AGU Fall Meeting 2013, San Francisco, United States.
Main Research Area: Technical/natural sciences

Bibliographical note
(Invited)

Juno Magnetometer Observations in the Earth's Magnetosphere

**General information**
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems, IT-Department
Authors: Connerney, J. E. (Ekstern), Oliversen, R. J. (Ekstern), Espley, J. R. (Ekstern), MacDowall, R. J. (Ekstern), Schnurr, R. (Ekstern), Sheppard, D. (Ekstern), Odom, J. (Ekstern), Lawton, P. (Ekstern), Murphy, S. (Ekstern), Jørgensen, J. L. (Intern), Jørgensen, P. S. (Intern), Merayo, J. M. (Intern), Denver, T. (Intern), Bloxham, J. (Ekstern), Smith, E. J. (Ekstern), Murphy, N. (Ekstern)
Number of pages: 1
Publication date: 2013
Event: Poster session presented at AGU Fall Meeting 2013, San Francisco, United States.
Main Research Area: Technical/natural sciences
Micropropulsion Systems for Precision Controlled Space Flight

Space science is subject to a constantly increasing demand for larger coherence lengths or apertures of the space observation systems, which in turn translates into a demand for increased dimensions and subsequently cost and complexity of the systems. When this increasing demand reaches the practical limitations of increasing the physical dimensions of the spacecrafts, the observation platforms will have to be distributed on more spacecrafts flying in very accurate formations. Consequently, the observation platform becomes much more sensitive to disturbances from the space environment. This project is thus concentrating on developing a method by which an entire, efficient, control system compensating for the disturbances from the space environment and thereby enabling precision formation flight can be realized.

The space environment is initially studied and the knowledge gained is used to deduce the requirements for a propulsion system constituting the actuator part of a control system eliminating the disturbances from the space environment. Due to the minute magnitudes of the forces to be delivered, this type of propulsion has been denoted Micropropulsion. Initially a theoretical study of the disturbance forces and their influence on a precision controlled spacecraft, is used to deduce the requirements for a micropropulsion system compensating for these. Following this an LTCC based resistojet microthruster is developed and fabricated, utilizing water as fuel. Towards the end of the project, a proof of concept has been conducted, by proving the principle is working in atmospheric conditions. The solution to evolve the concept into being applicable for space applications is then given.

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Larsen, J. (Intern), Jørgensen, J. L. (Intern)
Number of pages: 144
Publication date: 2013

Publications information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
Thesis_1_.pdf
Publication: Research › Ph.D. thesis – Annual report year: 2013

Need for a mission to understand the Earth-Venus-Mars difference in Nitrogen

General information
State: Published
Organisations: National Space Institute, IT-Department, Measurement and Instrumentation Systems
Authors: The NITRO proposal Team
Number of pages: 1
Publication date: 2013
Event: Poster session presented at European Geosciences Union General Assembly 2013, Vienna, Austria.
Main Research Area: Technical/natural sciences

Bibliographical note
EGU2013-3049
Publication: Research - peer-review › Poster – Annual report year: 2013

Opportunity Science Using the Juno Magnetometer Investigation Star Trackers

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Jørgensen, J. L. (Intern), Connerney, J. E. (Ekstern), Malinnikova Bang, A. (Intern), Denver, T. (Intern), Oliversen, R. J. (Ekstern), Benn, M. (Intern), Lawton, P. (Ekstern)
Number of pages: 1
Publication date: 2013
Event: Poster session presented at AGU Fall Meeting 2013, San Francisco, United States.
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Poster – Annual report year: 2013
Pose Estimation of an Uncooperative Spacecraft from Actual Space Imagery

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems, German Aerospace Center
Authors: D'Amico, S. (Ekstern), Benn, M. (Intern), Jørgensen, J. L. (Intern)
Number of pages: 17
Publication date: 2013

Host publication information
Title of host publication: Proceedings of 5th International Conference on Spacecraft Formation Flying Missions and Technologies
Place of publication: Munich, Germany
Main Research Area: Technical/natural sciences
Conference: 5th International Conference on Spacecraft Formation Flying Missions and Technologies, München, Germany, 29/05/2013 - 29/05/2013
Electronic versions:
4081p.pdf
Links:
Source: dtu
Source-ID: u::10008
Publication: Research - peer-review › Article in proceedings – Annual report year: 2013

Post-Cluster: Need for a mission to understand Nitrogen in space

General information
State: Published
Organisations: National Space Institute, IT-Department, Measurement and Instrumentation Systems
Authors: The NITRO proposal Team
Number of pages: 1
Publication date: 2013
Event: Abstract from 23rd Cluster Workshop, Tromso, Norway.
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2013

Recent developments in fluxgate magnetometers

General information
State: Published
Organisations: National Space Institute, IT-Department, Measurement and Instrumentation Systems
Authors: Merayo, J. M. (Intern)
Number of pages: 1
Publication date: 2013
Event: Abstract from International conference on materials and applications for sensors and transducers, Prague, Czech Republic.
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2013

Segmented seismicity of the Mw 6.2 Baladeh earthquake sequence (Alborz mountains, Iran) revealed from regional moment tensors

The Mw 6.2 Baladeh earthquake occurred on 28 May 2004 in the Alborz Mountains, northern Iran. This earthquake was the first strong shock in this intracontinental orogen for which digital regional broadband data are available. The Baladeh event provides a rare opportunity to study fault geometry and ongoing deformation processes using modern seismological methods. A joint inversion for hypocentres and a velocity model plus a surface-wave group dispersion curve analysis were used to obtain an adapted velocity model, customised for mid- and long-period waveform modelling. Based on the new velocity model, regional waveform data of the mainshock and larger aftershocks (Mw ≥3.3) were inverted for moment tensors. For the Baladeh mainshock, this included inversion for kinematic parameters. All analysed earthquakes show dominant thrust mechanisms at depths between 14 and 26 km, with NW–SE striking fault planes. The mainshock ruptured a 28° south-dipping area of 24 × 21 km along a north-easterly direction. The rupture plane of the mainshock does not coincide with the aftershock distribution, neither in map view nor with respect to depth. The considered aftershocks form two main clusters. The eastern cluster is associated with the mainshock. The western cluster does not appear to be connected with the rupture plane of the mainshock but, instead, indicates a second activated fault plane dipping at 85° towards the north.
Synthesis and Validation of Vision Based Spacecraft Navigation

This dissertation targets spacecraft navigation by means of vision based sensors. The goal is to achieve autonomous, robust and efficient navigation through a multidisciplinary research and development effort, covering the fields of computer vision, electronics, optics and mechanics.

The attention of space organizations worldwide, both public and private, is once again directed at our natural satellite. The Moon offers an unimaginably rich reservoir of resources exposed on its surface; a prime example being Helium-3. Furthermore, its distance from Earth's electromagnetic interferences and its lack of atmosphere make it a naturally optimal location for scientific observation of Earth and outer space. Finally, it is an ideal location for establishing outposts for deeper Solar System exploration. Despite the successful endeavours of the past century, direct or remote manned operation of vehicles directed to the Moon's surface is still prohibitively expensive and not ideal for missions such as cargo delivery. The first part of this book focuses on a lunar landing scenario as case study and discusses software and hardware components for an optimal vision based sensor for precision planetary landing. Computer vision techniques are applied to the problems of horizontal velocity estimation, and hazard detection. Experimental implementations are henceforth presented and the results show their potential for integration on a space qualified processing unit. The study concludes with recommendations for key physical parameters of the camera system.

In connection with the PRISMA experimental mission for rendezvous and docking and formation flight, DTU Space has implemented, own and validated the Vision Based Sensor (VBS). This sensor has required development of novel techniques for calibration of the target optical model and custom hardware verification tools, both described in this book. One such tool personally developed is Pharos, an electro-opto-mechanical stimulator that physically interfaces with the camera to simulate the conditions of far range rendezvous in space. Pharos is now also being used by the Department to verify algorithms for asteroid detection, installed on the Juno spacecraft on its way to Jupiter.

Another important outcome of the R&D effort of this project has been the integration of a calibration and validation facility for the vision based sensors developed at DTU Space. The author's work has covered all phases from concept to design and construction of the laboratory, which is equipped with precise manipulators and a controlled lighting setup in order to simulate the kinematics and optical conditions under which the sensors will operate. Testing of sensors and algorithms for the upcoming ESA PROBA-3 mission is currently under way. The laboratory also includes a physical analog terrain for verification of planetary landing algorithms.

The general methods of autonomous navigation investigated and described in this book have also been applied to two external projects. The research stay at the NASA Ames Research Center's Intelligent Robotics Group (ARCIRG) resulted in the successful implementation of an infrastructure-free global localization algorithm for surface robotic navigation. The algorithm is now integrated with other rover navigation routines developed by IRG. Finally, collaboration with DTU Automation culminated in the development of a novel terrain mapping and obstacle detection technique based on Gaussian processes. These results have been published on a peer-reviewed conference paper at the 2011 IEEE International Conference on Machine Learning and Applications.

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Massaro, A. S. (Intern), Jørgensen, J. L. (Intern)
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The Ahar-Varzaghan (Iran) double earthquakes (Mw 6.5 and 6.2) of August 11th, 2012: A seismotectonic interpretation from regional moment tensors and kinematic parameters

The region of northwestern Iran is exceptional within the Arabian-Eurasian continental collision zone. Tectonics is dominated by the NW-SE striking right-lateral North Tabriz Fault (NTF) where regional seismicity (historical and modern one) concentrates. North of the NTF seismicity is rare and almost nothing is known about active structures so far. Here, GPS velocity records are directed to North-East, while the direction changes to direct North south of the NTF. On 11th of August 2012 the region was surprisingly struck by a shallow Mw 6.5 earthquake with pure right-lateral strike-slip character only about 50 km north of the NTF. An east-west striking surface rupture of about 18 km length was observed in the field. Only 11 minutes later and about 6 km further NW a second shallow event with Mw 6.2 occurred. It showed an NE-SW
oriented oblique thrust mechanism. Until the end of August, 409 earthquakes with ML 2.0 were observed. In the eastern part of the earthquake sequence, along 3/4 of the rupture length, the aftershocks concentrated in a depth of about 14 km. In the western part they became shallower with about 7 km depth. On 7th of November a strong aftershock (Mw 5.4) occurred at the western edge of the sequence. Here, we present point source moment tensor solutions obtained from inversion of regional waveform data for the two mainshocks and larger aftershocks, including the one from 7th of November. We use 3-component broadband data of the Iranian National Seismic Network (INSN) operated by the International Institute of Earthquake Engineering and Seismology (IIEES) in Tehran. For half of the studied aftershocks we obtain pure E-W / N-S oriented strike-slip mechanisms. The other half shows oblique thrust mechanisms with an orientation of NE-SW. The analysed aftershocks are located in depths between 5 and 18 km. In addition, we show the kinematic parameters of the rupture plane for the two mainshocks and the aftershock of 7th of November. We propose that more than one fault must have been activated during the sequence assembling a complex structure of strike-slip and thrust faults. This sequence was a surprise in an area, where recent seismicity on active faults has not been observed so far. Due to the lack of knowledge about such structures in the region, seismic hazard analyses must underestimate the risk. This earthquake sequence provides an opportunity to better understand the processes of active deformation and their causes in NE Iran.
Low-power attitude determination for magnetometry planetary missions

This work covers the subject of orientation or attitude in space and on the surface of a planet. Different attitude sensor technologies have been investigated with emphasis on very low power consumption and mass. In addition robust methods for attitude determination have been covered again with emphasis on the limited budget onboard very small satellites. A true low-power attitude sensor using the Anisotropic Magneto Resistor effect have been designed to late prototype state. Two prototypes of the AMR magnetometer have been built. One of the prototypes has an analog output and the second prototype has a digital output similar to that of the VFM fluxgate magnetometer.

Four different sensors have been tested and the most suitable sensor has been selected for the AMR magnetometer. The AMR magnetometer has been tested with respect to range, linearity, sensitivity, noise and bandwidth. A scalar calibration has been performed on both of the prototypes of the AMR magnetometer with very good overall result.

Different attitude representations such as orthogonal matrices, Euler angles and quaternions are presented. Also methods for attitude determination of a sensor platform with more than one vector instrument are presented. To achieve the highest possible accuracy the process of intercalibration of the sensor platform is also covered. Intercalibration in this respect means the determination of the relative attitude between the vector instruments in question.

The magnetic survey of the region between the North Pole and northern Greenland was used as a case. The sensor platform for the magnetic survey consists of a vector magnetometer and a vector accelerometer. The two instruments were individually calibrated followed by Intercalibration of the sensor platform. The data collected during the airborne magnetic survey was used to determine the attitude of the sensor platform. With the attitude of the vector magnetometer known, maps of the magnetic anomalies were made with the vector information still intact. The maps of the magnetic anomalies using vector data showed a greater level of details than the maps obtained using only scalar data.

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems, IT-Department
Authors: Christensen, T. H. (Intern), Merayo, J. M. (Intern), Jørgensen, J. L. (Intern)
Number of pages: 124
Publication date: 2012

Magnetic activity at Mars - Mars Surface Magnetic Observatory

We use the extensive database of magnetic observations from the Mars Global Surveyor to investigate magnetic disturbances in the Martian space environment statistically, both close to and far from crustal anomalies. We discuss the results in terms of possible ionospheric and magnetospheric currents, and use this to provide an estimate of the expected magnetic disturbances at the Martian surface. Far from crustal anomaly regions the expected magnetic disturbances originating from currents associated with the induced magnetosphere are very weak at the day-side, but most likely larger on the night-side. Close to crustal anomalies the expected surface perturbation is larger and more variable both in space and time. It is important to note that these variations are not confined to the intense crustal anomalies in the southern hemisphere, but occur in large parts of the equatorial region. The disturbances around medium intensity radial anomalies in the equatorial region appear to derive from local current loops or vortices around cusp-like radial fields, acting to partly cancel the crustal field. The radial perturbation is further found to depend on upstream solar wind dynamic pressure. We define a magnetic experiment at the martian surface, the Mars Surface Magnetic Observatory (MSMO) including the science objectives, science experiment requirements, instrument and basic operations. We find the experiment to be feasible within the constraints of proposed stationary landing platforms.

General information
State: Published
Organisations: National Space Institute, Solar System Physics, IT-Department, Measurement and Instrumentation Systems, Centre d'études des Environnements Terrestre et Planétaires
Authors: Vennerstrøm, S. (Intern), Menvielle, M. (Ekstern), Merayo, J. M. (Intern), Falkenberg, T. V. (Intern)
Pages: 364-375
Mechanics of DTUsat-2. Small Satellites Systems and Services
Monitoring the West Bohemian earthquake swarm in 2008/2009 by a temporary small-aperture seismic array

The most recent intense earthquake swarm in West Bohemia lasted from 6 October 2008 to January 2009. Starting 12 days after the onset, the University of Potsdam monitored the swarm by a temporary small-aperture seismic array at 10 km epicentral distance. The purpose of the installation was a complete monitoring of the swarm including micro-earthquakes (ML < 0). We identify earthquakes using a conventional shortterm average/long-term average trigger combined with sliding-window frequency-wavenumber and polarisation analyses. The resulting earthquake catalogue consists of 14,530 earthquakes between 19 October 2008 and 18 March 2009 with magnitudes in the range of −1.2 ≤ ML ≤ 2.7. The small-aperture seismic array substantially lowers the detection threshold to about Mc = −0.4, when compared to the regional networks operating in West Bohemia (Mc > 0.0). In the course of this work, the main temporal features (frequency–magnitude distribution, propagation of back azimuth and horizontal slowness, occurrence rate of aftershock sequences and interevent-time distribution) of the recent 2008/2009 earthquake swarm are presented and discussed. Temporal changes of the coefficient of variation (based on interevent times) suggest that the swarm earthquake activity of the 2008/2009 swarm terminates by 12 January 2009. During the main phase in our studied swarm period after 19 October, the b value of the Gutenberg–Richter relation decreases from 1.2 to 0.8. This trend is also reflected in the powerlaw behavior of the seismic moment release. The corresponding total seismic moment release of $1.02 \times 10^{17}$ Nm is equivalent to ML,max = 5.4.
Regional enhancement of the mean dynamic topography using GOCE gravity gradients
The main objective of this study is to study how gradients can be used to extract more short wavelength information of the gravity field and to use this enhancement to improve modelling of ocean circulation, i.e. MDT in regional area. This is done by development of a method for regional gravity field recovery by using GOCE gradients in addition to the global models. The Least Squares Collocation method requires the solution of as many linear equations as the number of data, so GOCE gradient data needs to be thinned prior to applying the method. To overcome this thinning, a Reduced Point Mass (RPM) method is developed as a part of this study. The RPM is based on the reduced point mass response. The results presented in this study are based on all available GOCE gradient data in the GOCINA region, i.e. 18 months of observations.

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Organisations: National Space Institute, Measurement and Instrumentation Systems, Geodesy
Authors: Herceg, M. (Intern), Knudsen, P. (Intern)
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Use of In-Flight Data to Validate Mars Sample Return Autonomous RvD GNC

General information
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Authors: Barrena, V. (Ekstern), Colmenarejo, P. (Ekstern), Rössler, D. (Intern), Pedersen, D. A. K. (Intern), Ankersen, F. (Ekstern)
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Source-ID: u::4896
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Use of In-Flight Data to Validate Mars Sample Return Autonomous RvD GNC

During the last years, the number of studies having as objective rendezvous and docking/capture missions around Mars or other planets/asteroids has significantly increased.

Following this tendency, a team led by GMV has developed HARvD (High Integrity Autonomous Rendezvous Docking Control System), an ESA-funded activity implementing a high integrity autonomous multi-range rendezvous and capture control system demonstrator for future exploration missions around Mars, Earth or potentially other planets, with a wide set of scenarios and particularizing on the MSR (Mars Sample Return) mission. HARvD is based on RF, camera and LIDAR measurements. It includes design, prototyping and verification at three different levels: algorithms design and verification in a Functional Engineering Simulator, SW demonstrator verified in Real Time Avionics Test Benching and Dynamic Test Benching.

Moreover, the technology readiness of the SW demonstrator will enable to envisage as a next step the in-flight demonstration of an autonomous docking and capture GNC system. In this respect, PRISMA mission was identified as a suitable platform for validation of the HARvD-GNC system, and the development, calibration and testing of a vision based optical stimulator (ViSOS by DTU) to enhance the on-ground validation capabilities. After checking different alternatives for the proposed HARvD-GNC experiment with PRISMA resources, an efficient but cost-effective approach was chosen. The approach is based on designing MSR-like dedicated manoeuvres sequencing using the already existing on-board PRISMA GN/C/AOCS system (based on relative GPS measurements for the closed-loop execution of the manoeuvres sequencing and acquiring RF and camera images as part of the HARvD-GNC experiment data). This option allows downloading the sensor measurements and telemetry data from PRISMA to validate off-line essential functions of the HARvD-GNC, as well as calibrating and testing ViSOS system with real flight images. While the HARvD control system validation is limited by the nature of the off-line approach, it shall be highlighted that in this approach the on-board SW does not require modification. Such modifications are costly and complex. Therefore the results of the HARvD system validation can be maximized with respect to the involved effort.

This paper presents the experiment definition and development of the HARvD-PRISMA experiment and the use of the in-flight data as an economic way to achieve the testing and validation up to TRL6 of essential functions of the HARvD-GNC in the off-line approach. The approach itself is suitable to be applied to other systems and using other experiment hosting platforms.

General information
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Organisations: National Space Institute, Measurement and Instrumentation Systems, GMV, European Space Agency
Authors: Barrena, V. (Ekstern), Colmenarejo, P. (Ekstern), Suatoni, M. (Ekstern), Rössler, D. (Intern), Pedersen, D. A. K. (Intern), Ankersen, F. (Ekstern)
Number of pages: 9
Publication date: 2012
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Attitude Fusion Techniques for Spacecraft

Spacecraft platform instability constitutes one of the most significant limiting factors in hyperacuity pointing and tracking applications, yet the demand for accurate, timely and reliable attitude information is ever increasing. The PhD research project described within this dissertation has served to investigate the solution space for augmenting the DTU μASC stellar reference sensor with a miniature Inertial Reference Unit (IRU), thereby obtaining improved bandwidth, accuracy and overall operational robustness of the fused instrument. Present day attitude determination requirements are met and surpassed by the μASC in the low frequency domain. However, the intrinsic limitation in the photon flux available from starlight necessitates relatively long sensor exposure periods for the μASCs unparalleled performance to be realized, thus introducing an inherently limited time resolution of the instrument, and affecting operations during agile and complex spacecraft attitude maneuvers. As such, there exists a theoretical foundation for augmenting the high frequency performance of the μASC instrument, by harnessing the complementary nature of optical stellar reference and inertial sensor technology. With both sensor types providing measurements of the spacecraft attitude in space, harnessing the extreme accuracy of the μASC throughout the low frequency range and the inherent fidelity of miniature accelerometers in the high frequency domain allows the combined instrument to provide unsurpassed accuracy over the entire span of frequencies applicable to spacecraft attitude control systems. Completing the first steps from theoretical possibility towards a proven concept constitutes the primary focus of the project, having necessitated extensive research and development within several diverse technical areas such as highly miniaturized analog and digital electronics, instrument space qualification, test and validation procedures, sensor fusion techniques and optimized software implementations to reach a successful conclusion. The content of the project thus represents cutting edge aerospace technology due to the extreme performance that must be ascertained on all fronts whilst harnessing only a minimum of resources. Considering the physical limitations imposed by the μASC instrument as well as the next generation of smaller and more agile satellites, the main design drivers of the IRU implementation become critical parameters such as power consumption, volume and mass in addition to system level robustness and operational safety. The nature of the Ph.D. project requires not only cross disciplinary research, but also the application of emerging technologies never before employed in High-Rel space instrumentation systems.
The aim of this paper is to describe how a CDIO based four semester study can be documented in such a way, that a homogeneous quality can be maintained over time. One purpose is to help new teachers to fully understand their role and obligations, not only in their particular course, but also as a part of the complex CDIO based education. The case used is the B.Eng. study in Electronics at the Technical University of Denmark (DTU). Implementing CDIO calls for many changes in the way that we build and document an program; having implemented CDIO at the B.Eng. program in electronics, it has been found that the normal public and internal course documentation platforms are insufficient to keep the large amount of information needed to describe the program as a whole, and the large amount of interaction between the individual courses, a master document describing the program has been developed to cover the first 4 semesters in the program, this paper is meant as an inspiration to others that might find this method beneficial. In today's modern and constantly changing society it must be expected that staff is constantly moving in and out between different research projects, while at the same time teaching courses at levels ranging from very advanced topics to introductory courses. In most cases a course will be given by the same teacher every semester, but for some courses (often the introductory courses) teachers change frequently. In this dynamic system the master document proposed helps in conveying crucial information from prior to new teachers, that otherwise could be lost in the teacher exchange process.

General information
State: Published
Organisations: Electronics, Department of Electrical Engineering, Measurement and Instrumentation Systems, National Space Institute, Automation and Control
Authors: Kjærgaard, C. (Intern), Brauer, P. (Intern), Andersen, J. C. (Intern)
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Conference: 7th International CDIO Conference, Copenhagen, Denmark, 20/06/2011 - 20/06/2011
Design build projects, Soft skills implementation, CDIO-based curriculum, Quality assurance, Cross disciplinary projects, Curriculum planning, Master document, Learning objectives
Source: orbit
Source-ID: 313058
Publication: Research - peer-review › Article in proceedings – Annual report year: 2011

CDIO Projects In DTU's B.Eng. In Electronics Study Programme
This paper describes the four cross disciplinary CDIO semester projects in the B.Eng. in Electronics study at DTU, and – along with similar papers describing the other six B.Eng. programs – provides documentation to accompany an exposition with students demonstrating their projects, furthermore the paper is meant as an inspiration to others working on implementing cross disciplinary projects in their curriculum. In the B.Eng. in Electronics programme each of the first 4 semester contains a cross disciplinary project, two of these are CDIO Design Build courses which are placed in the 1st and 4th semesters. Additionally almost all courses contain projects of various size. The 4 cross disciplinary projects are described with emphasis on the two design build projects, the learning objectives are listed for each of the courses and the results from of the course evaluation (performed at the end every course) are listed for the 1st and 2nd semester courses where sufficient material exists

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CDIO-based curriculum, Cross disciplinary projects, Design-build projects, Student-demonstrations
Source: orbit
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2011
Fabrication of LTCC based Micro Thruster for Precision Controlled Spaceflight

The paper at hand presents the initial investigations on the development and fabrication of a micro thruster based on LTCC technology, delivering a thrust in the micro Newton regime. Using smaller segments of an observation system distributed on two or more spacecrafts, one can realize an observation platform with a huge effective aperture. However, when having instruments on several spacecrafts cooperating, a demand arises for highly accurate positioning of the formation flying spacecrafts. Consequently, the purpose of the micro thruster being developed here is to facilitate constant elimination of the disturbance forces perturbing the orbits and attitudes of formation flying spacecrafts. In the flowing the investigations on the dimensioning and the calculations on the somewhat predictive performance are presented in short form.

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Authors: Larsen, J. (Intern), Jørgensen, J. L. (Intern)
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Local seismic tomography velocity and attenuation structure and joint interpretation

General information
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Organisations: Measurement and Instrumentation Systems, National Space Institute, University of Leipzig, German Research Centre for Geosciences
Authors: Mousavi, S. (Ekstern), Korn, M. (Ekstern), Rössler, D. (Intern), Bauer, K. (Ekstern)
Publication date: 2011
Event: Poster session presented at PIER-ICDP project meeting, .
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Electronic versions:
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Source-ID: 286552
Publication: Research › Poster – Annual report year: 2011

Source mechanisms of the 2004 Baladeh (Iran) earthquake sequence from Iranian broadband and short-period data and seismotectonic implications

The northward movement and collision of the Arabian plate with Eurasia generates compressive stresses and resulting shortening in Iran. Within the Alborz Mountains, North Iran, a complex and not well understood system of strike-slip and thrust faults accommodates a fundamental part of the NNE-SSW oriented shortening. On 28th of May 2004 the Mw 6.3 Baladeh earthquake hit the north-central Alborz Mountains. It is one of the rare and large events in this region in modern time and thus a seldom chance to study earthquake mechanisms and the local ongoing deformation processes. It also demonstrated the high vulnerability of this densely populated region.

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Organisations: Measurement and Instrumentation Systems, National Space Institute, University of Potsdam, Institute for Advanced Studies in Basic Sciences
Authors: Donner, S. (Ekstern), Rössler, D. (Intern), Krüger, F. (Ekstern), Ghods, A. (Ekstern), Strecker, M. (Ekstern)
Publication date: 2011
Event: Poster session presented at AG Seismologie : 37. meeting, Sankelmark, Germany, .
Main Research Area: Technical/natural sciences
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http://opus.kobv.de/ubp/volltexte/2011/5398/
Source: orbit
Technology on the Move: Recent and Forthcoming Innovations for Tracking Migratory Birds

Basic questions about the life histories of migratory birds have confounded scientists for generations, yet we are nearing an era of historic discovery as new tracking technologies make it possible to determine the timing and routes of an increasing number of bird migrations. Tracking small flying animals as they travel over continental-scale distances is a difficult logistical and engineering challenge. Although no tracking system works well with all species, improvements to traditional technologies, such as satellite tracking, along with innovations related to global positioning systems, cellular networks, solar geolocation, radar, and information technology are improving our understanding of when and where birds go during their annual cycles and informing numerous scientific disciplines, including evolutionary biology, population ecology, and global change. The recent developments described in this article will help us answer many long-standing questions about animal behavior and life histories.
Terrain Mapping and Obstacle Detection Using Gaussian Processes

In this paper we consider a probabilistic method for extracting terrain maps from a scene and use the information to detect potential navigation obstacles within it. The method uses Gaussian process regression (GPR) to predict an estimate function and its relative uncertainty. To test the new methods, we have arranged two setups: an artificial flat surface with an object in front of the sensors and an outdoor unstructured terrain. Two sensor types have been used to determine the point cloud fed to the system: a 3D laser scanner and a stereo camera pair. The results from both sensor systems show that the estimated maps follow the terrain shape, while protrusions are identified and may be isolated as potential obstacles. Representing the data with a covariance function allows a dramatic reduction of the amount of data to process, while maintaining the statistical properties of the measured and interpolated features.

General Information

State: Published
Organisations: Automation and Control, Department of Electrical Engineering, Measurement and Instrumentation Systems, National Space Institute, University of Southern Denmark
Authors: Kjærgaard, M. (Intern), Massaro, A. S. (Intern), Bayramoglu, E. (Intern), Jensen, K. (Ekstern)
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2011

Vision Based Navigation Sensors for Spacecraft Rendezvous and Docking

Space missions have recently entered a new stage where concerted mission, i.e. mission where multiple space segments cooperate in forming a combined platform on which improved or new physics or services can be achieved. The best-known existing example is probably the TDRSS constellation of 24 active spacecraft together providing the global positioning service dubbed GPS. However, several other present missions provide augmented performances based on multi space segment configuration, e.g. the GRACE twin spacecraft form together the world’s hitherto most accurate gravimeter, which has provided new information and insight into gravitational related physics as diverse as desert growth, ocean circulation, gravity anomaly mapping and precipitation and climate models. Plans and projects for future multi segment missions are plenty, with missions from all major space agencies in progress. Denmark has, with DTUs design of the Swarm mission, ESAs next Earth Observation Programme magnetic mapping mission, and DTUs...
participation in GRACE, ELISA and Alsat2, a leading role in designing and verifying sensor systems for this new class of spacecraft. The Swedish led PRISMA mission is a technological demonstration mission, where all aspects of space rendezvous and docking to both a cooperative and a non-cooperative target is researched, with the use of novel methods, instruments and technologies. Amongst other equipment, DTU has delivered a vision based sensor package to the Main spacecraft of this constellation, providing both position and pose information for the Target vehicle. This dissertation will describe the study, implementation and verification methods that has led to the realization of this optical Vision Based Sensor (VBS), which is used on the PRISMA mission. On June 15th 2010 the PRISMA satellites were launched successfully into orbit, and after the commissioning phase and system check-out the two joined satellites were separated August 9th, initiating the operation phase of the mission. The Early Harvest started August 30th for the Far Range VBS CHU and September 9th for the Short Range VBS CHU, from where the first in-flight data and analysis will be presented and discussed in this dissertation. While writing, the PRISMA mission is continuously providing new VBS data on a daily basis.

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**Inflight Calibration of a Vision Based Sensor for Pose and Position Determination Inbetween Satellites**

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Organisations: Measurement and Instrumentation Systems, National Space Institute
Authors: Benn, M. (Intern), Jørgensen, J. L. (Intern)
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**Low Power Attitude Determination of Small Satellites using a 3-axis AMR magnetometer**

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Organisations: National Space Institute, Measurement and Instrumentation Systems, IT-Department
Authors: Christensen, T. H. (Intern), Merayo, J. M. (Intern), Brauer, P. (Intern)
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Main Research Area: Technical/natural sciences
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Publication: Research - peer-review › Paper – Annual report year: 2010
Automated system for the calibration of magnetometers
A completely nonmagnetic calibration platform has been developed and constructed at DTU Space (Technical University of Denmark). It is intended for on-site scalar calibration of high-precise fluxgate magnetometers. An enhanced version of the same platform is being built at the Czech Technical University. There are three axes of rotation in this design (compared to two axes in the previous version). The addition of the third axis allows us to calibrate more complex devices. An electronic compass based on a vector fluxgate magnetometer and micro electro mechanical systems (MEMS) accelerometer is one example. The new platform can also be used to evaluate the parameters of the compass in all possible variations in azimuth, pitch, and roll. The system is based on piezoelectric motors, which are placed on a platform made of aluminum, brass, plastic, and glass. Position sensing is accomplished through custom-made optical incremental sensors. The system is controlled by a microcontroller, which executes commands from a computer. The properties of the system as well as calibration and measurement results will be presented. ©2009 American Institute of Physics
Circular Piezoelectric Accelerometer for High Band Width Application
An uniaxial bulk-micromachined piezoelectric MEMS accelerometer intended for high bandwidth application is fabricated and characterized. A circular seismic mass (radius = 1200 µm) is suspended by a 20 µm thick annular silicon membrane (radius = 1800 µm). A 24 µm PZT screen printed thick film is used as the sensing material on top of the silicon membrane. Accelerations in the out of plane direction induce a force on the seismic mass bending the membrane and a potential difference is measured in the out of plane direction of the stressed PZT. A resonance frequency of 23.50 kHz, a charge sensitivity of 0.23 pC/g and a voltage sensitivity of 0.24 mV/g are measured.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Measurement and Instrumentation Systems, National Space Institute, Department of Physics
Authors: Hindrichsen, C. C. (Intern), Larsen, J. (Intern), Lou-Møller, R. (Intern), Hansen, K. (Ekstern), Thomsen, E. V. (Intern)
Publication date: 2009

Host publication information
Title of host publication: IEEE Sensors 2009
Publisher: IEEE
ISBN (Print): 978-1-4244-4548-6
Main Research Area: Technical/natural sciences
Electronic versions: Hindrichsen.pdf
Range Management of a Vision Based Rendezvous and Docking Navigation Sensor

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Benn, M. (Intern), Jørgensen, J. L. (Intern)
Number of pages: 7
Pages: IAC-09.C1.4.4
Publication date: 2009

Host publication information
Title of host publication: Proceedings of the International Astronautical Conference
Volume: 2009
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 256500
Publication: Research › Article in proceedings – Annual report year: 2009

Instrumentation for in-situ measurements of magnetic fields in the solar system

General information
State: Published
Organisations: National Space Institute, Measurement and Instrumentation Systems
Authors: Thomsen, M. (Intern), Brauer, P. (Intern), Merayo, J. M. (Intern), Jørgensen, J. L. (Intern)
Number of pages: 140
Publication date: Aug 2008

Publication information
Place of publication: Kgs. Lyngby, Denmark
Publisher: Technical University of Denmark (DTU)
ISBN (Print): 978-87-92477-01-9
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 256900
Publication: Research › Ph.D. thesis – Annual report year: 2008

DTUsat-2: The Next Generation Animal Migration Research Platform
The DTUsat-2 project aims to demonstrate pico-class (}

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute
Authors: Bjarnø, J. B. (Intern), Fléron, R. (Intern)
Publication date: 2008

Host publication information
Title of host publication: Small Satellites Systems and Services: Proceedings of the 4S Symposium
Volume: SP-660
Publisher: European Space Agency
ISBN (Print): 978-92-9221-224-7
Main Research Area: Technical/natural sciences
Feasibility of a Constellation of Miniature Satellites for Performing Measurements of the Magnetic Field of the Earth

This paper studies the requirements for a small constellation of satellites to perform measurements of the magnetic field of the Earth and a payload and boom design for such a mission is discussed. After studying communication, power and mass requirements it is found that it is feasible to develop a 10 x 10 x 30 cm(3) satellite with a mass of about 2.5 kg, which can fulfill such a mission. We also study the feasibility of controlling a constellation of such small satellites by means of air drag by extracting one or more flaps. It is found that it is indeed possible, but for best performance it is limited to altitudes around 450 to 550 km, depending on the time of launch with regard to the solar sunspot cycle.

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute, Solar System Physics
Authors: Thomsen, M. (Intern), Merayo, J. M. (Intern), Brauer, P. (Intern), Vennerstrøm, S. (Intern), Olsen, N. (Intern), Tøffner-Clausen, L. (Intern)
Number of pages: 406
Pages: 123-132
Publication date: 2008

Magnetic giant magnetoresistance commercial off the shelf for space applications

The increase of complexity and miniaturizing level of Aerospace platforms make use of commercial off the shelf (COTS) components constitute a plausible alternative to the use of military or rad-tolerant components. In this work, giant magnetoresistance commercial sensors are studied to be used as COTS, the next missions to be launched in the framework of the Spanish National Space Program: OPTOS and SEOSAT. This technology of magnetic sensors is interesting due to their high operating range up to 2 mT and the high temperature dynamic range from -50 up to 150 degrees C. However, in contrast, it presents high hysteresis and nonlinearity, temperature dependence, and poor repeatability. To improve the hysteretic, nonlinear and nonrepetitive behavior, a method consisting of a combination of reset and biasing has been designed and implemented for the +/- 75 µm T linear region centered around 300-375 µm T biasing field. (c) 2008 American Institute of Physics.

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute
Authors: Michelena, M. (Ekstern), Oelschlägel, W. (Intern), Arruego, I. (Ekstern), del Real, R. (Ekstern), Mateos, J. (Ekstern), Merayo, J. M. (Intern)
Pages: 07E912
Publication date: 2008
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Applied Physics
Volume: 103
Issue number: 7
ISSN (Print): 0021-8979
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.953 SJR 0.739
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.72 SJR 0.906 SNIP 0.977
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.821 SNIP 0.996 CiteScore 1.57
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.039 SNIP 1.197 CiteScore 2.04
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.155 SNIP 1.286 CiteScore 2.24
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.312 SNIP 1.291 CiteScore 2.13
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.374 SNIP 1.3 CiteScore 2.24
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.484 SNIP 1.204
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.51 SNIP 1.237
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.644 SNIP 1.326
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.695 SNIP 1.387
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.944 SNIP 1.667
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.055 SNIP 1.605
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.128 SNIP 1.591
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.078 SNIP 1.532
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 2.184 SNIP 1.7
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 2.147 SNIP 1.554
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 2.009 SNIP 1.53
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.973 SNIP 1.486

Original language: English
Electronic versions:
On-the Fly Merging of Attitude Solutions

Recent advances in autonomous attitude determination instrumentation enable even small satellites flying fully autonomous multi head star trackers providing full accurate and robust attitude information. Each sensor provides the full attitude information but for robustness and optimal usage of the available information, i.e. optimal accuracy, methods for merging such data should be investigated. The need for and desirability of attitude merging depends on the mission objective and available resources. To enable real-time attitude control and reduce requirements on download budget, on-board merging of attitude data will often be advantageous. This should be weighted against the need for post observation reconstruction of attitudes, especially needed when end products are sensitive to optimal attitude reconstruction. Instrument integrated merging algorithms will reduce the complexity of on-board AOCS. Methods for attitude merging are many. Two examples of merging methods taking into consideration anisotropic noise distributions are presented and discussed.

Self-Compensating Excitation of Fluxgate Sensors for Space Magnetometers

The paper presents design and implementation of the new self-compensating excitation circuitry to the new generation of high-precise space vector magnetometers. The application starts with complex study including design of new robust model of the non-linear inductor leading to investigation of the most crucial points, continuous by design of the self-compensating excitation unit and concludes with unit complex testing and application to the magnetometer. The application of the self-compensation of the excitation decreases temperature drift of the magnetometer offset caused by the temperature drift of the sensor (dominant source of the offset drift) by factor of 7.
The Swarm Magnetometry Package

The Swarm mission under the ESA’s Living Planet Programme is planned for launch in 2010 and consists of a constellation of three satellites at LEO. The prime objective of Swarm is to measure the geomagnetic field with unprecedented accuracy in space and time. The magnetometry package consists of an extremely accurate and stable vector magnetometer, which is co-mounted in an optical bench together with a start tracker system to ensure mechanical stability of the measurements.

Fluxgate magnetometry for precise mapping of the Earth's field

The requirements for precise global mapping of the Earth's vector magnetic field from a high inclination LEO satellite needs a stable and precise vector magnetometer. Equally important are the measurement of the stellar attitude of the vector sensor and establishment of the calibration by onboard comparison to an absolute scalar magnetometer. In addition, the position in orbit and the precise timing relative to the UTC is needed. Finally, the end-to-end system precision also depends on a known and controlled local satellite magnetic field.

Fluxgate magnetometry for precise mapping of the Earth's field

The requirements for precise global mapping of the Earth's vector magnetic field from a high inclination LEO satellite needs a stable and precise vector magnetometer. Equally important are the measurement of the stellar attitude of the vector sensor and establishment of the calibration by onboard comparison to an absolute scalar magnetometer. In addition, the position in orbit and the precise timing relative to the UTC is needed. Finally, the end-to-end system precision also depends on a known and controlled local satellite magnetic field.

Fluxgate magnetometry for precise mapping of the Earth's field

The requirements for precise global mapping of the Earth's vector magnetic field from a high inclination LEO satellite needs a stable and precise vector magnetometer. Equally important are the measurement of the stellar attitude of the vector sensor and establishment of the calibration by onboard comparison to an absolute scalar magnetometer. In addition, the position in orbit and the precise timing relative to the UTC is needed. Finally, the end-to-end system precision also depends on a known and controlled local satellite magnetic field.
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.167 SNIP 0.234 CiteScore 0.43
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.155 SNIP 0.271 CiteScore 0.37
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.219 SNIP 0.454 CiteScore 0.59
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.228 SNIP 0.499 CiteScore 0.68
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.242 SNIP 0.48 CiteScore 0.62
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.242 SNIP 0.58 CiteScore 0.87
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.256 SNIP 0.279
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.235 SNIP 0.458
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.502 SNIP 0.766
Scopus rating (2007): SJR 0.58 SNIP 0.534
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.343 SNIP 0.45
Scopus rating (2005): SJR 0.242 SNIP 0.961
Web of Science (2005): Indexed yes
Web of Science (2004): Indexed yes
Web of Science (2003): Indexed yes
Original language: English
stellar camera, scalar magnetometer, vector magnetometer, space magnetic measurement
DOIs:
10.1166/sl.2007.081
Source: orbit
Source-ID: 205052
Publication: Research - peer-review › Journal article – Annual report year: 2007

GEPI-D-B, GEP Interface Control Document for the MSMO Instrument for the ExoMars mission

General information
State: Published
Organisations: Solar System Physics, National Space Institute, Measurement and Instrumentation Systems
Authors: Vennerstrøm, S. (Intern), Menvielle, M. (Ekstern), Merayo, J. M. (Intern)
Publication date: 2007

Publication information
Publisher: DRC
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 209921
Publication: Research › Report – Annual report year: 2007

High precision Vector Field Magnetometer for space applications

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute
Authors: Merayo, J. M. (Intern), Brauer, P. (Intern), Primdahl, F. (Intern)
Proton Irradiation of SONY CCD, Image Analysis and Homogeneity Checks

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute, Measurement & Instrumentation, Department of Electrical Engineering
Authors: Denver, T. (Intern), Guldager, P. B. (Intern), Jørgensen, F. E. (Intern), Aage, H. K. (Ekstern), Thuesen, G. (Intern)
Publication date: 2007

Publication information
Publisher: ESA
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 209866
Publication: Research - peer-review › Report – Annual report year: 2007

TID Sr-90 Irradiation of SONY CCD ICX039DLA-6 B0840065000 Image Analysis

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute
Authors: Aage, H. K. (Ekstern), Jørgensen, J. L. (Intern), Thuesen, G. (Intern)
Publication date: 2007

Publication information
Publisher: ESA
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 209865
Publication: Research - peer-review › Report – Annual report year: 2007

The Science Grade Vector Magnetometer for the PROBA-2 Mission

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute
Authors: Merayo, J. M. (Intern), Brauer, P. (Intern), Primdahl, F. (Intern), Jørgensen, J. L. (Intern)
Publication date: 2006

Host publication information
Title of host publication: ESA SP-625
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 207966
Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

Formation Flying Using an Optical Sensor (Advanced Technology Approaches)
Long Lived Martian Geoscience Observatory

General information
State: Published
Organisations: Solar System Physics, National Space Institute, Measurement and Instrumentation Systems, University Paris Diderot - Paris 7, Deutsches Zentrum Für Luft- und Raumfahrt, Max Planck Institute, Royal Observatory of Belgium, Swiss Federal Institute of Technology, Centre d'études des Environnements Terrestre et Planétaires, Imperial College London, Geodetic and Geophysical Research Institute, Technische Universität München, University of Coimbra, Utrecht University
Publication date: 2005

Host publication information
Title of host publication: Proc. 39th ESLAB Symposium,
Main Research Area: Technical/natural sciences
Conference: ESLAB Symposium, 01/01/2005
Links:
Source: orbit
Source-ID: 208651
Publication: Research - peer-review › Article in proceedings – Annual report year: 2005

NEA Detection, a Possible Use of the Flying Laptop Micro-Satellite Reconfigurability

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute
Authors: Jørgensen, J. L. (Intern), Jørgensen, P. S. (Intern), Grillmayer, G. (Ekstern)
Pages: 428-435
Publication date: 2005

Host publication information
Title of host publication: Small Satellites for Earth Observation : Selected Proceedings of the 5th International Symposium of the IAA
Publisher: Mouton de Gruyter
ISBN (Print): 3-11-018851-1
Main Research Area: Technical/natural sciences
Conference: 5th IAA Symposium on Small Satellites for Earth Observation, Berlin, Germany, 04/04/2005 - 04/04/2005
Source: orbit
Source-ID: 186161
Publication: Research - peer-review › Article in proceedings – Annual report year: 2005
The feasibility of laryngoscope-guided tracheal intubation in microgravity during parabolic flight: A comparison of two techniques

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute
Authors: Groemer, G. E. (Ekstern), Brimacombe, J. (Ekstern), Haas, T. (Ekstern), de Negueruela, C. (Ekstern), Soucek, A. (Ekstern), Thomsen, M. (Intern), Keller, C. (Ekstern)
Pages: 1533-1535
Publication date: 2005
Main Research Area: Technical/natural sciences

Publication information
Journal: Anesthesia and Analgesia
Volume: 101
Issue number: 5
ISSN (Print): 0003-2999
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 1.518 SJR 1.472
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 1.489 SNIP 1.769 CiteScore 2.57
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.619 SNIP 1.638 CiteScore 2.54
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.743 SNIP 1.666 CiteScore 2.67
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.758 SNIP 1.871 CiteScore 2.59
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.58 SNIP 1.73 CiteScore 2.61
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.585 SNIP 1.804 CiteScore 2.74
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.586 SNIP 1.629
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.422 SNIP 1.585
BFI (2008): BFI-level 2
Scopus rating (2007): SJR 1.206 SNIP 1.345
Scopus rating (2006): SJR 1.212 SNIP 1.355
Scopus rating (2005): SJR 1.366 SNIP 1.562
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.249 SNIP 1.479
Scopus rating (2003): SJR 1.379 SNIP 1.453
Scopus rating (2002): SJR 1.424 SNIP 1.311
Scopus rating (2001): SJR 1.599 SNIP 1.443
Scopus rating (2000): SJR 1.418 SNIP 1.386
Scopus rating (1999): SJR 1.488 SNIP 1.437
Original language: English
Source: orbit
Source-ID: 196622
Publication: Research - peer-review › Journal article – Annual report year: 2005
The Micro Advanced Stellar Compass for ESA's PROBA 2 Mission

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute
Authors: Jørgensen, P. S. (Intern), Jørgensen, J. L. (Intern), Denver, T. (Intern), Breambussche, P. V. D. (Ekstern)
Pages: 299-303
Publication date: 2005

Host publication information
Title of host publication: Small Satellites for Earth Observation : Selected Proceedings of the 5th International Symposium of the IAA
Publisher: De Gruyter
ISBN (Print): 3-11-018851-1
Main Research Area: Technical/natural sciences
Conference: 5th IAA Symposium on Small Satellites for Earth Observation, Berlin, Germany, 04/04/2005 - 04/04/2005
Source: orbit
Source-ID: 186163
Publication: Research - peer-review › Article in proceedings – Annual report year: 2005

Reply to Comment on 'Scalar calibration of vector magnetometers' by V.G.Semenov
This is a reply to a comment on our paper [1]. The comment suggests an inconsistency in the relation between the magnetic field and the magnetometer measurements. This is resolved, once the existence of two physically different sensor systems is appreciated, as has also been discussed in some detail in our paper [2].

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute, Solar System Physics, Department of Automation
Authors: Merayo, J. M. (Intern), Brauer, P. (Intern), Primdahl, F. (Intern), Petersen, J. R. (Intern), Nielsen, O. V. (Intern)
Pages: 238-238
Publication date: 2003
Main Research Area: Technical/natural sciences

Publication information
Journal: Measurement Science & Technology
Volume: 14
Issue number: 2
ISSN (Print): 0957-0233
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 1.061 SJR 0.53
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.75 SJR 0.672 SNIP 1.234
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.704 SNIP 1.368 CiteScore 1.71
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.704 SNIP 1.416 CiteScore 1.58
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.639 SNIP 1.417 CiteScore 1.53
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.748 SNIP 1.604 CiteScore 1.65
Determining the direction of a geometrical/optical reference axis in the coordinate system of a triaxial magnetometer sensor

The reference coordinate axes of a magnetic vector field sensor are related to the instrument digital output vector (\(U\)) over bar by the calibration matrix \(C\) and the offset vector \(O\) over bar. In addition, this reference coordinate system must be related to (at least) two externally accessible optical or geometrical axes in order to be able to determine the precise orientation of the magnetic coordinate axes in an external reference system. Two methods for determining a reference axis in the sensor coordinates are discussed: (1) using a triaxial coil facility to measure the sensor orientation for two different positions, rotated about a fixed reference axis; (2) in the Earth's field the magnetometer sensor is rotated about a fixed axis into a number of (at least three) positions.
The spinning Astrid-2 satellite used for modeling the Earth's main magnetic field

The Swedish micro-satellite Astrid-2 was successfully launched into a near polar orbit in December 1998. Despite the fact that the primary science mission was auroral research, the magnetic instrument was designed to accomplish high-resolution and high-precision vector field magnetic measurements, and therefore mapping of the Earth's magnetic field was possible. The spacecraft spins about a highly stable axis in space. This fact and the globally distributed data make the magnetic measurements well suited for the estimate of a magnetic field model at the spacecraft altitude (about 1000 km). This paper describes the initial analysis of the Astrid-2 magnetic data. As a result of the study of a single day (February 7, 1999), magnetically fairly quiet, it was possible to in-flight adjust the calibration of the magnetometer and find a magnetic field model fitting the scalar component of the measurements to better than 5 nT(rms) for latitudes Equatorward of 50 degrees. Several methods for field modeling are discussed in this paper under the assumption that the direction of the spin axis in inertial space is nearly constant, and this assumption is corroborated by the observations. The approximate inertial orientation of the magnetometer could then be determined simultaneously with the instrument intrinsic calibration and the estimate of main field model coefficients. Hence, apart from the scientific use of the magnetic data, the attitude of the spacecraft may be estimated with high precision.

General information
State: Published
Organisations: Department of Electrical Engineering, Measurement and Instrumentation Systems, National Space Institute, Solar System Physics
Authors: Merayo, J. M. (Intern), Jørgensen, P. (Ekstern), Risbo, T. (Ekstern), Brauer, P. (Intern), Primdahl, F. (Intern), Cain, J. (Ekstern)
Pages: 898-909
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Volume: 40
Issue number: 4
ISSN (Print): 0196-2892
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 2.774 SJR 2.649
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 5.45 SJR 2.616 SNIP 3.184
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.486 SNIP 3.107 CiteScore 4.7
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.445 SNIP 3.459 CiteScore 4.71
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.283 SNIP 3.227 CiteScore 4.22
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.337 SNIP 3.833 CiteScore 4.26
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.249 SNIP 2.988 CiteScore 3.85
ISI indexed (2011): ISI indexed yes
A Portable Single Axis Magnetic Gradiometer

The single axis magnetic gradiometer based on two compact detector compensation (CDC) fluxgate ringcore sensors separated 20 cm is described. Despite its high stability and precision better than 1 nT, the calibration procedures are not straightforward. Firstly, the mono-axial measurement does not provide vector information about the magnetic field. Secondly, one of the sensors measures the ambient magnetic field and is used to compensate for the main field at both sensors. Several methods have been developed for characterization of the 2 gradiometer, and the calibration of the gradient measurements is achieved by using a magnetic dipole of strength 2 mA.m(2). In a coil facility, the gradient can be determined with an accuracy of 0.3 nT/m(RMS).
The storm of 10 November 2000

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Geophysical Research
ISSN (Print): 0148-0227
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SJR 2.272 SNIP 1.475
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.36 SJR 2.369 SNIP 1.558
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.754 SNIP 1.605 CiteScore 3.39
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.853 SNIP 1.757 CiteScore 3.27
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.088 SNIP 1.809 CiteScore 3.38
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.917 SNIP 1.522 CiteScore 2.93
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.018 SNIP 1.474 CiteScore 3.03
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.056 SNIP 1.753
Web of Science (2010): Indexed yes
ATEX - Auroral timing explorer: Proposal to NASA in response to the Announcement of Opportunity for the SMEX programme

General information
State: Published
Organisations: Solar System Physics, National Space Institute, Measurement and Instrumentation Systems
Authors: Burch, J. (Ekstern), Primdahl, F. (Intern), Brauer, P. (Intern), Gjerløv, J. (Ekstern), Olsen, N. (Intern)
Publication date: 2000

Publication information
Original language: English
Main Research Area: Technical/natural sciences


General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute, Solar System Physics, National University of Ireland
Authors: McKenna-Lawlor, S. (Ekstern), Jørgensen, J. L. (Intern), Brauer, P. (Intern), Primdahl, F. (Intern), Vennerstrøm, S. (Intern), Moretto, T. (Ekstern), Olsen, N. (Intern)
Publication date: 2000

Publication information
Scalar Calibration of Vector Magnetometers

The calibration parameters of a vector magnetometer are estimated only by the use of a scalar reference magnetometer. The method presented in this paper differs from those previously reported in its linearized parametrization. This allows the determination of three offsets or signals in the absence of a magnetic field, three scale factors for normalization of the axes and three non-orthogonality angles which build up an orthogonal system intrinsically in the sensor. The advantage of this method compared with others lies in its linear least squares estimator, which finds independently and uniquely the parameters for a given data set. Therefore, a magnetometer may be characterized inexpensively in the Earth's magnetic-field environment. This procedure has been used successfully in the pre-flight calibration of the state-of-the-art magnetometers on board the magnetic mapping satellites Orsted, Astrid-2, CHAMP and SAC-C. By using this method, full-Earth-field-range magnetometers (+/-65536.0 nT) can be characterized down to an absolute precision of 0.5 nT, non-orthogonality of only 2 arcsec and a resolution of 0.2 nT.
Star tracker and vision systems performance in a high radiation environment

A part of the payload of the second Ariane 5 prototype vehicle to be launched by Arianespace, was a small technology demonstration satellite. On October 30th, 1997, this test satellite, dubbed Teamsat, was launched into Geostationary Transfer Orbit and would as such pass the Van Allen radiation belts twice per orbit. One of the experiments onboard Teamsat was the so-called Autonomous Vision System (AVS). The AVS instrument is a fully autonomous star tracker with several advanced features for non-stellar object detection and tracking, real-time image compression and transmission. The objectives for the AVS in Teamsat were to test these functions, to validate their autonomous operation in space, and to assess the operational constraints of a high radiation environment on such processes. This paper describes the AVS experiment, and the radiation flux experienced onboard TEAMSAT. This overview is followed by examples of the radiation impact on the AVS instrument flown onboard the TEAMSAT, and finally the operations of the various countermeasures are discussed.

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute, Department of Automation
Authors: Jørgensen, J. L. (Intern), Riis, T. (Intern), Betto, M. (Intern)
Publication date: 1999

Host publication information
Volume: 2
Publisher: IEEE
ISBN (Print): 0-7803-5425-7
Main Research Area: Technical/natural sciences
Conference: 1999 IEEE Aerospace Conference, Snowmass at Aspen, CO, United States, 07/03/1999
Electronic versions:
Jørgensen.pdf
DOIs:
10.1109/AERO.1999.793149

Bibliographical note
Momentum and Energy Transfer in an Ionospheric Critical Ionization Velocity Experiment

We present new data from the subpayload of the GRIT II ionospheric active injection experiment. The analysis made possible by these data provides a good understanding of the momentum transfer between the injected ions and the ambient ionosphere. It resolves the conflict between the two competing models for the energy transfer from the newly created ions to hot electrons, while also giving a natural coupling between the energy and momentum transfer processes.

General information
State: Published
Organisations: Measurement and Instrumentation Systems, National Space Institute, KTH - Royal Institute of Technology, Utah State University
Authors: Bolin, O. (Ekstern), Brenning, N. (Ekstern), Swenson, C. M. (Ekstern), Primdahl, F. (Intern)
Pages: 3673-3676
Publication date: 1995
Main Research Area: Technical/natural sciences

Publication information
Journal: Physical Review Letters
Volume: 75
Issue number: 20
ISSN (Print): 0031-9007
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): SNIP 2.464 SJR 3.622
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.33 SJR 4.196 SNIP 2.61
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 4.656 SNIP 2.538 CiteScore 5.76
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 5.232 SNIP 2.71 CiteScore 6.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 5.675 SNIP 2.781 CiteScore 7.46
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 6.292 SNIP 2.867 CiteScore 7.19
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 6.314 SNIP 2.905 CiteScore 7.02
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 6.45 SNIP 2.757
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 6.325 SNIP 2.947
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 6.194 SNIP 2.837
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 5.95 SNIP 2.738
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 4.781 SNIP 2.443
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 4.082 SNIP 2.101
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 3.847 SNIP 2.122
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 4.661 SNIP 2.651
Web of Science (2003): Indexed yes
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 5.884 SNIP 3.375
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 5.618 SNIP 3.135
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 5.771 SNIP 2.941
Original language: English
Electronic versions:
Primdahl.pdf
DOIs:
10.1103/PhysRevLett.75.3673
Links:
http://link.aps.org/doi/10.1103/PhysRevLett.75.3673

Bibliographical note
Source: orbit
Source-ID: 252443
Publication: Research - peer-review › Journal article – Annual report year: 1995

Projects:

Thermo-chemical structure and evolution of the continental lithosphere: the hen-and-egg problem
National Space Institute
Measurement and Instrumentation Systems
Period: 01/11/2014 → 06/02/2015
Number of participants: 1
Project participant:
Herceg, Matija (Intern)
Project

Engineering Qualification Model (EQM) of a High-Performance Computer for Space Applications for the Atmosphere-Space Interactions Monitor (ASIM) Mission
Development of a qualification computer board for the ASIM MMIA instruments.
National Space Institute
Astrophysics and Atmospheric Physics
Measurement and Instrumentation Systems
Period: 01/04/2014 → 01/06/2017
Number of participants: 3
Acronym: ASIM EQM
Project participant:
Plauborg, Kim (Ekstern)

Project Manager, academic:
Brauer, Peter (Intern)
Project Coordinator:
Neubert, Torsten (Intern)

Project

GOCE USER TOOLBOX, Maintenance, Evolution, Scientific Studies and Product Validation (GUT3)

National Space Institute
Measurement and Instrumentation Systems
Period: 12/09/2013 → 31/12/2015
Number of participants: 1
Acronym: GUT 3
Project participant:
Herceg, Matija (Intern)

Are xenoliths representative of the cratonic mantle

National Space Institute
Measurement and Instrumentation Systems
Period: 16/04/2012 → 31/12/2013
Number of participants: 1
Project participant:
Herceg, Matija (Intern)

Activities:

Presentation of the µASC Star Tracker: during Andreas Mogensens visit to DTU
Period: 27 Nov 2015
Mathias Benn (Invited speaker)
National Space Institute
Measurement and Instrumentation Systems
Links:
http://www.dtu.dk/Service/Kalender/2015/11/Andreas-Mogensen-besoeger-DTU?id=94a1b9af-8541-46b3-a08b-79807c38e19e (Andreas Mogensen Visits DTU)

Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Juno Earth Flyby: presented during 'Kulturnatten' at the Ministry of Science, Innovation and Higher Education
Period: 9 Oct 2015
Mathias Benn (Invited speaker)
National Space Institute
Measurement and Instrumentation Systems
Links:
Luftskibe i rumfarts tjeneste
Period: 11 Dec 2014
René Fléron (Lecturer)
National Space Institute
Measurement and Instrumentation Systems
Description
Foredrag om udvikling af en luftskibsbaseret platform til test og eksperimenter udført i stratosfæren afholdt i Teatret ved Sorte Hest.
Links:
http://www.sortehest.com/portfolio-item/hjernekassen/

ESA-CAS Workshop at DTU Space
Period: 24 Sep 2014
Alessandro Salvatore Massaro (Speaker)
National Space Institute
Measurement and Instrumentation Systems
Description
Presentation on rendezvous, landing, docking and formation flight sensors
Related event
ESA-CAS Workshop at DTU Space
24/09/2014 → …
Kongens Lyngby, Denmark
Activity: Talks and presentations › Conference presentations

IEEE Student Branch Space Talk: Vision Augmented Spacecraft Navigation
Period: 13 Feb 2014
Alessandro Salvatore Massaro (Invited speaker)
National Space Institute
Measurement and Instrumentation Systems
Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

5th International Conference on Spacecraft Formation Flying Missions and Technologies
Period: 31 May 2013
Mathias Benn (Speaker)
National Space Institute
Measurement and Instrumentation Systems
Description
Presentation of paper: Autonomous Vision Based Detection of Non-stellar Objects Flying in Formation with Camera Point of View.
Related event

5th International Conference on Spacecraft Formation Flying Missions and Technologies
29/05/2013 → 31/05/2013
Münich, Germany
Activity: Talks and presentations › Conference presentations

Luftskibe - en ideel platform for eksperimenter
Period: 2 May 2013
René Fiéron (Lecturer)
National Space Institute
Measurement and Instrumentation Systems

Description
Foredrag i forbindelse med forskningens døgn 2013

Related event

Bestil en forsker: Forskningens døgn
02/05/2013 → 04/05/2013
Denmark
Activity: Talks and presentations › Conference presentations

NASA Ames Research Center
Period: 4 Feb 2013 → 10 May 2013
Alessandro Salvatore Massaro (Visiting researcher)
National Space Institute
Measurement and Instrumentation Systems

Description
External Research Stay at NASA Ames Research Center
 Implemented and verified key components of an algorithm for infrastructure-free global rover localization. The algorithm is intended to enhance the autonomous navigation capabilities of surface vehicles stationed on remote planetary bodies for the scope of exploration and human support.
Activity: Visiting an external institution › Visiting another research institution

Rumsonden JUNO: - rumsonden JUNO ved Jupiter
Period: 6 Nov 2012
John Leif Jørgensen (Lecturer)
National Space Institute
Measurement and Instrumentation Systems

Description
Novaastronomi arrangement i Toldkammeret, Havnepladsen, Helsingør
Links:
http://novastronomi.wordpress.com/2012/11/02/novanyt-fredag-d-2-november-2012/

Related external organisation

Unknown external organisation
Activity: Talks and presentations › Conference presentations

Ledestjener, stjernekameraer og DTU som rumfartsuniversitet
Period: 8 Dec 2011
John Leif Jørgensen (Speaker)
National Space Institute
Camera-based Navigation in Space: Lecture at Ny Lyngbygård
Period: 13 Oct 2011
Mathias Benn (Lecturer)
National Space Institute
Measurement and Instrumentation Systems
Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Grib talentet - og lad innovationen blomstre
Period: 6 Oct 2011
John Leif Jørgensen (Speaker)
National Space Institute
Measurement and Instrumentation Systems
Documents: InnovationÅbentHus6okt.pdf
Related event
Grib talentet - og lad innovationen blomstre
06/10/2011 → 06/10/2011
Experimentarium, Hellerup
Activity: Other

Besat af rumraketter
Period: 20 Sep 2011
John Leif Jørgensen (Speaker)
National Space Institute
Measurement and Instrumentation Systems
Description
Place: Tycho Brahe Planetariet, København
Links:
http://www.vcaf.dk/1351 (EXT-OA)
Related external organisation
Unknown external organisation
Activity: Talks and presentations › Conference presentations

Stjernekompasset der ændrede rumfarten
Period: 31 May 2011
John Leif Jørgensen (Lecturer)
National Space Institute
Danmarks første satellit, "Ørsted", har givet verden de mest nøjagtige magnetfeltsmodeller og -kort over Jorden, der nogensinde er fremstillet.

Foredrag arrangeret af Ingeniørhuset, Kalvebod Brygge 31-33, Kbh. (Med tilmelding til IDA)

Links:
http://rumfart.dk/vis.asp?moedeid=270

**På tommelfinger rundt i Solsystemet**

**Period:** 29 Apr 2011
**John Leif Jørgensen** (Speaker)
National Space Institute
Measurement and Instrumentation Systems

**Description**
In filmen om Apollo 13s mislykkede månefærd bliver NASAs ingeniører og astronauter vist som de helt store helte, der med snarrådighed, mod og ingeniørkunst redder besætningens liv, efter at en iiltank på rumfartøjet eksploderede kort efter opsendelsen, og derved redder både nationens ære og besætningens liv.

Foredrag arrangeret af IDA, Ingeniørhuset
Links:
http://rumfart.dk/vis.asp?moedeid=260

**Small Satellite Systems and Services**

**Period:** 31 May 2010 → 4 Jun 2010
**Mathias Benn** (Speaker)
National Space Institute
Measurement and Instrumentation Systems

**Description**
Presentation of the papers:
Inflight Calibration of a Vision Based Sensor for Pose and Position Determination Inbetween Satellites.
Star Trackers on Spinning Spacecrafts.

Related event

**Small Satellite Systems and Services**
31/05/2010 → 04/06/2010
Funchal, Madeira, Portugal
Activity: Talks and presentations › Conference presentations

**Space Technology: Lecture at Kolding Gymnasium**
Period: 6 May 2010
Mathias Benn (Lecturer)
National Space Institute
Measurement and Instrumentation Systems

Related external organisation

**Unknown external organisation**
Activity: Talks and presentations › Conference presentations

**60th International Astronautical Conference 2009**
Period: 14 Oct 2009
Mathias Benn (Speaker)
National Space Institute
Measurement and Instrumentation Systems

Description

Related event

**60th International Astronautical Conference 2009**
12/10/2009 → 16/10/2009
Daejeon, Korea, Republic of
Activity: Talks and presentations › Conference presentations

**3rd International Symposium on Formation Flying, Missions and Technologies**
Period: 25 Apr 2008
Mathias Benn (Speaker)
National Space Institute
Measurement and Instrumentation Systems

Description
Presentation of paper: Short Range Pose and Position Determination of Spacecraft Using a μ-Advanced Stellar Compass.

Related event

**3rd International Symposium on Formation Flying, Missions and Technologies**
23/04/2008 → 25/04/2008
Noordwijk, Netherlands
Activity: Talks and presentations › Conference presentations

**Mars Surface Magnetic Observatory: Presentation at the first GEP consortium meeting**
Period: 1 Jan 2007 → …
José M.G. Merayo (Speaker)
National Space Institute
Measurement and Instrumentation Systems
Proton Testing of Micro Advanced Stellar Compass: TEC-QCA Support Activity to PROBA-II
Period: 1 Jan 2007 → …
Peter Buch Guldager (Speaker)
National Space Institute
Measurement and Instrumentation Systems

Prizes:

E-gruppens 100 års jubilæum og uddeling af E-priser
Jonas Bækby Bjarne (Recipient)
National Space Institute, Measurement and Instrumentation Systems

Ingeniørforeningens Elektrofond har netop uddelt årets E-priser, som i år var mangedolet i antal pga. 100-året for etableringen af E-gruppen.

Andreas Härstedt Jørgensen, DTU Space og Jonas Bækby Bjarne, DTU Space
Prismodtagere; Andreas Härstedt Jørgensen, DTU Space og Jonas Bækby Bjarne, DTU Space

NASA Group Achievement Award: Juno Earth Flyby ASC Earth-Moon Movie Development
Alessandro Salvatore Massaro (Recipient)
National Space Institute, Measurement and Instrumentation Systems

For outstanding technical accomplishment in the imaging, production and release of the captivating Juno Earth Flyby 4-day Earth-Moon Movie

Press clippings:

Med livet som indsats - Fatalt fald
René Fléron
21/12/2016
Sigurd and Snake trust science. They trust facts. But do they trust laws of nature so much that they are willing to put their life on the line? What would it for instance require to survive a fatal drop? Hopefully they will soon find out. Otherwise they’ll be dead before the program ends.


Subject
TV education/entertainment
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Med livet som indsats - Fatalt fald
21/12/2016
Danish Radio, Television
Jonas Damstrup Fried
28min
Danish Radio Link to the program expires 19/1-17
René Fléron
National Space Institute, Measurement and Instrumentation Systems

DTU delivering equipment for Mars2020: PIXL instrument
David Arge Klevang Pedersen
12/10/2016

Description
Explanation of mission objective and DTU deliveries for the PIXL instrument onboard NASAs Mars2020 mission
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

DTU delivering equipment for Mars2020: PIXL instrument
12/10/2016
DR2, Television
Dagen
https://www.dr.dk/tv/se/dr2-dagen/dr2-dagen-2016-10-12#!
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

DTU PIXL
David Arge Klevang Pedersen
24/05/2016

Subject
Mars2020, PIXL
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

DTU PIXL
24/05/2016
Alt Om Data, Web
http://www.altomdata.dk/dtu-kamera-gaar-paa-jagt-liv-paa-mars
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute
DTU PIXL
David Arge Klevang Pedersen
11/03/2016

Subject
Mars 2020, PIXL
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

DTU PIXL
11/03/2016
TV2 Nyheder, Television
http://nyheder.tv2.dk/2016-02-26-mars-mission-fyldt-med-dansk-teknologi
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

Live fra stjærne
René Fléron
14/12/2015

Description
Do you know about Star Wars than the stars on the sky? What's a light-year, a meteor shower and distant galaxies? To night we'll have a hole through to space when DR3 transmits LIVE from the telescope at La Palma in order to fact check the Star Wars films. Is it pure imagination or is there live out there?
Ask questions at #DR3stjernekik.

Ved du mere om Star Wars end om stjernehimlen? Hvad er et lysår, en meteorregn og fjerne galakser? I aften har vi hul igennem til verdensrummet, når DR3 sender LIVE fra stjernekikkerten på La Palma for at faktatjekke Star Wars-filmene. Er det ren fantasi eller er der liv der ude?
Stil spørgsmål på #DR3stjernekik.

Invited as expert to appear in the studio during the event

Subject
Live TV event
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Live fra stjærne
14/12/2015
Danish Radio, Television
Lars Ostenfeldt
2h
René Fléron
National Space Institute, Measurement and Instrumentation Systems

Live fra verdensrummet
René Fléron
02/09/2015

Description
DR3 will transmit live from space and you may follow it. We'll send a balloon to the edge of the atmosphere and see how far we'll get before either the connection is lost or the balloon explodes. A TV experiment which no one knows where ends.
DR3 science geeks will be at the ready to answer all questions at #DR3rum.

DR3 sender live fra rummet, og du kan følge med. Vi sender en ballon ud til kanten af atmosfæren og ser hvor langt vi når, inden forbindelsen forsvinder eller ballonen eksploderer. Et tv-eksperiment ingen ved hvor ender. DR3s videnskabsnærder sidder klar og svarer på alle spørgsmål på #DR3rum.

Helped in experiment design, planning and manufacturing. Participated as expert in the studio during the TV event.
Subject
Live TV experiment
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Live fra verdensrummet
02/09/2015
Danish Radio, Television
Lars Ostenfeldt
2h
René Fléron
National Space Institute, Measurement and Instrumentation Systems

Phileas landing på kometen 67p
David Arge Klevang Pedersen
14/11/2014
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Phileas landing på kometen 67p
14/11/2014
Kringvarp Føroya, Radio
Kári Olsen
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

Phileas landing på kometen 67p
David Arge Klevang Pedersen
12/11/2014
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Phileas landing på kometen 67p
12/11/2014
DR2, Television
Lene Johansen
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

Juno Earth Fly By filmklip: Omkring produktionen af filmklippet og eksponeringen af denne.
David Arge Klevang Pedersen
03/10/2014
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Juno Earth Fly By filmklip: Omkring produktionen af filmklippet og eksponeringen af denne.
03/10/2014
DR P3, Radio
David Mandel
http://www.dr.dk/radio/ondemand/p3/gandhi-107/#!/08:53
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

Press / Media
NASA Juno Earth Fly By: Film lavet af danske phd studerende
David Arge Klevang Pedersen
24/09/2014
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

NASA Juno Earth Fly By: Film lavet af danske phd studerende
24/09/2014
TV2 Lorry, Television
Stine Sylvestersen
http://www.tv2lorry.dk/arkiv/2014/9/24?video_id=95439
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

NASA Juno Earth Fly By: Film lavet af danske phd studerende
17/09/2014
TV2 Lorry Nyheder, Television
http://www.tv2lorry.dk/arkiv/2014/9/17?video_id=95205
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

Danske studerende står bag kæmpe NASA-succes
David Arge Klevang Pedersen
16/09/2014
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Danske studerende står bag kæmpe NASA-succes
16/09/2014
Videnskab, Print
Lise Brix
http://videnskab.dk/teknologi/danske-studerende-star-bag-kaempe-nasa-succes
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

Interview i forbindelse med opsendelsen af DTUsat-2: Live optagelse af første pass over Danmark - med tilhørende tracking af første beacons.
René Fléron
19/06/2014
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Interview i forbindelse med opsendelsen af DTUsat-2: Live optagelse af første pass over Danmark - med tilhørende tracking af første beacons.
19/06/2014
TV2 News, Television
1min 40sec
René Fléron
National Space Institute, Measurement and Instrumentation Systems
Interview i forbindelse med opsendelse af DTUsat-2
René Fléron
18/06/2014
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Interview i forbindelse med opsendelse af DTUsat-2
18/06/2014
DR2, Television
Niels Krause-Kjær og Sanne Gram
René Fléron
National Space Institute, Measurement and Instrumentation Systems

Arbejde med Juno Earth Fly By filmklip
David Arge Klevang Pedersen
20/12/2013
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Arbejde med Juno Earth Fly By filmklip
20/12/2013
Kringvarp Føroya, Television
Liv Mikkelsen
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

Arbejde med billeder fra NASA’s rumsonde Juno
David Arge Klevang Pedersen
19/12/2013
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Arbejde med billeder fra NASA’s rumsonde Juno
19/12/2013
Kringvarp Føroya, Radio
Rúni Jákupson
http://kvf.fo/netvarp/uv/2013/12/19/arbeirir-vi-myndum-sum-fylgisveinurin-juno-tekur
David Arge Klevang Pedersen
Measurement and Instrumentation Systems, National Space Institute

JUNO Earth Flyby Image Series: Earth and Moon system captured from Juno Spacecraft during Earth Flyby
Mathias Benn
09/10/2013

Description
During the Earth Flyby of the Juno Spacecraft, the DTU developed star compass was retuned for enabling images to be captured of the Earth and the Moon. The linked video shows the outcome of this process.

Subject
Juno Spacecraft
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)
NASA, Web

Mathias Benn
National Space Institute, Measurement and Instrumentation Systems
Press / Media

DTU leverer udstyr til nyt NASA-instrument på rumstationen: Nyt røntgenteleskop på rumstationen bliver forsynet med danskudviklet navigationsmodul
John Leif Jørgensen
15/04/2013
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

DTU leverer udstyr til nyt NASA-instrument på rumstationen: Nyt røntgenteleskop på rumstationen bliver forsynet med danskudviklet navigationsmodul
15/04/2013
Ingeniøren, Print
Jens Ramskov
http://ing.dk/artikel/dtu-leverer-udstyr-til-nyt-nasa-instrument-paa-rumstationen-157926
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media

NASA på nye eventyr - vil indfange asteroide
John Leif Jørgensen
10/04/2013
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

NASA på nye eventyr - vil indfange asteroide
10/04/2013
DR2, Television
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media

Minedrift på månen
John Leif Jørgensen
28/03/2013
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Minedrift på månen
28/03/2013
DR/Deadline, Television
Martin
http://www.dr.dk/DR2/deadline2230/seudsendelser.htm#75052
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media

Til rumstationen med raketfart
John Leif Jørgensen
28/03/2013
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Til rumstationen med raketfart
Fremtidens strøm skal komme fra rummet
John Leif Jørgensen
13/01/2013
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Fremtidens strøm skal komme fra rummet
13/01/2013
DR Temaer, Web
Marie Hougaard
http://www.dr.dk/Nyheder/Viden/Naturvidenskab/2013/01/10133526
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

Rumstrøm i kontakten: Videnskabens Verden
John Leif Jørgensen
08/01/2013

Subject
Man regner med at vi skal bruge ca. en halv gang mere energi i 2050 end i dag. Vi slubrer det i os i takt med vindmølleen røter, kulminerne bliver dybere og oliestrommen hoster. Og derfor er vi nødt til at finde nye energiformer.

Og de er kæmpe fordele ved at hente strøm fra rummet fortæller professor på DTU John Leif Jørgensen: "Det vil give os en fantastisk energikilde der er fri for CO₂ og så er der masser af den. Kun ca. 1/10 af den energi som solen sender mod jorden bliver brugt – resten forsvinder bare videre ud i rummet".

National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Rumstrøm i kontakten: Videnskabens Verden
08/01/2013
P1, Radio
Sara-Cirkeline Ertbølle
57:02
http://www.dr.dk/P1/Videnskabensverden/Udsendelser/2013/01/04135502.htm
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

Sætter livet på spil for at sprænge lydmuren
John Leif Jørgensen
08/10/2012
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Sætter livet på spil for at sprænge lydmuren
08/10/2012
TV2 nyheder, Television
Jeppe Lykke Hansen
http://nyhederne.tv2.dk/article.php?id-58373102:video-s%C3%A6ttet-livet-p%C3%A5-spil-for-at-spr%C3%A6nge-lydmuren.html
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

Press / Media
Aftenshowet: Voyager missionens bedrifter og den teknologi den bygger på: Interview af DTU Professor John Leif Jørgensen
John Leif Jørgensen
05/09/2012
Subject
Interview om missionens bedrifter og dens teknologier
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Aftenshowet: Voyager missionens bedrifter og den teknologi den bygger på: Interview af DTU Professor John Leif Jørgensen
05/09/2012
Aftenshowet, Television
DR
http://www.dr.dk/DR1/Aftenshowet/index.htm
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media

Introduktion til Ingeniørarbejde i geofysik og rumteknologi
René Fléron
21/08/2012
Subject
Kursusbeskrivelse af kursus nr. 30100
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Introduktion til Ingeniørarbejde i geofysik og rumteknologi
21/08/2012
DTUbroadcast, Web
Astrid Degersbøl
12:59
http://www.youtube.com/watch?v=BpiPKqpiErE
René Fléron
National Space Institute, Measurement and Instrumentation Systems
Press / Media

Amatørraket affyret i Østersøen
René Fléron
12/08/2012
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Amatørraket affyret i Østersøen
12/08/2012
TV2, Television
http://nyhederne.tv2.dk/article.php/id-52976253 amat%23%28raket-affyret-i-%C3%B8sters%C3%B8en.html
René Fléron
National Space Institute, Measurement and Instrumentation Systems
Press / Media

Houston, we have an eyeproblem: En ny undersøgelse viser, at længere tid i rummet kan forårsage dårlige øjne for astronauter
Houston, we have an eyeproblem: En ny undersøgelse viser, at længere tid i rummet kan forårsage dårlige øjne for astronauter
12/03/2012
Metroxpress, Print
Lasse Spang-Hanssen
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media

Planet fra Solen
John Leif Jørgensen
19/11/2011
National Space Institute, Measurement and Instrumentation Systems

Mars500 eksperimentet: om projektet med et menneske på Mars
John Leif Jørgensen
31/10/2011
National Space Institute, Measurement and Instrumentation Systems

Væn jer til nedstyrtende satellitter
John Leif Jørgensen
19/10/2011
National Space Institute, Measurement and Instrumentation Systems

Væn jer til nedstyrtende satellitter
19/10/2011
TV2 News, Television
Natali Braagaard
EXT-OA
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media
Go’Morgen P3: RoSat og aspekter ved genindtræden af skrottede satelitter i atmosfæren
John Leif Jørgensen
14/10/2011
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Go’Morgen P3: RoSat og aspekter ved genindtræden af skrottede satelitter i atmosfæren
14/10/2011
DRs P3 program - Go’Morgen P3, Radio
http://www.dr.dk/p3/programmer/gomorgen-p3
EXT-OA
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

Antistof og fremtidens rumfart
John Leif Jørgensen
13/09/2011
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Antistof og fremtidens rumfart
13/09/2011
Videnskabernes Verden, DR P1, Radio
http://www.dr.dk/P1/Videnskabensverden/20050902132728.htm
EXT-OA
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

Dansk teknologi på Jupiter-rumfartøj
John Leif Jørgensen
19/08/2011
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Dansk teknologi på Jupiter-rumfartøj
19/08/2011
DR2 Deadline, Television
http://www.dr.dk/DR2/deadline2230/seudsendelser.htm#/15712
EXT-OA
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

Rumsonden Juno på vej mod Jupiter
Peter Siegbjørn Jørgensen
05/08/2011
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Rumsonden Juno på vej mod Jupiter
05/08/2011
TV2, Television
EXT-OA
Peter Siegbjørn Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Rumsonden Juno er sendt mod Jupiter  
John Leif Jørgensen  
05/08/2011  
National Space Institute, Measurement and Instrumentation Systems  

Media contribution (1)  

Rumsonden Juno er sendt mod Jupiter  
05/08/2011  
DR, Television  
http://www.dr.dk/Nyheder/Udland/2011/08/05/194457.htm  
EXT-OA  
John Leif Jørgensen  
National Space Institute, Measurement and Instrumentation Systems  

Dansker forskere med i eliten: Danske forskere har udviklet et kamera som skal med NASA til Jupiter  
Peter Siegbjørn Jørgensen  
01/08/2011  
National Space Institute, Measurement and Instrumentation Systems  

Media contribution (1)  

Vi så stor meteor over Middelfar: Meteor brændte op i luften over Skrillinge ved Middelfart  
John Leif Jørgensen  
28/06/2011  
National Space Institute, Measurement and Instrumentation Systems  

Media contribution (1)
**Asteroide kommer usædvanligt tæt på**
John Leif Jørgensen
27/06/2011
National Space Institute, Measurement and Instrumentation Systems

**Media contribution (1)**

**Asteroide kommer usædvanligt tæt på**
27/06/2011
Print
EXT-OA
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

**Asteroide tæt på Jorden**
John Leif Jørgensen
27/06/2011
National Space Institute, Measurement and Instrumentation Systems

**Media contribution (1)**

**Asteroide tæt på Jorden**
27/06/2011
DR1, TV Avisen kl. 18.30, Television
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media

**Når den sidste rumfærge er gået...**
John Leif Jørgensen
22/05/2011
National Space Institute, Measurement and Instrumentation Systems

**Media contribution (1)**

**Når den sidste rumfærge er gået...**
22/05/2011
Print
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media

**Endeavour på sin sidste mission i rummet**
John Leif Jørgensen
16/05/2011
National Space Institute, Measurement and Instrumentation Systems

**Media contribution (1)**

**Endeavour på sin sidste mission i rummet**
16/05/2011
DR Deadline, Television
http://www.dr.dk/DR2/Deadline17/Deadline17.htm#/9554
EXT-OA
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media
Dansk rumraket er bygget på simple løsninger
John Leif Jørgensen
30/08/2010
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Dansk rumraket er bygget på simple løsninger
30/08/2010
Viden.jp.dk, Print
Maj Bach Madsen
http://viden.jp.dk/rummet/rummet/rumfart/default.asp?cid=150076
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

Computer der kan holde i 900 år
John Leif Jørgensen
03/10/2007

Subject
Interview-indlæg på P1 den 4. Okt. 2007, kl. 20:03
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Computer der kan holde i 900 år
03/10/2007
DR’s Hardisk, Radio
16:37
http://www.dr.dk/P1/harddisken/Udsendelser/2007/10/04234536.htm
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

Flotte månedbilleder med dansk bidrag: Præcise danske stjernekameraer er forudsætningen for skarpe billeder af Månen, som strømmer ned fra ESA’s mission SMART-1
John Leif Jørgensen
20/06/2005

Subject
Stjernekamera på europæisk rumfartsorganisation ESA’s fartøj, SMART-1
National Space Institute, Measurement and Instrumentation Systems

Media contribution (1)

Flotte månedbilleder med dansk bidrag: Præcise danske stjernekameraer er forudsætningen for skarpe billeder af Månen, som strømmer ned fra ESA’s mission SMART-1
20/06/2005
ESA Danmark, Web
http://www.esa.int/dan/ESA_in_your_country/Denmark/Flotte_maanebilleder_med_dansk_bidrag
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems

Det "umuligt" præcise kamera
John Leif Jørgensen
27/05/2002

Subject
Den europæiske rumfartsorganisation ESAs satellit Proba, som blev opsendt i efteråret 2001, er nu kørt ind og har gennemført en række observationer af Jorden med meget stor nøjagtighed. Blandt andet er der fra 600 kilometers højde taget billeder, der er så skarpe, at man kan se variationen i vegetationen inden for få meter.
Det "umuligt" præcise kamera
27/05/2002
ESA Danmark, Web
http://www.esa.int/dan/ESA_in_your_country/Denmark/Det_umuligt_praecise_kamera
John Leif Jørgensen
National Space Institute, Measurement and Instrumentation Systems
Press / Media