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50 Years of Women in Space and the Culture of Results

By Claudia Kessler



Claudia Kessler, CEO HE Space

1963 was a remarkable year in many respects – remarkable as the year of Martin Luther’s famous speech „I have a dream“, as the year of the assassination of John F. Kennedy, or as the year of the „great train robbery“ – a real story that later turned into blockbusting TV-reality. However, the year 1963 also marked the beginning of women in space.

No doubts, it takes extraordinary characters to make one’s way up into space; however, the personal ingredients to that recipe of success haven’t changed much over the past 50 years. The outstanding merits of Valentina Terechkova and those women who followed her – from Sally Ride, Sveltana Savitskaya, Bonnie Dunbar to Claudie Haigneré, to name but a few out of the impressive international list – was to prove that those „ingredients“ are neither male nor female. What they brought into the business was discipline and the will to reach the goal, while society provided education and training, both resulting in self determined development regardless of gender, cultural and social heritage.

Today, space business in daily life is not only focused on humans serving as astronauts, cosmonauts and taikonauts, though their endeavours sure are still the most exiting ones in the eyes of the general public and the media. Today, the space business is in need of specialist for areas like remote sensing, satellite communications, data evaluation, robotics, and hundreds more including also traditional fields like accounting, account management, marketing, human resources management and public relations. Alone approximately 1,000 commercial communications satellites at a value of almost half a billion dollars are in service today: space means business, and it’s a rapidly growing business.

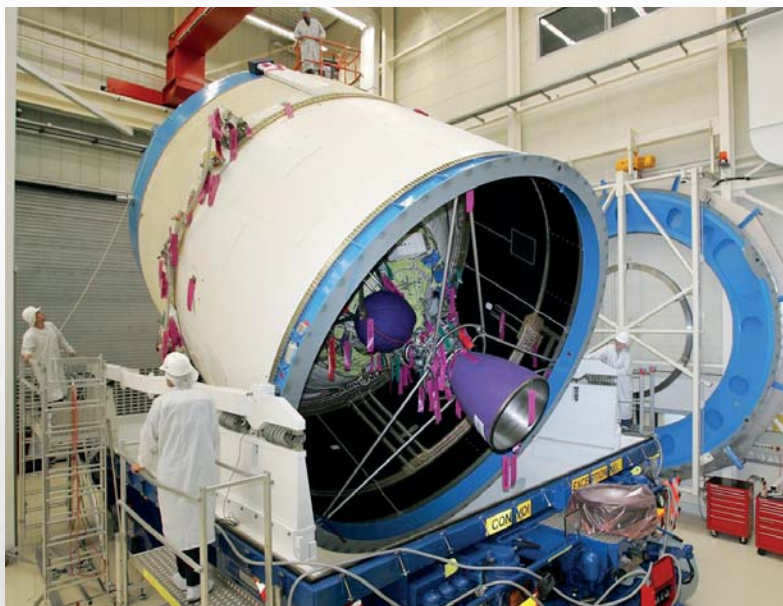
Initiatives like „Women in Aerospace“ (www.wia-europe.org) help to keep up that pace of growth by supporting female professionals to find their ways, offering national and international networking and communication platforms that up to now are being vividly taken advantage of „women in space“ around the globe. Women, who exactly do „what Facebook’s COO Sheryl Sandberg demands: They „lean in to their careers and (are) dedicated to staying in the work force“. While that is what the individuals – female and male – already bring into

the business themselves, society still needs to create broader support mechanisms to allow progress to take place. And, just like in the case of the individual women in space that process begins in the mind.

Progress is not supported by explanations why things are impossible, but by plans and actions to pave new ways to make them possible. Sure, sometimes it may not seem easy, because still most of our daily life is based on an old set of habits which over the times materialized in a kind of „behavioral infrastructure“: a standard working time at daylight, strict separation between home and business outside, women to take kids to kindergarten... Evolution may have influenced our genes, but more than that, it certainly created nothing but habits. Habits that we can and must change on personal and on corporate levels, **since the infrastructure of our habits has led to reductions, while what we need is to come closer to a culture of results.** Strict timing schemes are a reduction: apart from supporting outdated role behavior they also implicitly promote quantity over quality, process over result. Decision finding through huge matrix and meeting cultures bears the danger of reduction: apart from eating up time and thereby supporting the process over its results, it reduces individual responsibility and finally motivation. Just two of many examples.

The cure goes beyond just „officially“ and mentally overcoming traditional role schemes, which we are about to master anyway. But just to find men and women now caged alongside in old schemes of reduction? It’s time to create a new infrastructure of habits that even goes beyond the new wave of „work-life balance“ recipes – the word itself already implies that work and life need to be separated rather than combined. Integrating the best of those two worlds into one will finally lay the foundations for a culture that also provides room, time and instruments to nurture the talents of humans best from the beginning, because we need more than just some women in space. Moreover, because after 50 years we need a culture that does not need that discussion any more. What we need is a culture of results. And that will be gender neutral by nature – in space as well as on earth.

Astrium: Together, pioneering excellence



Ariane 5 ECA, Image: Astrium GmbH /Ingo Wagner.

Astrium is the number one company in Europe for space technologies and the third in the world. It is the only global company that covers the full range of civil and defence space systems, equipment and services.

In 2012, Astrium had a turnover over €5.8 billion and 18,000 employees worldwide. Its three business units are: Astrium Space Transportation, the European prime contractor for launchers, orbital systems and space exploration; Astrium Satellites, a leading provider of satellite system solutions, including spacecraft, ground segments, payloads and equipments; Astrium Services, the Space services partner for critical missions, providing comprehensive fixed and mobile solutions covering secure and commercial satcoms and networks, and bespoke geo-information services, worldwide.

Astrium is a wholly owned subsidiary of EADS, a global leader in aerospace, defence and related services. In 2012, the Group – comprising Airbus, Astrium, Cassidian and Eurocopter – generated revenues of €56.5 billion and employed a workforce of over 140,000.

Astrium Space Transportation

The prime contractor for European civil and military space transportation, and orbital infrastructure. We design, develop and produce the Ariane launchers, and

ballistic missiles for France's nuclear deterrent force. We are also the industrial prime contractor for the Columbus laboratory and the ATV cargo vessel operating for the International Space Station, and are a specialist in atmospheric re-entry vehicles, space robotics, propulsion systems and space equipment.

Astrium Satellites

A world leader in the design and manufacture of satellite systems and payloads for all applications, covering civil and military telecommunications, Earth observation, science and navigation programmes. We also provide a complete range of associated ground and space equipment.

Astrium Services

Your space services partner for critical missions, providing comprehensive fixed and mobile solutions covering secure and commercial satcoms and networks, and bespoke geo-information services, worldwide.

ACCESS TO SPACE

Everyone should benefit from space, because space belongs to all of us. Astrium plays a crucial role in ensuring that Europe has independent and competitive access to space by designing, developing and building the launch systems of today and tomorrow.

Sole prime contractor for the Ariane 5 heavy-lift launchers, Astrium coordinates the activities of over 60 companies across Europe to deliver a fully integrated and tested launch vehicle to Arianespace, the launch services company, in which Astrium is the largest industrial shareholder.

This is underpinned by Astrium's commitment to finding innovative and creative solutions that make every space mission more efficient, more reliable and more competitive.

SECURITY AND DEFENCE

Space technologies enable governments and armed forces to protect populations and preserve freedom in troubled times. To help make earth a safer place for its seven billion inhabitants, Astrium provides a full range of space-based security and defence systems and services to many government and military customers, including the British armed forces, the French MoD, the German Bundeswehr, the US DoD, NATO and allied countries.

Customers use our information gathering satellites to stay one step ahead in order to protect lives and assets. Our teams deliver secure defence satellite communications through systems such as Skynet 5 and SATCoMBw, while our space-based and airborne monitoring systems provide commanders with a clear picture of operations on the ground.



SATCOM BW satellite, Image: Astrium GmbH.

We have been developing and supplying ballistic missile systems for the French deterrent force for more than 40 years, experience which has given us exceptional skills and technologies that enable Europe to meet future needs for the deployment of anti-missile defence systems.

TELECOMMUNICATIONS AND NAVIGATIONS

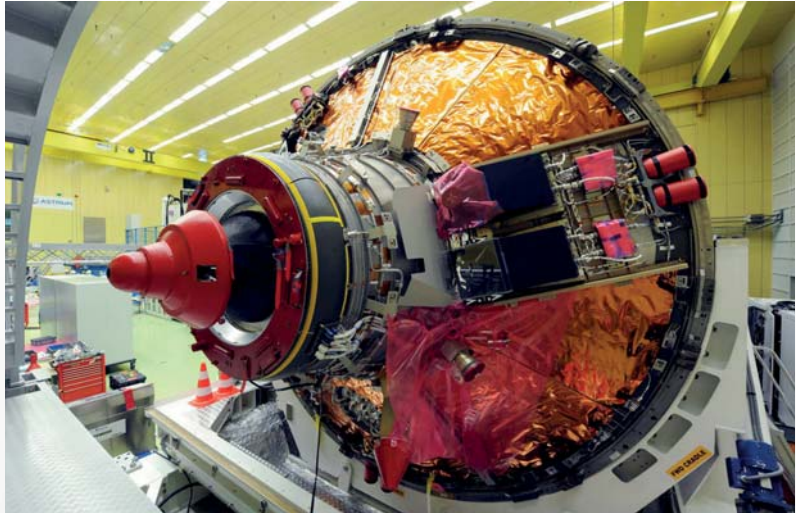
More reliable telecommunications, more efficient transport, more Internet access: space improves our daily lives.

Astrium is a major player in telecommunications and navigation systems, and our people constantly strive to set the standards for reliability and service levels.

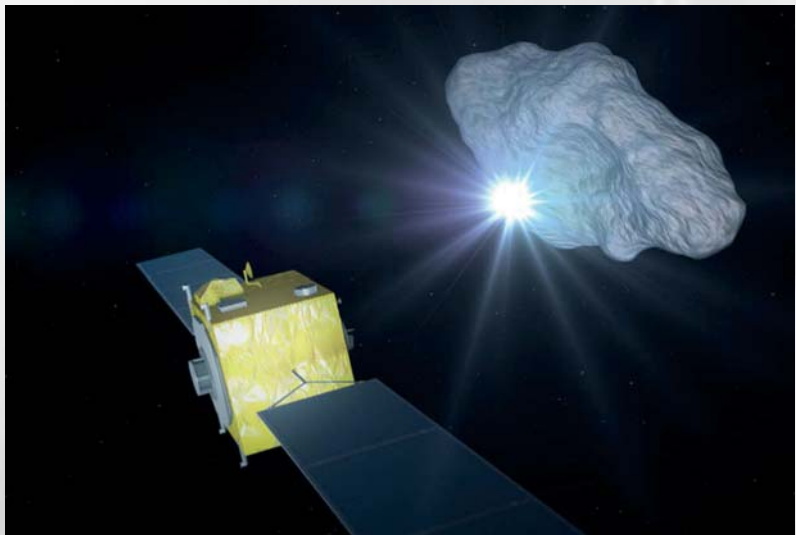
From satellite design to delivery in orbit, our capabilities offer customers – which include the largest telecoms operators in the world – solutions explicitly tailored to their needs. For example, our eurostar series of geostationary communications satellites provides exceptional reliability and innovation, with over 400 accumulated years of successful in-orbit operation. We also offer Mobile Satellite Services (MSS) and Very Small Aperture Terminal (VSAT) systems for air, land and maritime communications.

EARTH OBSERVATION AND PROTECTION

We need to protect our planet. Pollution, natural disasters, climate change and threats to the environment and biodiversity are increasing challenges for the human race. Space-based technologies help us to take better care of the world around us. Astrium is a pioneer in this field. Our geo-



ATV-4 in integration at Astrium Bremen, Image: Astrium GmbH/J. Wagner.



European programme NEOShield, Image: Astrium GmbH.

information and meteorological activities, combined with our optical and radar satellites and instruments, deliver highly-accurate and continuous earth observation data.

In partnership with the European Space Agency and the main national space agencies, Astrium designed and developed Envisat, the highly sophisticated Earth observation satellite, and the Spot series of satellites.

We are also prime contractor for many latest-generation observation satellites, including CryoSat, TerraSAR-X and TanDeM-X, Aeolus, Pléiades, Metop, Swarm and Sentinels. The European leader in Earth observation systems and geo-information services, Astrium is fully committed to the EU's Global Monitoring for environment and Security (GMeS) programme.

MANNED SPACE MISSIONS

The International Space Station (ISS) programme not only fosters international cooperation, it is also a unique platform for scientific experiments and research. Astrium is the European Space Agency's principal industrial contributor to the ISS and is responsible for the industrial operation and utilisation of all the European elements on the ISS.

Our engineers designed and built the Columbus laboratory, which provides researchers from around the world with an unparalleled environment for zero-gravity research in fields as diverse as material science, medicine, fluid dynamics and astronomy. We develop and manufacture the ATV space cargo vessel, which is designed to replenish the ISS with fuel, food, water and all other essentials. It also corrects the ISS' orbit, compensating for



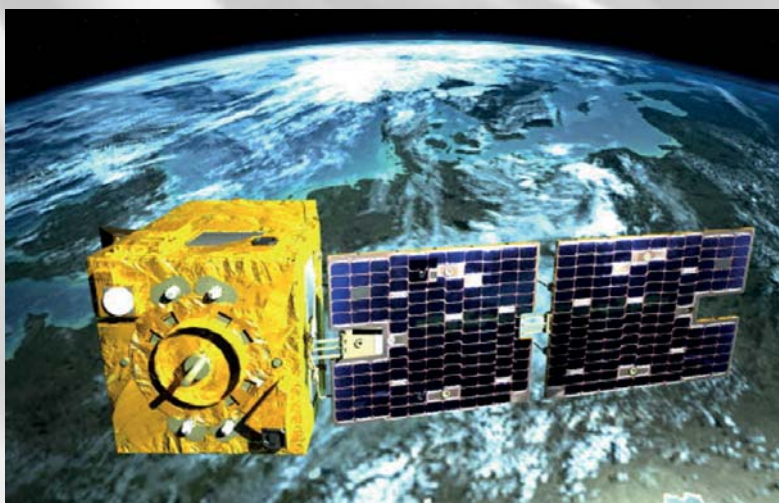
Bepi Colombo fully mounted at ESTEC on July 2012. Image: Astrium GmbH/Mathias Pikelj.



The third unit of the minus 80 degree freezer (MELFI) under testing. Image: Astrium GmbH/Alfred Rutloff.



Rosetta, Image: Astrium GmbH.



Vnresat - Optical Earth observation system for Vietnam, Image: Astrium GmbH.

the station's regular loss of altitude. Looking to protect and most effectively use the space environment, our experts are also doing pioneering work in debris removal and space robotics.

EXPLORING THE UNIVERSE

Many of the fundamental questions about our very existence can only be answered by exploring our solar system and getting closer to the origins of the universe. From the Soho solar observatory to the Rosetta and Huygens probes, from the Cluster II fleet to the XMM-Newton X-ray space telescope, Astrium is the creator and prime contractor of the most ambitious spacecraft and instruments developed for the European Space Agency.

The Herschel Space observatory carries the biggest, most advanced all-silicon carbide space telescope ever made – and it was built by Astrium. We designed and developed Mars express and Venus express, the first European probes sent to investigate our nearest neighbours. Soon BepiColombo will be heading off to explore Mercury; Rosetta will reach its destination, the mysterious comet Churyumov-Gerasimenko, after a 10-year journey; LISA Pathfinder will measure gravity waves that could still be echoing through space from the very birth of the universe; and Gaia will plot a 3D map of the Milky Way. And when Europe takes its turn in placing a man on the Moon, and then on Mars, Astrium will be there.

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IABG performs dynamic characterisation tests on Vinci engine

In line with a long-standing tradition, however, above all due to the excellent technical possibilities and profound know-how of the IABG test teams with regard to specific test requirements and procedures of launcher components, IABG was contracted to perform the dynamic characterisation tests on the M5 test model of the Vinci upper stage rocket engine.

The Vinci engine is developed by Snecma (Safran) in Vernon and is designed both for a higher-thrust version of the Ariane 5 upper stage as well as for Ariane 6 variants as re-ignitable upper stage engine. Characteristic feature of the Vinci engine is an extendable nozzle. With the test model M5, for the first time, a Vinci engine is subjected to dynamic vibration loads on a shaker facility before the engine is put on the test stand for the firing test. On the shaker facility, vibrations loads as expected during the launcher's

initial start phase are simulated. This test approach is to verify that vibration loads neither impair the nozzle extension mechanism, nor the engine function. IABG's commissioning primarily consisted of five tasks:

- 1) Manufacturing and qualification of mechanical tools to handle and to integrate the engine in the test house thus enabling handling and mounting of the engine on the test facilities
- 2) Provision and qualification of engine handling procedures, as well as verification that all test steps can be carried out safely in the provided testing facilities
- 3) Implementation of a comprehensive modal engine test in the two engine configurations "nozzle retracted" and "nozzle extended"

iABG

4) Implementation of a comprehensive vibration test programme, also in the two engine configurations specified above

5) Determination of the engine's mass characteristics.

A special challenge was the production of the mechanical tools required to integrate and handle the engine in the test house (e.g., nozzle installation and testing of the extension mechanism under full gravity compensation). Turning the completely integrated engine in test direction and transporting it to the test facilities were among the tasks to be completed here. The Figure shows the combined "Integration and Transport Rig", surrounded by a functional work platform.

The characterisation programme on the M5 test model was successfully completed in time and in compliance with all test objectives by mid June 2013. The success of the project is based on the outstanding co-operation between the IABG project and test teams and the customer teams, in connection with precise and subsequently fully confirmed technical planning as well as scheduling efforts.



iABG

MGSE for Integration and Handling
Vinci Engine Ariane 5ME

OHB AG

A leading independent force in the European aerospace sector



Domiciled in Bremen, OHB AG is Germany's first listed space technology group. With more than 30 years of experience in high technology together with its integrated skills in the areas of aviation and space, the group is ideally positioned in Europe. It is a sought-after partner for the European Space Agency ESA and the German Aerospace Centre DLR as well as for customers in the private and public sector.

Business Unit „Space Systems“

This business unit is focusing on developing and executing space projects. In particular, it is responsible for developing and fabricating low-orbiting and geostationary small satellites for navigation, research, communications and earth observation including scientific payloads. Its human space flight activities chiefly entail projects for the assembly and fitting of the International Space Station ISS, Columbus and ATV. The exploration segment works on studies and models for exploring our solar system. Reconnaissance satellites and broadband wireless transmission of image data form core technologies for security and reconnaissance.

Earth observation and reconnaissance

Developed and built by OHB System, the SAR-Lupe system with its five radar satellites, ground segments and the combined German-French reconnaissance satellite system comprising SAR-Lupe (radar images) and Helios 2 (optical images) is operating stably and to the full satisfaction of the customer. In 2011, OHB conducted preparatory studies for a follow-up SAR-Lupe.

As a partner of Thales Alenia Space, OHB System was selected by ESA and EUMETSAT for the development and construction of the third-generation European weather satellites MTG (Meteosat Third Generation). The contract provides for the delivery of six satellite platforms, two payloads to be supplied by Kayser-Threde with infrared sounders and the integration of these payloads with two of the platforms to fabricate fully enclosed satellite systems. The four other platforms will be delivered to Thales Alenia Space in France, where they will form the basis for the imager satellites. The technological basis for all six satellites is the SmallGEO platform developed by OHB.

Thanks to contributions made by OHB System and Kayser-Threde, the scientific proposal for a greenhouse gas monitoring mission (CarbonSat) under the lead management of the University of Bremen was selected by ESA out of two candidates for the next Earth Explorer Mission. In 2012, OHB System and partners have been selected to carry out one of two parallel studies.

Developed and assembled by Kayser-Threde for the German Aerospace Center (DLR), the TET-1 technology testing satellite was launched at the Russian space center in Baikonur at the end of July on board a Soyuz launcher.

Communications

The award by commercial Spanish satellite services provider HISPASAT of a contract for the delivery of the AG1 satellite in 2009 marked an important milestone for OHB System in the ongoing commercial exploitation of the SmallGEO platform. For this purpose, OHB's new SmallGEO



SmallGEO: Artist's impression of a SmallGEO-based communication satellite. Images: OHB System AG/Carl-Christian Meyer.

platform is being deployed directly in a satellite operator's commercial system, with the satellite scheduled for a 2014 launch.

ESA has also selected the SmallGEO platform as a basis for the European Data Relay Satellite (EDRS) within the ARTES-7 program. ESA awarded the contract to satellite operator Astrium Satellite Services. Accordingly, OHB System is supplying the satellite. The enhancements to the SmallGEO model for use as a specialized data relay satellite in ultra-high-speed satellite-to-satellite communications are creating an important new strategic segment in both the civilian and military market.

This OHB-developed platform was also selected by DLR as the basis for a national telecommunications mission ("Heinrich Hertz Satellite"). In this connection, OHB System was contracted for the development phase for this mission in July 2012.

Developed by LUXSPACE and the first satellite to be built in Luxembourg, "VesselSat1" was launched successfully from the Indian space center Sriharikota on board a PSLV vehicle in October 2011 and placed in an orbit close to the equator. The identical "VesselSat2" satellite was also successfully launched in China in January 2012. The satellites form part of the existing ORBCOMM system, which now comprises a total of 28 satellites and are responsible for the satellite-aided monitoring of Automatic Identification Service (AIS) data.

Navigation

EU and ESA contracted OHB System for the construction and testing of 22 satellites for the Galileo FOC (Full Operational Capability) space segment. Considerable progress has been made



Galileo: Artist's impression of Galileo FOC satellites in orbit. Image: OHB System AG/Carl-Christian Meyer.

on the development work to the customer's complete satisfaction. The critical design review (CDR) of the project was successfully completed in December 2011. The first FOC satellite integration was completed mid-2012, the first satellite rolled-out for environmental testing on May 15, 2013.

Space exploration

In 2011, CGS was able to reinforce its role in scientific space programs with the development and execution of complex contributions. The AMS-02 Alpha magnetic spectrometer was launched into space on May 16, 2011. CGS made a significant contribution to completing the laboratory, which is operating flawlessly. The LARES satellite, which had been developed and assembled by CGS, was launched on February 13, 2012 on board the first European Vega vehicle for small to mid-size payloads.

In a contract awarded by the Bavarian State Government for Munich's Ludwig Maximilian University (LMU), Kayser-Threde constructed a technically highly innovative 2-meter-class telescope for the Wendelstein Astro-Physical Observatory in 2011. At the end of December 2011, the new telescope went into operation for the first time, collecting a very promising amount of data. It was officially handed over to the customer in the first half of 2012.

Space research and robotics

In August 2011 the operation of the formation flying and rendezvous system PRISMA consisting of two highly innovative and autonomous spacecraft was brought back to OHB Sweden after being on loan to DLR/GSOC for a period of five months. The original purpose of the now completed mission was to demonstrate the autonomous satellite formation flight and to prepare future in-orbit inspection and repair missions. The system is now being used to conduct experiments for institutional and commercial customers.

Human spaceflight

In 2011, OHB System's contract for the support of work on board the International Space Station

ISS was renewed. This contract includes the management of experiments as well as maintenance and repair work for the equipment developed and supplied by OHB System.

Ground stations

CGS completed its contributions to the ground segment for the small European launcher Vega at the end of 2011. The maiden flight from the space center in French-Guyana was executed on February 13, 2012.

In December 2011, Antwerp Space N.V. received a contract to design, develop and assemble the FOC phase of the mission data distribution network as part of the ground mission segment (GMS) for the European Galileo* program. This will ensure steady utilization of the capacity available within this segment of Antwerp Space until 2014. Antwerp Space has been working since 2006 on the existing IOV (in-orbit verification) ground network, achieving the main milestones in 2011.

Business Unit "Aerospace + Industrial Products"

This segment is primarily responsible for fabricating aviation and space products as well as other industrial activities. In this area, OHB has established itself as a significant supplier of aerospace structures for the aviation and space industry; among other things, it is the largest German supplier of components for the Ariane-5 program and an established producer of critical components for aircraft engines. In addition, OHB is an experienced vendor of mechatronic systems for antennas and telescopes and is involved in several major radio telescope projects.

Seven Ariane-5 launches were successfully executed in 2012. Production and delivery of all Ariane-5 components by MT Aerospace proceeded according to schedule.

In 2012, the company's business in aircraft products primarily entailed the production and delivery of fresh and waste water tanks for Airbus aircraft.



MT: tank dome production at MT Aerospace in Augsburg

The first new series component for business in light-weight structures for the A400M military transporter was delivered in December 2011.

In 2011, the 64-meter radio telescope in the SRT Sardinia project were successfully handed over to the customer. In 2013, the ALMA observatory in Chile was officially inaugurated. As well as this, MT Mechatronics GmbH received a contract from the Fraunhofer Institute for the construction of a bearer structure for an XXL computer tomography system.

Aerotech Peissenberg is involved in new projects for nearly all aircraft engine producers. The strategic relations with Rolls-Royce, the largest European manufacturer of aircraft engines, is an important factor in the participation in the current phase of market growth. In this connection, Aerotech Peissenberg is playing a particularly important role as a strategic supplier of rotating parts for Rolls-Royce. Further master contracts were signed in 2011 and 2012.

Paris Air Show Le Bourget 2013

OHB will showcase their products and programmes at the Paris Air Show from June 17 to 23, 2013. For further information, the group's stand can be found in hall 2C, at booth C316.



ATP: lathe for precision machining of components at Aerotech Peissenberg. Images: ATP/Chris Müller

space for success



Jena-Optronik, a subsidiary of Astrium GmbH, is a true pioneer in the field of attitude and orbit control sensors for satellites and optical instruments for Earth observation.



The Jena-based company, with currently 175 employees, is a reliable partner for space agencies as well as for space companies in Asia, Russia, Europe and North America.

For many decades we enable and support spectacular and successful space missions.

Our goal is the success of our customers around the world. The quality of our durable products speaks for itself. And for us, too: With well-trained, highly motivated employees, we continue to set new standards.

Our home base is Jena, a city in Germany that was the home of optics pioneer Carl Zeiss – and a high-tech center where the art of German engineering and research meets passion and drive.

20 years of experience and precise solutions stand for successful products and projects:

- attitude and orbit control systems (AOCS) sensors
- instruments for Earth observation as well as
- software & data processing

As vast as the universe is, there is no space for inaccuracy: Sensors by Jena-Optronik keep satellites stable and on track

Whether telecommunication, navigation, weather forecast, environmental management, or reconnaissance missions – Jena-Optronik's sensors provide the preconditions that European, American or Asian satellites keep their designated orbits.

A wide variety of sensors for highly specific needs: our products include the autonomous ASTRO star sensors, different Rendezvous- and Docking Sensors (RVS) and the Fine Sun Sensor FSS. But they all have one thing in common: they do what they were designed to do.

With the RVS 3D LIDAR we are ready for

the next rendezvous. The advanced 3D imaging LIDAR enables acquisition, tracking and imaging of both cooperative and non-cooperative targets. The new sensor is based on the RVS experience and several national and European development projects. Powerful sensor systems are essential in order to reliably detect and capture space debris. The DLR project LiQuaRD's Imaging 3D-LIDAR developed by Jena-Optronik allows to capture the position and distance of a target object in all three-dimensions to ensure a safe and successful mission. The work was performed as part of the LiQuaRD study by DLR space agency under ref. no. 50RA1002 funded by the Federal Ministry of Economics and Technology according to an enactment by the German Bundestag.

Another new development is the Optical Sky Simulator (OSI). The Jena-Optronik OSI is a smart and powerful star tracker test equipment stimulating real star and real sky patterns on the optical path of a Star Sensor device.

It allows a real end-to-end test of the star tracker functions and can be used in closed loop tests of the AOCS equipment in ambient as well in thermal vacuum (TV) environment. The OSI consists of a light-weight optical head (OH) for the projection, a baffle mount, the connecting harnesses, and a control computer. The optical head of the OSI can be directly attached to the star tracker housing or on top of the baffle. The real sky scenery (stars, planets, moon, SEU's, etc.) is imaged in real-time on a high resolution micro-display in front of a special optics providing a collimated beam to the star tracker entrance aperture.

Visionary technology in the truest sense of the word:

Our optical instruments generate crucial data, helping to improve the quality of life on Earth

The fields of use for our Earth observation technology are numerous and diverse. Not only can our products acquire multi-spectral data of our planet; they also play an important role in environmental protection and meteorology. Jena-Optronik technology is used across the globe to perform a wide range of scientific and security tasks: compact multi-spectral cameras; high-performance radiometers; electronic and opto-mechanical subsystems and components for operational Earth observation:

- multi-spectral imager JSS 56 for RapidEye
- imaging Radiometer METimage for future meteorological satellites
- important contributions within GMES Sentinel-2 and Sentinel-3
- multi-spectral filter assemblies

METimage is a multispectral imaging radiometer for the next generation of weather satellites. The instrument performs precise measurement of thermal radiation and light reflected from the Earth to further improve weather forecasting and climate research. The concept for METimage with the rotating telescope was developed and patented by Jena-based Jena-Optronik with the help of the DLR, Germany's National Meteorological Service (DWD) and the Federal Ministry of

Transport, Building and Urban Affairs (BMVBS).

Core item of the METImage instrument is a rotating telescope scanner covering the large swath width of about 2,800 km, which is needed for a global coverage by a polar platform. The de-rotated image facilitates in-field spectral channel separation, which allows tailoring individual channel GSD (ground sampling distance) and features like TDI (time delay and integration). State-of-the-art detector arrays and read-out electronics will be employed. The reflecting telescope design is able to support demanding requirements on image quality and ground resolution.

Innovative technology knows no boundaries:

Satellite data is helping on Earth

Earth observation missions provide important data and global information, e.g. in the section of environmental protection and disaster control. They are relevant for preventing and forecasting environmental catastrophes.

We are a worldwide operating producer of multi-spectral earth observation instruments and the associated software.

There is a growing international awareness about the importance of the epidemiology of diseases and it is recognized that improved up-to date information of the environment, in which infectious diseases occur, will help epidemiologists to study, understand and predict threats to human health.

Within the scope of the Epidemio project satellites will join this field as data sources for epidemics. The scope of this ESA-funded project is to demonstrate and use the potential of Earth Observation for a new application supplying new types of environmental information on epidemiology. Jena-Optronik is the leader of the Epi-

demio project team. Since the work plan requires combining complementary skills and expertise, a consortium has been organized that is qualified and well experienced in the various relevant fields.

Another software project, GlobWetland II, led by Jena-Optronik, was launched in January 2010. The overarching objective of the GlobWetland II project is to contribute to the setup of a Global Wetlands Observing System (G-WOS). The GlobWetland II information system includes maps and system software. The GlobWetland II system software is available as an ArcGIS toolbox and consists of a remote sensing and a GIS component for tasks like satellite image pre-processing, Land Use/Land Cover classification, change detection and for the indicator computation.

Wetlands play a major role in the availability and quality of water. They are integral components in the hydrological cycle and contain most of the water utilized to meet human needs. Water resource management is largely dependent on the hydrological functions of wetlands and equally wetland ecosystems need a minimum amount of water to maintain these functions. The wise use of wetlands is essential for the delivery of sustainable water management that also promotes sustainable economic and social development.

For further information please visit the website:

www.jena-optronik.de

or contact Mrs. Annett Feige

Email: annett.feige@jena-optronik.de

Phone: +49 3641 200-255



contribution to success our products for your mission

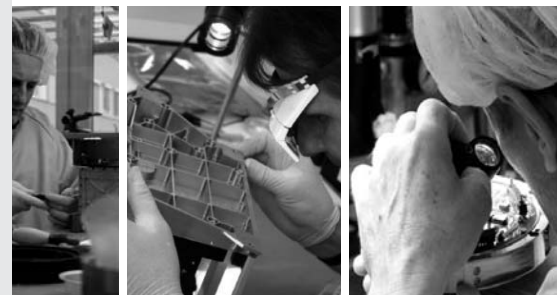
Any mission is only as good as its people, technologies and components. International space missions depend on our products and reliability.

We are proud to count the world's leading space companies among our clients. Facing the future together.

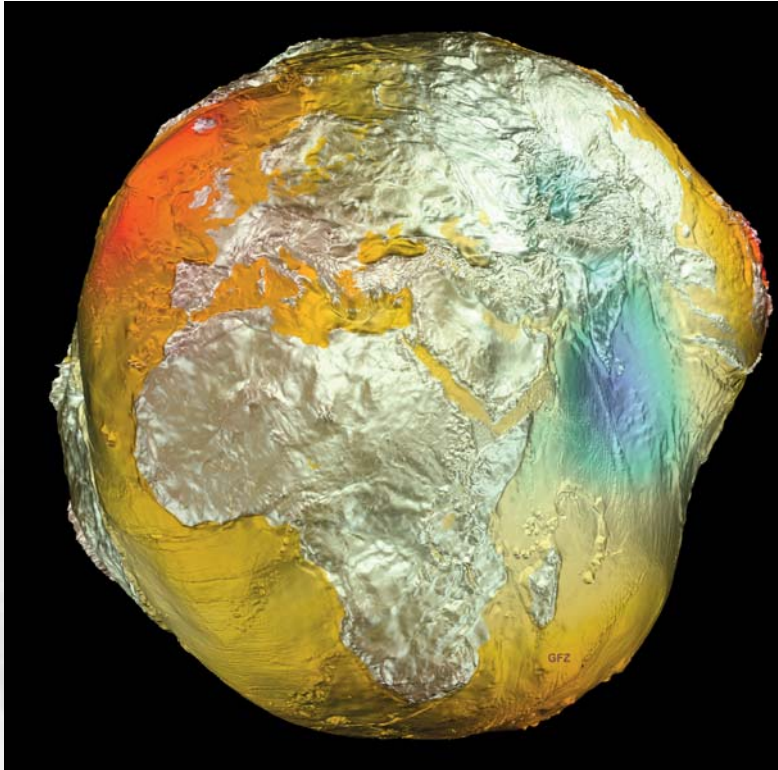
space for success meet us at the Paris Air Show Hall 2C, Booth C368.



German Chancellor Angela Merkel during her visit of Jena-Optronik in May 2013. Images: Jena-Optronik



Space Activities of GFZ



Geoid 2011, data based on satellite LAGEOS, GRACE and GOCE and surface data (airborne gravimetry and satellite altimetry). Image: GFZ

The Helmholtz Centre Potsdam GFZ is the German Research Centre for Geosciences. Global data sets are needed for the research on the complex system Earth with all its sub-systems like geosphere, hydrosphere, cryosphere and atmosphere. Such data can only be obtained with a global coverage and in a reasonable period of time from Earth observation satellites. GFZ has been and is actively involved in:

Completed Activities

CHAMP (July 2000 until September 2010)

The geoscientific CHALLENGING Minisatellite Payload (CHAMP) satellite was equipped with an onboard BlackJack GPS receiver, a STAR accelerometer, Overhauser and Fluxgate magnetometers, star sensors, a laser retro-reflector array and an ion drift-meter instrument incl. a Langmuir probe. CHAMP provided substantial contributions to improved modelling of the Earth's gravity and magnetic fields and contributed to atmospheric research. Outstanding results are maps of the crustal magnetisation and magnetic signatures of ocean tides. GFZ was responsible for the overall mission and the maintenance of the scientific data system.

Recent Satellite Missions

GRACE (since March 2002)

The Gravity Recovery and Climate Experiment (GRACE) is a US-German twin satellite mission. GRACE was launched on 17 March 2002 from Plesetsk into an almost circumpolar orbit at 500 km

altitude by a Russian ROCKOT carrier. GFZ's contributions to this mission are the two laser retro-reflectors onboard the satellites, the German components of the Science Data System and mission operations support. The changes of the distance (about 220 km) between the two GRACE satellites are measured with an accuracy of about 0.1 $\mu\text{m/s}$ by a high precision microwave link. These measurements allow the determination of the Earth's gravity field and its temporal variations with unprecedented accuracy. Various geophysical signals in the system Earth, such as the seasonal changes in the water storage of large river basins, the melting of ice sheets in Greenland and Antarctica or the mass displacement due to large earthquakes (e.g. Sumatra-Andaman (2004), Chilean Maule (2010) or Japan Tohoku-Oki (2011)) can be measured. GPS based atmospheric data from GRACE are continuously assimilated by the leading international weather prediction centers to improve their global numerical forecasts.

TerraSAR-X (since June 2007)

The German TerraSAR-X mission (altitude 510 km) carries a high frequency X-band SAR sensor that can be operated in different modes (resolutions) and polarizations. TerraSAR-X offers features that were not available from space before by providing high-quality, multi-mode X-band SAR data for scientific research and applications as well as the establishment of a commercial Earth Observation (EO) market. GFZ contributes a laser retro-reflector and a 2-frequency GPS receiver

(TOR: Tracking, Occultation and Ranging) to the TerraSAR-X satellite mission for precise orbit determination and radio occultation measurements for meteorological and climatological applications.

TanDEM-X (since June 2010)

The TanDEM-X mission carries the same instrumentation from GFZ as the TerraSAR-X satellite. GFZ is responsible for the operational computation of the baseline between the two satellites (distance down to 200 m) between TerraSAR-X and TanDEM-X at the 1mm-level using the GPS data.

Galileo

A stable and precise terrestrial reference frame is the key element and the basis to ensure the integrity of the Galileo System and related services. Therefore the "Galileo Geodetic Service Provider (GGSP)", whose main task is the provision of a precise Galileo Terrestrial Reference Frame (GTRF), is one of the components necessary to ensure the system integrity. In the past a GGSP Prototype was developed by a consortium of 7 partners from 5 countries led by GFZ. This prototype is presently running in the "In Orbit Validation (IOV)" environment for the first launched Galileo satellites, where the focus is on satellite clock and orbit assessment.

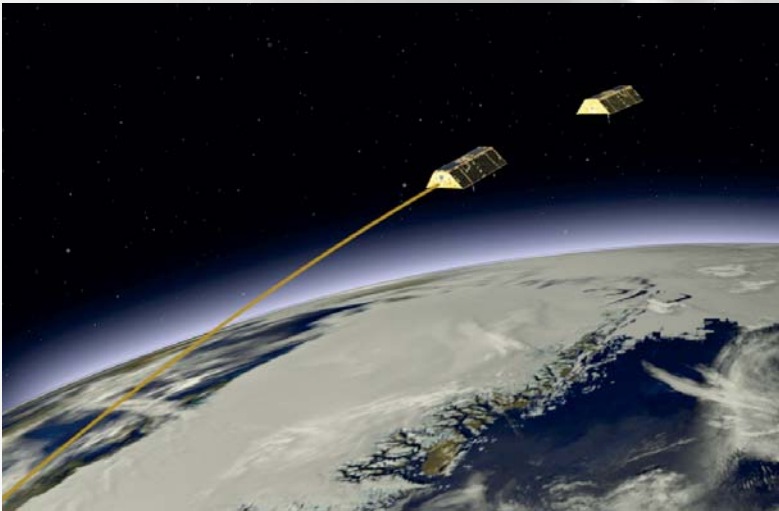
GOCE (since March 2009)

ESA's gravity field mission GOCE (Gravity Field and Steady-State Ocean Circulation Explorer Mission) has been launched on 17 March 2009 and is expected to orbit the Earth till end of 2013. The GOCE satellite (current equatorial altitude just 224 km) is the first space gravity gradiometer mission and has advanced the research in areas of ocean circulation and sea-level change, physics of the Earth's interior, geodesy and surveying. GFZ is involved as one of the processing centres within the framework of the European GOCE High Level Processing Facility (HPF) to map the gravity field of our planet with an unprecedented high spatial resolution of about 100 km. Meanwhile four releases of GOCE gravity field models have been published by the HPF.

Upcoming Satellite Missions

SWARM (Launch in October 2013)

The ESA mission SWARM, as part of the Living Planet Programme, consists of a constellation of three CHAMP-like satellites in three different polar orbits at 460 and 530 km of initial altitude. The main objective of the SWARM mission is to provide the best ever survey of the geomagnetic field and its temporal evolution, with the aim of gaining new insights into the Earth's interior and near-Earth's environment. Taking full advantage of a new generation of magnetometers and supporting instruments, the simultaneous measurements over different regions of the Earth will provide the necessary information to model the time variability and the various sources of the geomagnetic field. The payload complement consists of scalar and vector magnetometers, electric



Gravity Recovery and Climate Experiment Follow On, Image: Astrium.

field instrument, accelerometer, star trackers, GNSS receiver and laser retro-reflector. GFZ, as one of the PI institutions, supports the prime contractor EADS in the scientific conceptual design and performance verification. It furthermore contributes to the Level 2 data processing and data validation activities. The German Swarm Project Office, run by GFZ, coordinates the optimal use of data products and acts as a link to indus-

try, to public and policy maker. <http://www.swarm-projektbuero.de/>

EnMAP (Launch in 2017)

The primary goal of the German hyperspectral mission EnMAP (Environmental Mapping and Analysis Program) is to provide accurate, diagnostic information on the state and evolution of terrestrial ecosystems on a timely and frequent

basis, and to allow for a detailed analysis of surface parameters with regard to the characterization of vegetation canopies, rock/soil targets and coastal waters on a global scale. In this program GFZ has the scientific lead, Kayser-Threde is the industrial prime and OHB Systems provides the satellite bus. The German Space Agency is managing the project and the German Aerospace Establishment is responsible for the ground segment.

GRACE-FO (Launch in 2017)

As the GRACE mission end is expected for 2014/15 there is a strong need for a quick realization of a follow-on (GRACE-FO) mission to extend the long-term time series of mass change in system Earth and to keep the gap as short as possible. GRACE-FO is again realized in a strong US/German partnership where all German GRACE-FO contributions will be managed by GFZ. This includes the provision of a laser retro-reflector for each satellite, the launcher and mission operations and contributions to a Laser Ranging Interferometer which will be a demonstrator to improve the inter-satellite ranging accuracy. As for GRACE, GFZ will again be responsible to develop and operate a Science Data System and will also operate a GRACE-FO project office.

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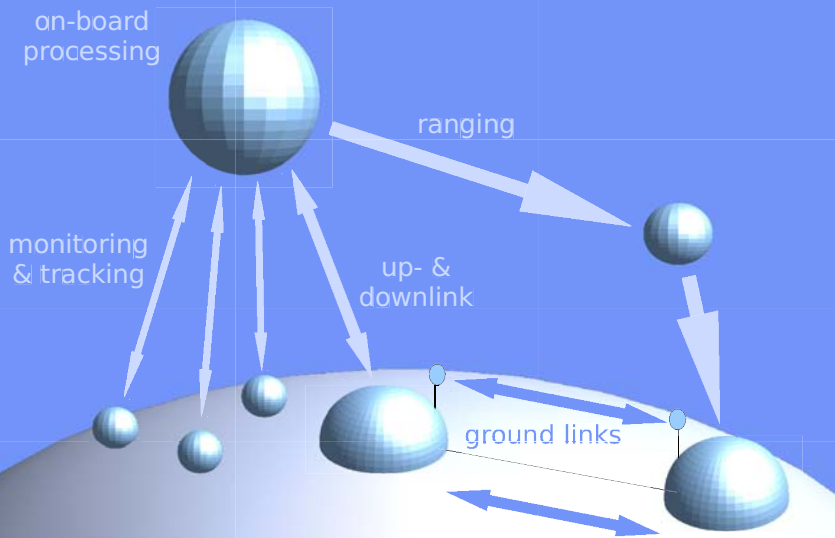
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→ TECHNOLOGY TRANSFER PROGRAMME

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Our network of brokers assesses market needs in areas where there is a potential for exploitation of space technologies, and initiates a technology transfer process between technology provider and receiver.

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