

Space – a must for s



Sensors for satellites, igniters for Ariane rockets... TNO has been developing instruments for the space industry for some forty years. But TNO is also playing an increasing role in the terrestrial applications of space technology such as Earth observation and climate research, navigation and telecommunication. Space research has an enormous significance for society, much more than we may think.

Nowadays, the Americans and Russians peacefully cooperate with the European Space Agency (ESA) in the international space station (ISS). The global space market, however, is becoming less and less institutional. And it is a market worth around 180 billion euros annually – 60 billion in government spending and 120 billion commercial spending. The US still takes the lion's share but Europe is surging ahead with more and more European companies

TRADE FAIR

TNO is taking part in the 61st International Astronautical Congress and Exhibition from 27 September till 1 October 2010 in Prague. You can meet the TNO specialists at the joint Dutch SpaceNed stand, booth B14-B19.

pulling in orders in the space market.

At the end of 2008 the French company Thales Alenia Space secured an order for sixteen satellites from O3b Networks. O3b stands for 'the Other 3 billion', or the other three billion people around the world still deprived of internet due to a lack of infrastructure. From 2011 O3b satellites orbiting above Africa, Asia, Latin America and the Middle East will facilitate a broadband internet connection. The sun sensors that are indispensable in determining the position of a satellite in respect of the sun are supplied by the Netherlands. They are just one example of the high-tech sensors TNO has developed for the space industry. TNO has been able to successfully miniaturise these sensors over the years and this small, robust instrument is now produced by the Dutch high-tech SME Bradford Engineering. The same sensors are also aboard the satellites of the

telecommunication satellite system Globalstar-2 and of Galileo, the global navigation system being developed by Europe.

EINSTEIN

Another proven TNO space system is the igniter for the main Ariane booster produced by TNO subsidiary Aerospace Propulsion Products (APP). At the end of 2009 APP signed a new contract for igniters and starters for the rocket engines of 35 Ariane 5 launchers.

TNO has been developing this technology for some forty years and thanks to a leading position in optomechanics, astrometry and astrophysics, TNO is also involved in fundamental astronomical research. Like co-responsibility with SRON and other Dutch organisations for the building of the HIFI instrument in the Herschel satellite and the forthcoming Laser Interferometer Space Antenna (LISA) joint ESA-NASA mission that will be verifying Einstein's basic theories of gravity by measuring the gravitational waves of black holes and binary stars. LISA comprises three satellites five million kilometres apart 1.5 million kilometres above the Earth. TNO will be using highly sensitive measuring equipment to measure that distance with utmost precision to detect the gravitational waves. Such an operation requires huge optical stability, and the technology being developed to achieve this will be of the order of picometre stability.

ociety



TERRESTRIAL SPIN-OFF

TNO and Bradford Engineering developed an innovative cool gas generator for ESA's Proba-2 demonstration satellite launched on 2 November 2009. A system containing cool gas generators is much safer than conventional propulsion and, what's more, the system is maintenance-free. The applications of cool gas generators are endless – for space (as in micropropulsion systems with very light cool gas generators) and outside (for inflating helicopter emergency floats or in a cool gas system to quickly and efficiently extinguish fires using very little water). This way parallel technology development is possible for space and terrestrial applications in areas where funding is often difficult to organise.

TNO promotes a strong SME sector in the Netherlands, in part through the special Dutch Technology Transfer Programme whereby space technology is transferred to all kinds of terrestrial domains like the medical sector (orthopaedics, endoscopy, minimal invasive surgery) or energy sector (use of hydrogen technology, nuclear power development).

For ESA's GAIA mission TNO is creating an optomechanical base angle monitoring system from silicon carbide. ESA wants GAIA to identify ten billion stars and other celestial bodies. The angle of the two telescopes in GAIA is defined with extreme precision and is tremendously accurate.

ENVIRONMENTAL RESEARCH

TNO has an acknowledged, longstanding international position in terms of Earth observation from space. Of increasing importance is TNO's role in one of the main terrestrial applications of space technology: environmental and climate research along with air quality assessment, an area in which TNO is a partner in the MACC European project that clusters many *space applications* to monitor and predict air quality. TNO combines satellite and local terrestrial measurements with computer models to predict the air quality for health services and warning systems like smog warnings, among others.

Along with the the Royal Netherlands Meteorological Institute KNMI, Dutch Space, cosine and the Netherlands Institute for Space Research SRON, TNO is developing a measuring instrument, TROPOMI, for ozone in the troposphere. It will also measure CO, CH₄, NO₂, NO_x and other gases. Its very wide viewing angle will allow every

point on Earth to be covered every 24 hours.

MACC and TROPOMI are part of GMES, the 'Global Monitoring for Environment and Security' programme whereby satellites and other systems will efficiently monitor the environment. GMES is a major European Commission programme. Part of this programme is the SubCoast project, funded by the European Commission and coordinated by TNO, which focuses on the subsidence of deltas. Radar measurements from space enable subsidence to be more precisely identified and major cost savings to be made.

In addition to the European GMES, there is a global geo-programme that gathers together cross-continental information about climate, environment, oceans and land use: GEOSS. Within this programme TNO is leading the EU project EnerGEO, an inventory of the impact of energy use on the environment worldwide. Moreover, EnerGEO generates essential location information for sustainable power plants that use wind or solar energy: where is the most wind and where does the sun shine strongest?

Together with Galileo, GMES is a cornerstone of the European Space Policy developed in 2007 by the EU and ESA in which TNO is involved in writing policy studies and recommendations in Brussels in the context of this European Space Policy. The Lisbon agreement reaffirmed the significance of the space sector, creating more

funds and boosting the growing role of Brussels in addition to ESA. This development together with the commercial space industry gives the sector the prospect of a good future.

SIGNIFICANCE FOR SOCIETY

TNO confirms a shift from *building to using* hardware, with exponential growth especially on the data side. The value of data has increased enormously. Weather forecasts and GPS navigation are only possible because of space data, just as the distribution of TV signals, telecommunication and observations of the sea, land, water and atmosphere. Of huge interest is how these can be combined to predict the impact of tsunamis, the passage of a hurricane or the movement of a toxic cloud following an industrial accident.

Space technology has an enormous significance for society. Not everyone realises this and politicians are reticent when it comes to setting budgets for space because not everyone sees the enormous value for society and the economy, in part because the pay-off, or return on investment, tends to become apparent only later. The prospects though are good for the development of a more commercial space industry – or Space 2.0.

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