SPACELINK

NOVEMBER 2002

THE NEWSLETTER OF
ESA'S TECHNOLOGY TRANSFER PROGRAMME

ESA/NASA Visits a Great Success

In 2001 staff from ESA's Technology Transfer and Promotion Office visited NASA HQ in Washington to exchange views on Technology Transfer (TT). This year a return visit took place at the end of August when a team from NASA visited ESTEC, ESA's Research and Technology Centre at Noordwijk in The Netherlands.

ESA's team was led by Dr Pierre Brisson and included representatives from Spacelink Partners MST, D'Appollonia and JRA Technology. The delegation from NASA was led by Dr Robert Norwood, Director of the Commercial Technology Programme. The visitors received briefings on ESA's developing approach to TT including plans for the incubator facility at Noordwijk, the 'Space Technology Inside' branding plans, event sponsorship, and the current programme of workshops designed to link different industrial sectors with space technology.

NASA provided details of the various TT activities underway including a number of new initiatives. Dr Norwood explained that one of their critical activities was technology outreach. The aim of the outreach programme is to identify technology being developed outside the space programme that could be of benefit to the programme and to inform US companies of technologies that could be transferred. More than 48,000 visits are being recorded each year to NASA Web sites with transactions varying from queries on intellectual property through to investors looking for new opportunities.

Successful technology spin offs have been running at about 50 per year since 1976. NASA's sponsorship to commercialisation incubators was particularly impressive with over 12,000 sq m of facilities provided in strategic positions and affiliations with a number of other research establishments across the US. Some 29 companies employing 292 staff were being sponsored through incubation at the present time.

The NASA team was given a tour of the space test facilities at ESTEC, one of the largest facilities in the world used to test spacecraft in a simulated space environment. They then went on to view Noordwijk Space Expo, a visitor centre devoted to explaining the International Space Station.

The meeting between NASA and ESA proved to be a great success where ideas were exchanged freely. Whilst the scale of NASA spending in technology transfer is orders of magnitude higher than that of ESA, the team from NASA were impressed at how much was being achieved for a much lower budget.

This is the second issue of Spacelink – the newsletter that gives you information and updates from ESA's Technology Transfer and Promotion Office. This issue focuses on the contribution that Germany is making to the TT Programme and describes a number of successful initiatives. In addition there is the next in our series of articles on best practice in technology transfer and a selection of technologies available for license and transfer.

In this issue >>

Spacelink's Force in Germany

MST Aerospace GmbH, based in Cologne in Germany, is the lead member of the Technology Transfer Programme's Spacelink network of specialist brokers.

MST is the centre of the Spacelink network.

Through MST, Germany has taken a leading role in the formation of the Spacelink network. Founded in 1982, the company provides a range of technology-related specialist services and works in the space arena for the German Aerospace Centre (DLR) as well as ESA. MST's technology transfer work often leads to collaborations with organisations around Europe and a considerable amount of expertise has been built up in helping Small and Medium-sized Enterprises (SMEs) in areas such as finding partners for joint activities, and acquiring funds for investment. In common with other Spacelink members, MST specialises in identifying transferable space technologies and searching for customers in other industrial sectors. The company also helps to determine market needs within non-space industries and searches for solutions from the space field. MST has particular expertise in opto-electronic components and systems, especially in the biophysical sector.

In this issue of Spacelink we take a closer look at some of the initiatives led by MST, together with a number of other important developments from Germany. MST's contact details are listed on the back page of this newsletter together with contact details for the other leading partners in the network.

MST Aerospace GmbH
Systemanalyse und Strategieberatung

Space and Automotive Meet

In November 2002, MST organised a Colloquium on Technology Exchange between the Space and Automobile Industries at the European Space Operations Centre (ESOC) in Darmstadt. The event was a great success for all concerned.

Many of the technologies used in the design and production of modern cars were originally developed for aerospace applications. Examples include: special coatings for high-capacity fuel cells and filters; sensors for windscreen wipers, side crash tests, and the detection of body structure deformation; and smart passive damping devices that help to lower component vibration. The potential for exchange of technology is huge.

At the event, a selection of space technologies from areas like materials sensors, measuring techniques, mechanical components and computer hardware and software were presented. They were selected because they offer the potential for innovations in various automotive subsystems including chassis, power train, engine and subsidiary units, body, exterior, interior fittings, driver assistance and safety.

MST is now following up the event to track the contacts made and facilitate the exchange of technology. More information regarding the relevant space technologies and the know-how to solve the specific demands of the automotive industry can be obtained from MST.

The TTP at Hannover

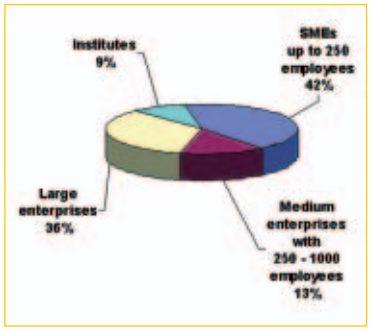
The world-famous Hanover Industry Fair attracts thousands of visitors and is known for the deals that are struck at the event. Led by MST, the ESA TTP has been represented since 1994 and at least 15 successful transfers between space technology donors and receivers have been established through this route. In many other cases the negotiations between partners are close to conclusion and so it is expected that the total number of successful transfers attributed to the Fair will increase substantially.

The next Hanover Fair takes place on 7 – 12 April 2003 and the TTP's participation is already being planned. Space companies located in the ESA Member States are invited to contact MST concerning the presentation of their technologies on the joint stand of ESA and the German Aerospace Centre DLR.

INTRA Delivers Solid Economic Benefits

Technology transfer can be time-consuming and expensive. One of the constant challenges for governments, intermediaries and brokers is to value the effect of their activities. One programme which has, however, been able to demonstrate very tangible benefits is INTRA - the German Initiative for Technology Transfer from Space.

INTRA started in 1994 and is delivered by MST on behalf of the German Aerospace Centre DLR. It aims to encourage the commercial exploitation of space technologies, including spin-off activities, and facilitates links between space companies or institutes and firms from other industries. The importance of technology transfer from space for smaller companies in Germany is shown by the figure below, which gives a breakdown of the sizes of companies involved in INTRA as receivers of technology.



A total of 117 projects have been initiated to date under INTRA with tangible benefits to the German economy. According to its own calculations, the space industry achieved a total turnover of some 3.5 MEuro with these transfers and an increase to about 15 MEuro is expected by the end of 2005. With regard to the receivers of technology, the turnover so far has been recorded at an impressive 80 MEuro.

As well as measuring the effect on turnover, an important measure of success is the effect on employment. INTRA's activities to date are estimated to have created or saved some 500 to 1500 positions. The country profits from all of this activity in the form of tax revenues and social security contributions; these state revenues created by INTRA exceed the related expenses by more than 17 times.

ESCUBE Senses Success

One of the most effective ways of transferring technology is via start-ups. MST has helped with a number of such ventures. One of the most promising is ESCUBE Space Sensor Systems GmbH, which has spun out of the Space Systems Institute of the University of Stuttgart, Germany.

In 1993, the development of gas sensors with a ceramic base began at the Institute. It was the first time that conventional sensors, as used, for example, in air-fuel control in automotive applications, were used in re-entry experiments in vacuum chambers to measure the oxygen remaining. Since then a wide variety of sensors have been developed for many different uses.

ESCUBE develops high-quality gas sensor elements for use in environmental, medical and general industrial diagnostic applications. Its sensors have already been applied in:

- controlling small heaters and burners
- monitoring fuel cells
- vacuum-chamber leak detection
- cardio-respiratory performance analysis.

ESCUBE offers the customized production of sensor elements, which typically can be reduced to the size of a household match. The company is also capable of mass production of products. It can be contacted though MST.

An ALLROUND success.....

Many companies not yet active in the aerospace sector have a strong interest in becoming a supplier to the industry. About 90 such companies have joined forces in ALROUND - the "Association of Aerospace-oriented SMEs in Germany". MST takes a leading role in the association which aims to involve its members in ambitious technology projects in aeronautics and space as well as other technology fields. Over the last 10 years ALROUND has had considerable success, with more than 50 research and development projects with a value of over 25 MEuro initiated from within the group.

Space technologies have been utilised by companies from a wide range of industries and in applications as diverse as medical implants and cement mixers. Of almost equal diversity are the ways that space technology can be practically transferred to industry. Methods include licensing, joint ventures, further development, outright sale and so on.

These two pages contain a selection of currently available technologies from ESA's Technology Transfer Programme. Details of how to obtain further information and what to do next are given opposite.

Space manipulator

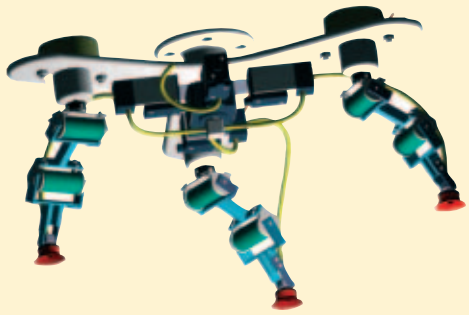
– for handling soft and thin objects

This is a system for the precision handling and manipulation of soft, limp, bi-dimensional objects such as flexible sheets of material. At present, this kind of operation is almost always performed manually or on rare occasions by complex and expensive dedicated systems.

The technology consists of a special gripping system, with several degrees of freedom, mounted on a conventional actuator such as an industrial robot or gantry. The system is very flexible as it can have up to 9 degrees of freedom. The gripper is a novel mechatronic instrumental hand having high versatility, low mass and low energy consumption. The simple design assures great reliability and high "Mean Time Before Failure." The use of control algorithms in the branched mechanical chain allows fast re-configuration and the adaptability for grasping objects of various shapes. The architecture is modular, allowing lower design costs and easy maintenance.

The technology has potential in the textile industry, clothing, leather, food processing, packaging, and also in the plastics industry, especially in polyurethane technology. This is a major growth area: many developments involve the application of thin sheets of polyurethane over support structures made of metal or other types of plastic. Another promising field is related to carbon-fibre technologies, namely for the application of carbon-fibre sheets over modelled and/or otherwise complex surfaces.

The system is patented and the donor is looking for joint-venture and licensing agreements.



POLYMET – advanced materials

POLYMET is a novel technique for producing materials that are resistant to tearing, to temperature and to most chemicals, yet are conductive. The process involves galvanotechnical metallizing of high-tech fabrics based on an endless three-dimensional polymer structure. A specific, geometric and microporous metal structure with micrometer accuracy can be produced. This new material is applicable in microchemical systems due to its variably designable metal coating.

POLYMET provides significant technical, economic and environmental advantages over existing technologies. Because of its uniquely adjustable microstructure, POLYMET is a very versatile material with completely new functional properties. Furthermore it has high potential for recycling. It is suitable for high- capacity batteries, fuel cells, filters and efficient catalysts, as well as for air regeneration systems which have already been tested for space applications.

The company is interested in customers and/or partners for joint projects and development activities or licensing arrangements.

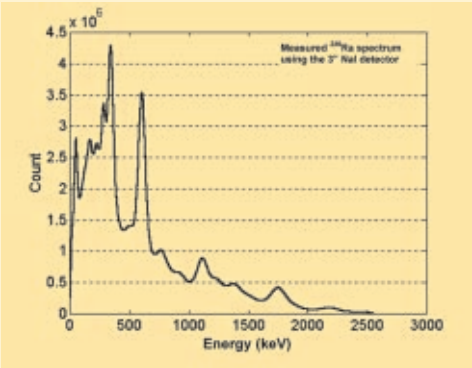
Gamma-ray spectroscopy

Gamma-ray spectroscopy is utilised in many terrestrial applications, as well as in space exploration, where it has been used both in gamma-ray astronomy as well as in the remote geo-chemical analysis of planets having thin atmospheres.

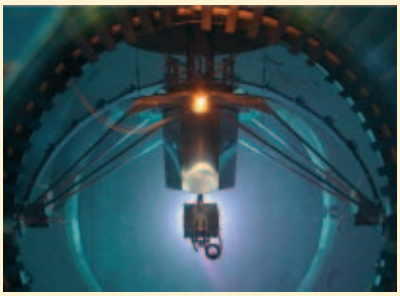
Scintillation-counter detectors are manufactured from transparent crystals with a high effective atomic number, such as thallium-doped sodium iodide (NaI), which produces an optical flash when a gamma-ray is absorbed. These photons are captured using a photo-detector. These devices are significantly cheaper to produce than HPGe detectors, but their spectral resolution is significantly worse. This is due to a combination of factors including the low scintillation efficiency of the crystal, the quantum efficiency of the detector and variances introduced in the crystal itself.

A new detector design based on scintillation counters and associated spectral processing software has been developed for the remote geo-chemical analysis of planet crusts. This provides sufficient resolution to enable the elemental abundance mapping of the planet's crust without making any prior assumptions about the composition of the rock.

The dramatic improvements in the quality of both the spectral resolution and the sensitivity of gamma spectrometers, viewed using PIN photodiodes, has been achieved through the development of a new detector design (Scintisphere™). This utilises a spherical scintillation crystal viewed by a photon diode having a small area compared to the total surface area of the scintillation crystal. This design leads to improved uniformity in the collection of the light from the scintillation counter and diminishes the effect of non-uniformities in the response of the photo-sensor.



Instrumentation for very-low-force measurement



One of the UK's foremost research and technology organisations has developed techniques and instrumentation for the measurement of very low forces directly traceable to fundamental SI standards. A number of low-force instruments have been designed and proven to provide measurement of forces in the range 10's of micro-Newtons to 100's of milli-Newtons. Forces measured can be in 1,2 or 3 axes. A feature of the instruments is that they have an excellent transient response, and so can measure dynamically changing forces or impulses of force. The instruments also use advanced stabilisation techniques to negate the effects of vibration, and thermal variations and atmospheric conditions.

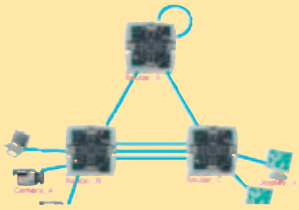
This low-force work derives from the growing worldwide interest in the use of micro-thrusters in satellites for highly precise station-keeping, attitude control and synchronised space flight. Accurate, traceable thrust and thrust-noise measurement is a clear requirement.

The organisation is seeking to transfer these measurement techniques and designs for the benefit of wider industrial and medical applications, and is interested in talking to end users, instrument suppliers, and academia to seek out applications.

Robust deterministic networks

The SpaceWire standard for packet switching has grown from specialized payload applications on European spacecraft to widespread deployment on both European and US missions. Like the Internet, but unlike several LAN technologies, SpaceWire networks are fault tolerant, their throughput grows with the addition of nodes, links, or routers, they are transparent to a wide variety of different protocols, and they have complete freedom of topology.

While retaining full compatibility with the SpaceWire standard, the developer has brought additional differentiating features to the technology, including a simple yet powerful network management capability, and accurate distribution of time allowing isochronous and deterministic transfers.

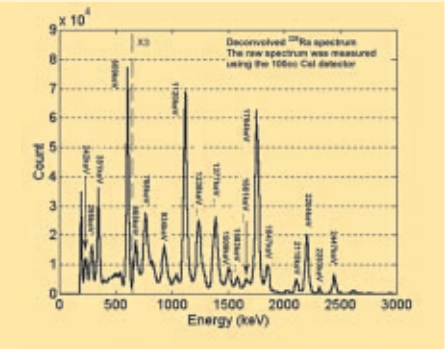


The figure shows the display of the network management system demonstrating uncompressed digital video traversing a highly redundant network. All the paths in the network can be used to provide additional bandwidth and/or fault tolerance.

The developer has introduced the improvements in SpaceWire back into the IEEE standard that SpaceWire evolved from. Commercial applications of this technology have included a physical layer capable of transmission over 100 metres. They also include a variety of interfaces and bridges including digital video, RS232, USB, PCI and Ethernet. These designs are all implemented in Field Programmable Gate Arrays (FPGA), which are often considered to be expensive, but which give a silicon cost for this technology of around $2 per port.

The principal current application outside the space industry is for home networks, exploiting the low-costs and "user tolerance" as opposed to the fault-tolerance required for space. The developer is interested in other applications that can benefit from the robustness, scalability or determinism that the networks provide, and in funding to accelerate growth into such new applications.

This, combined with the specially developed software, gives a system that shows improvements over currently available systems based on the use of 3"x3" NaI spectrometers , as shown in the accompanying figures.



However, the group has now developed software algorithms appropriate for use with these industry-standard detectors to achieve an unprecedented spectral resolution up to energies as high as 10 MeV.

The technology has been developed and is being considered for possible inclusion in the payload of the BepiColombo Mission to study the planet Mercury. The technology developer is looking to offer its skills through consultancy or R&D contracts as well as collaboration in the development of products for specific markets.

If you are interested in any of the technologies featured on these pages please contact the Technology Transfer Network Member nearest to you. The contact details for the Network Members are listed on the back page of this publication. These organisations are committed to responding to your enquiry as soon as possible.

Space technologies offered by the Technology Transfer Programme are also available at http:/www-technology-forum.com. This is a free-to-use market place offering you the ability to:

- **Search for technologies**
- **Submit requests for technologies (not appearing in the market place)**
- **Offer solutions for technical requests**
- **Promote your own technologies, services or know-how.**

Security Through Diversity

The European space industry is dominated by a small number of very large firms whose supply chains are characterised by a large number of smaller firms or SMEs. These typically have very specialised and niche capabilities. When there's a lull in activity in the industry (as is often the case in space), the smaller companies are often the first to suffer as the large firms cut back, entrench and turn to internal resources. One way to shield against the effects of such action is for SMEs to develop alternative, non-space markets for their products, technologies and services.

Technofi, an innovation consultancy based in France led by Serge Galant, obtained support from the ESA TTP and the European Commission to set up an SME support programme called Lostesc (Leveraging on Space Technologies to Enhance SME Competitiveness). The programme was delivered by a consortium of innovation consultancies from six countries. It worked by inviting firms which believed they might have technologies with applications outside the space industry to outline the work that would be needed to adapt them to a different market. The consortium members then identified suitable projects and worked with the SMEs to put together funding proposals to the Commission.

The results are very fruitful for the participating SMEs: 18 space technologies were proposed for funding by the EC FP5 to address non-space issues. 10 of them are today funded with a total of 6.6 MEuros, whereas the private partners of these SMEs are bringing 6.6 MEuros of validation budget. 8 technologies will be proposed at the beginning of FP6 for further funding.

The main issue with the programme, according to Galant, is not the technology but the people involved. "First, their management has to be willing to get out of the core business, and second, they have to be entrepreneurs. Most of the applicants talked only 'space language', and needed to learn new ways of thinking".

Although Lostesc has now ended, help on technology transfer is still available from consortium members. If you are interested in this type of help you can contact any of the Spacelink Partners identified on Page 8, or Technofi:
Tel: +33 4 9365 3444
e-mail: sgalant@symple.tm.fr

Web Provides a Window on Space Technology....

The World Wide Web continues to transform many business processes and technology transfer is no exception. ESA's Technology Transfer Programme long ago recognised the value of the Web and currently supports three independent but complementary sites providing both a window on the rich world of space technologies, and also a range of services that help companies take them on board.

The three portals act in close synergy, each of them having complementary roles within the TTP. ESA's own portal http://www.esa.int/technology/ which aims at giving an overall view of ESA's TT-related activities – including information on the organisations involved and the success that has been achieved to date. The T4Techonline portal http://www.t4tech.com/ offers consultancy, provided by ESA experts, on new and innovative technologies. The experts are virtually linked to users through the site so that they can directly interact. Developed by TTP Network Member D'Appolonia in Italy, the portal is now being developed to provide assistance to new technology-based businesses.

The remaining site, developed by MST in Germany and at http://www.technology-forum.com/, is a virtual market place for promoting the ESA technology portfolio. This free-to-use site offers organisations the ability to search for space technologies available for transfer, submit requests for technologies not appearing in the market place, offer solutions to technical requests, and promote their technologies, services or know-how.

The result of this commitment and investment is that the number of companies potentially involved in space technology transfer has expanded hugely and a more direct and targeted approach to the technology donors and receivers has become possible.

Your Technology –

Benchmarking against the state-of-the-art

Graham Thomas

In his second article on best-practice in technology transfer, JRA's Operations Director, Graham Thomas, tackles a vital early step – technology benchmarking

One thing that should never be overlooked in the early stages of assessing a technology for commercialisation is the need to benchmark it against competing technologies, particularly in the market sector being targeted. The object of the benchmarking process is to confirm that a technology matches, or exceeds, the industry status and offers good prospects for gaining market entry. At JRA we try to establish a number of criteria regarding the technology's position in the market place and hence it's exploitation potential:

- State-of-the-art of existing established technologies, market trends and key players.
- Comparative performance of our technology.
- Overview of the direction of emerging technologies.
- Technology positioning in the supply-value chain.

Benchmarking tools

To establish these parameters we apply a number of largely Internet based technology watch, patent search and market intelligence tools. In some cases we also call in specialist consultants in specific technology areas.

For example, one web-site that has been used to good effect by JRA is Dialogue, which through a subscription offers in-depth technology and market analysis. Using tools such as these it is possible to gain a clear view of a market sector, what technologies are currently being used, and what might be considered as the next generation of technology that is being worked up. Specifically we would look to:

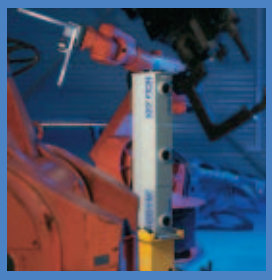
- Establish the position of the technology in the industry sector supply-value chain to gain an understanding of competing technologies and new developments.
- Establish the structure of an industry and identify who the key player companies are.
- Identify barriers to market entry to see if the emerging technology is able to support the market drivers and overcome some of the potential barriers.

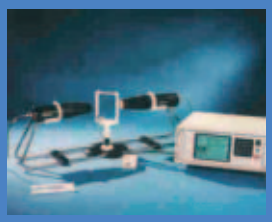
Patent searching is another effective way of assessing the state-of-the-art in a technology sector. A patent classification search can give quite good pointers to new developments, applications in new market sectors and an indication of which companies are active in the field.

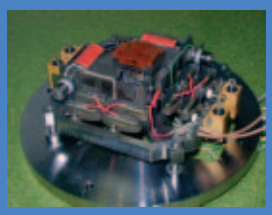
Company investor web-sites have been found to be a good source of information on product developments and new technology thrusts. The technical sales and investor web-pages of key player companies in a market sector, for example, often give otherwise unpublished information on its technologies and R&D plans.

Have you got the right application?

Sometimes an outcome of the JRA technology benchmarking exercise is that the technology has value, but in a different application to that originally considered. In the next issue I will tell you how we go about identifying the *optimum* market for the technology, analysing and valuing it, and start to identify possible customers, licencees or joint venture partners.







No Longer a Search for a Needle in a Haystack

A ground-breaking collaboration between ESA's Technology Transfer Network and the European Community's network of Innovation Relay Centres (IRCs) is beginning to bear fruit.

The network of IRCs was created in 1995 by the EC under the 4th Framework Programme. It consists of 68 organisations, with 250 offices and around 1000 professional technology brokers covering all of the EU's Member States and many candidate companies. The IRCs facilitate trans-national cooperation between the providers, developers and users of technology, with technology requests and offers being relayed via a central database system.

On behalf of the TTP, MST in Germany recently completed one of the first technology transfers to have come about as a direct result of collaboration with the IRC network. A German engineering company needed low-friction materials to use for facing engine components. MST put the request to its technology transfer network and produced some contacts, but not the definitive answer to the problem. So the enquiry was passed on to the IRC Luxembourg, which put it on the IRC network database.

One of the companies that responded is involved in aerospace research. This Swiss firm is developing and producing ion optical components for the three sensors of the ROSINA module, being provided by the University of Bern for ESA's Rosetta scientific satellite. This probe will be launched in January 2003 and will meet the comet Wirtanen eight years later.

The Swiss company could offer metal-ceramic composites with a very good fit to the needs of the German inquirer. The two companies have met and concluded a technical cooperation agreement. There are great benefits to both sides – for the supplier a new market with opportunities for wide application, not just in aerospace, and for the receiver savings in time and finance.

Clearly there are real advantages for each network to such a collaboration. Better than searching for a needle in a haystack, the link-up promises to help make each operation that little bit more effective.

Providing the Link

Technology transfer can take numerous forms. All of the mechanisms tend to have their complexities, and specialists are often required to guide companies through the various stages necessary to secure a technology transfer agreement.

To assist you in these areas ESA has set up an international network of technology transfer specialists and brokers. Each of the Network Members promotes the identification and exploitation of space technology spin-offs and can provide support to both potential donor and receiving organisations.

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