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esa

FITNESS, LEISURE & LIFESTYLE

Technology Transfer Programme

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What do lifestyle and satellites have in common? This brochure will help you find out, and tell you just how the European space industry is having an increasing impact on our way of life.

Several of the fitness and leisure consumer goods we use everyday were first developed for applications in space. I hope this brochure will give you an insight into how advanced European space technologies are being applied to assist us in living better, safer or even easier.

Many innovative non-space products and services that will benefit society are now being introduced as a result of technological spin-offs from the space industry, and it is worth remembering that fitness and leisure are not the only sectors to take advantage of the new technologies developed by European space companies.

I hope this brochure will enable you to discover the new and unexpected ways in which space activities improve our daily lives.

Pierre Brisson
Head of the Technology Transfer and Promotion Office

Our quality of life and leisure time are becoming even more important to us as we face increasing demands at work. You may not be aware of it, but space technology is helping us enjoy our lives just that little bit more. It is incredible how big the impact of space technology is in our life! Space technology transfers are everywhere and often we even don't know we use them! Wireless communication, sports equipment, musical instruments, golf clubs or even potato crisps are just a few examples of space spin-offs in our daily life.

This Ericsson Bluetooth module is extremely compact

HELLO! HOW ARE YOU ?

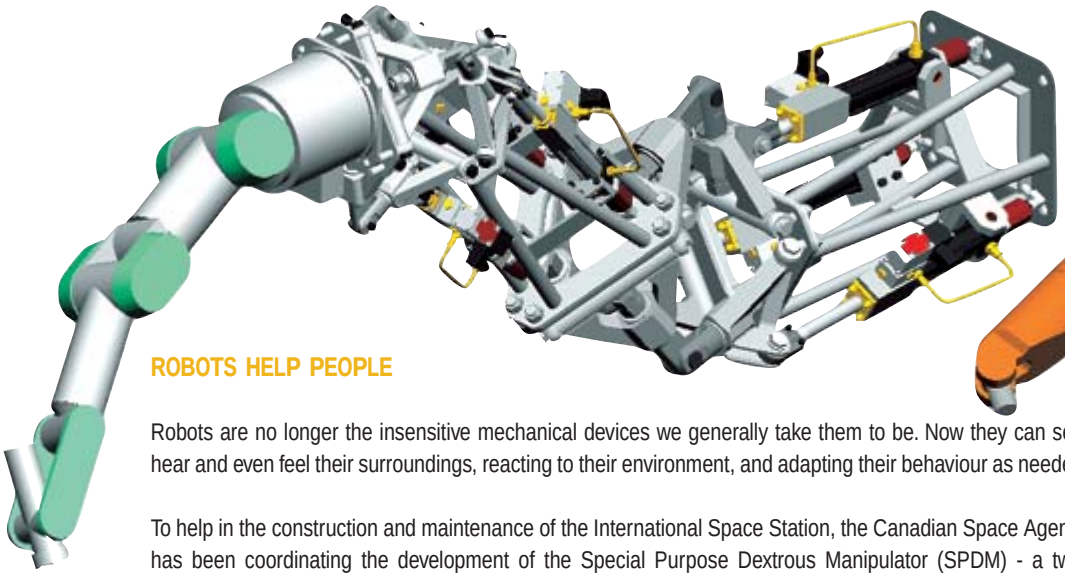
The mobile phone has revolutionised personal communications. Wireless, handheld devices can combine many different features including a connection to the Internet and text messaging (as anyone who has children knows!). Now the frontiers of wireless technology are expanding even further with a new wireless communications standard called Bluetooth™, named after Harald Bluetooth, a medieval Scandinavian king. Bluetooth was developed by a consortium of leading electronics companies - the Bluetooth Special Interest Group (SiG) - which includes 3Com, Ericsson, IBM, Intel, Lucent, Microsoft, Motorola, Nokia and Toshiba.

In practice, Bluetooth is a tiny microchip which incorporates a radio transceiver that is built into a variety of digital devices such as mobile phones, personal digital assistants, printers, fax machines, PC's, laptops, digital cameras, MP3 players, stereos and headsets, allowing the user to listen to phone calls or music through a headset with no visible connection between the two devices. In the next few years Bluetooth technology will be built into hundreds of millions of electronic devices worldwide.

ESA quickly recognised the unique value of Bluetooth for space exploration - where wireless connections between spacecraft equipment and astronauts are the ideal solution. ESA sponsored Parthus Technologies, an Irish company, to develop a wireless technology based on Bluetooth that could easily be embedded into a variety of spacecraft equipment. Parthus is a world leader in the design and development of the integrated circuits and software that underpin mobile devices.

The result was BlueStream, a chip design that can be used as a basis for a wide range of wireless applications not just for spacecraft operations, but also for computing and global positioning systems. Parthus' approach of integrating BlueStream with other complementary technologies also helps to overcome one of the main challenges of wireless-technology's power consumption.

Today, the Parthus BlueStream chip design is the most widely licensed Bluetooth technology in the wireless industry, with four of the top 10 wireless semiconductor companies integrating it into their products. Some of the announced licensees include 3Com, Agilent and Hitachi, the world's largest supplier of mobile-phone chip sets. Parthus now employs over 400 people worldwide and BlueStream accounts for 35% of its revenues.



ROBOTS HELP PEOPLE

Robots are no longer the insensitive mechanical devices we generally take them to be. Now they can see, hear and even feel their surroundings, reacting to their environment, and adapting their behaviour as needed.

To help in the construction and maintenance of the International Space Station, the Canadian Space Agency has been coordinating the development of the Special Purpose Dextrous Manipulator (SPDM) - a two-handed robot which is essentially an extension of the astronauts' own limbs. Until recently, these augmented limbs lacked one critical feature - a sense of touch. Without a sense of touch, machines can easily accidentally knock over or bump into other objects. In space, obviously, this can have drastic consequences. Although automated vision systems have been under intensive development for several years, tactile sensing technologies are rare and relatively primitive.

Recognising this challenge, Canadian company Canpolar East developed KINOTEX - a novel sensor that emulates human touch and can be applied like a skin or sleeve to cover entire robotic limbs. Described as a deformable integrating cavity, the sensor consists of a sheet or block of polymer foam with an opto-electronic transducer embedded in it. When the foam is deformed its optical properties are altered, generating a proportional signal in the transducer. Normally arranged in arrays, these sensors can detect and interpret contact at many points over the surface of the machine. Because they use light to detect change, KINOTEX sensors can be very small and are immune to interference from sources such as electromagnetic radiation. They are also very responsive, sensing minute amounts of pressure and reacting extremely quickly to change.

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Canpolar East is aware that KINOTEX could have many commercial uses and is adapting the technology in partnership with a number of other organisations. One of the first companies to market an application is Tactex Controls. Their KINOTEX touch pad measures the pressure and position of fingers placed on its surface, so a musician can 'play' it like an instrument. The touch pad can also be used to control mixers and other sound processors, and in 2001 won an award for "Most Innovative Product" from a leading music-industry publication. Tactex is also developing touch pads for the computer games market.

KEEPING FIT WITH A YOYO

Keeping fit in the weightless environment of space requires special kinds of exercise programmes and equipment. After all, what use are free exercise weights if they just float around of their own accord? In space, everyone can manoeuvre objects they would not have a chance of lifting on Earth, but the down side of this is that the body does not get the exercise it needs to keep in top condition. Being in space is an extremely demanding activity, and a huge amount of attention is paid to astronauts' well-being and fitness. As missions get longer and longer, this becomes even more important, and engineers and doctors are working together to design equipment and exercise programmes suited to the specific needs of space travel and weightlessness.

YoYo Technology based in Stockholm, Sweden has developed a machine designed to meet these unusual requirements. With support from the Karolinska Institute, the Swedish Space Corporation and the Swedish National Space Board, YoYo developed equipment that uses the inertia of flywheels to provide resistance. The Fly-Wheel Resistance Exerciser (FWRE) differs from

the normal equipment found in gyms because it provides 'two-way' resistance. The user is required to pull the cord from a flywheel; at the full stroke the flywheel begins to wind back in the cord. The user has then to resist this by pulling back on the cord. In effect, this is the same principle as that behind the yoyo - a children's toy which has certainly stood the test of time.

The advantage of this system is that the load can be easily varied by changing the flywheel or altering its diameter. Users can also determine the amount of 'impact' in their training. Unusually, astronauts in space are encouraged to do high-impact exercise as it maximises body strength while also minimising bone loss.

Having successfully designed equipment to meet the needs of the space industry, YoYo Technology is now turning its attention to terrestrial applications such as in sports training and medical rehabilitation. The equipment is being used by the Swedish Olympic athletics team. It is also being employed in orthopaedics to aid the recovery of stroke patients, and is proving particularly useful in re-establishing nerve connections in damaged muscles. A variant of the equipment is also being developed for use in home gyms, a market that is worth many millions of Euros worldwide.

FILAMENT-WOUND GAS BOTTLES

Through its support to many space-related programmes, the French company Aerospatiale has developed a considerable capability in the area of composite filament-winding technologies. In particular, it has developed a capability to produce wound-filament composite high-pressure gas bottles with considerable weight savings over metal bottles having the same specification.

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Another French company, Composites Aquitaine, is taking advantage of this know-how to market a complete range of cylinders for the storage and transportation of gas. These high-pressure vessels were developed for medical purposes, various pneumatic applications for transport systems, and underwater diving activities. There are many specific examples of spin-off applications. For portable emergency breathing equipment, 6 litre (300 bar) containers made from glass fibre and epoxy resin weigh only 5.85 kg as opposed to 11.1 kg for their metal counterparts. Another advantage is that they significantly reduce the risk of accidental explosions. The technology is also being applied to divers' air bottles, which are wound with aramid fibre on a thermoplastic matrix – thus making them very light. Composite pneumatic reservoirs have been fitted to the braking systems of lorries and there are other types of applications such as gas tanks in methane driven buses, HGVs and family cars.

GETTING CLOSER TO THAT HOLE-IN-ONE

Golf is a pastime enjoyed by millions, but many players find putting to be the most frustrating and unpredictable aspect of their game. The ball just seems to miss the hole for no reason at all. Certainly that magical hole-in-one is likely to remain a dream for most of us.

Trying to land a probe from a spacecraft on a planet or some other body in space is also a tricky exercise. The probes are usually unguided, and the mechanisms that eject the probes from the spacecraft must perform in a precise and predictable way. To ensure stability, the probes are given, in addition to the linear momentum of ejection, a spinning motion. Much the same principle is employed when a bullet leaves the barrel of a pistol or rifle. So it follows that if a golf ball can be endowed with a spin as it leaves the face of the putter, the chances of holing the shot might be increased.

This is the approach that the Norwegian-based companies Prototech and Saab Ericsson Space took when they developed a 'Spin-and-Eject Device' (SED) mechanism for ESA. During the development, the R&D team used advanced computer tools for simulating motion to model the ejection phase of releasing space probes, and to investigate the effects of surface irregularities. Extensive testing using high-speed cameras verified the performance of the SED technique.

In addition to developing and manufacturing equipment for space applications, Prototech prides itself in converting bright ideas into commercial products. The company soon realised that the SED technology could be usefully applied to designing new sports equipment. Furthermore, the simulation techniques developed would be invaluable in investigating the practicality of new designs.

Being keen golfers, the Prototech team turned its attention to this sport first, and used the motion-simulation tools to design a club with an optimised spin and eject phase that caused the ball to start spinning immediately after it was struck. Currently, golfers are testing the novel putter design on the green, and a new company, Clyve AS, has been set up to commercialise the golf club. It remains to be seen whether it will accepted by the sport's authorities, but in the meantime, there are at least a few Norwegian golfers who appear to have a unique competitive advantage!

LANDING A POTATO CRISP

A glance around the shelves of any supermarket shows the enormous variety of packaging to which we have become accustomed. Foodstuffs in particular can be awkwardly shaped, fragile and difficult to handle, yet the requirements for greater production speeds continue to grow in the face of consumer demand.

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In 1998, ROVEMA, a German packaging machine manufacturer was faced with the problem of designing a machine that could fill packets with lightweight food products such as potato crisps more quickly than its competitors. Surprisingly, the aerodynamics of dropping a potato crisp into a packet without breaking it are conceptually similar to those of landing a spacecraft. Both must consider the optimum speed of descent and how ambient conditions and airflow will affect the falling object. With this in mind, ROVEMA approached MST, the German partner of ESA's Technology Transfer Network, for help. Familiar with this type of problem, MST introduced ROVEMA to another German company, Hypersonic Technology (HTG) in Katlenburg-Lindau near Goettingen. Hypersonic Technology is a small company that specialises in aerodynamic modelling and computation for space projects such as ESA's ELITE initiative, which examines the flight characteristics of Europe's launchers. The company has access to wind tunnels and has developed considerable expertise in solving problems relating to aerodynamic flow.

Working with ROVEMA, HTG was able to design a bagging system that could be incorporated into a new, market-leading, packaging machine that would be capable of handling irregularly shaped light foods at a rate between 30-50% faster than standard equipment. Despite its greatly increased operating speed, the new machine was able to maintain an acceptable level of breakages. The two companies then worked together to develop the system further for general use. Their efforts were successful and, following its first public viewing in May 1999 at the Dusseldorf international packaging trade fair, the machine is now available on the international market.

GEARING UP FOR ELECTRIC BIKES

STAM s.r.l., an Italian company based in Genova specializing in mechanical design, is finding additional applications for its Nutating Gear. The mechanical gear is based on the principle of nutation and, even though it was originally designed and patented for the space industry as Space Gear, has many appealing characteristics for the civil sector.

The most recent application of the reduction gear is to enable the development of a retrofit to power electric bicycles based on space batteries. A recent study carried out by the European Environmental Agency revealed that in Europe 76 million inhabitants are exposed to air whose quality standards are lower than the ones agreed upon by the World Health Organization. The European Commission acknowledged the seriousness of the problem in Directives aimed at the reduction of urban pollution levels and at the improvement of health standards for European citizens. Urban regulations in the United Kingdom (especially in Cambridge and Oxford) led to a significant improvement of 25-30% in air quality, through the creation of urban areas in which vehicles were banned. However, even if electric bicycles have been around for many years, their use and spread is limited because of high prices, heavy weight and the battery's limited life cycle.

This led to the idea of using the reduction gear to obtain a light, durable and cheap device, which can be easily fitted to any traditional bicycle. The small device called PLUG2DRIVE weights less than 3 kg, and has a battery that can run for 80 km in urban areas. The device will cost less than 150 Euros and will be maintenance-free. The transmission system requires the development of a plastic gear, to be coupled with a highly durable battery of space-related origin. The results will be beneficial also for companies working in other fields, such as the aeronautical sector, where the need for a durable, cheap electric transmission is acute.

Benefits for our daily lives: The ESA Technology Transfer Programme

Over the past 35 years, the European space industry has gained considerable expertise in building, launching, controlling and communicating with satellites. From this long experience of how to overcome the hazards and problems created by such a hostile environment, many valuable new technologies, products and procedures have been developed. Today, this expertise is improving our daily lives by providing many innovative solutions for products and services on Earth.

Groundbreaking European space technologies are becoming increasingly more available for development and licensing to the non-space industry through the process of technology transfer. The ESA Technology Transfer Programme has already achieved over 120 successful transfers or spin-offs from space to non-space sectors.

This success is reflected by the fact that since 1991 technology transfer has generated more than 20 million euros in turnover for European space companies and 120 million euros for the non-space industries involved. Already 2,500 jobs and 25 new companies have been created.

The ESA Technology Transfer Programme is carried out by a network of technology brokers across Europe and Canada. Their job is to identify technologies with potential for non-space applications on one side, and on the other side to detect the non-space technology needs. Subsequently, they market the technology and provide assistance in the transfer process.

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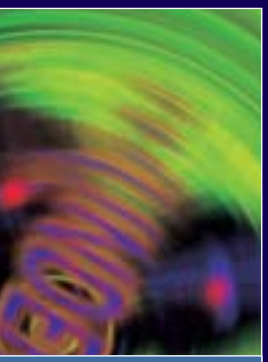

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