

Science2Business

DLR.de/en

Dear visitor,

Innovation2gether – shaping innovation with our institutes and cooperation partners from the business sector: DLR Technology Marketing is committed to this principle.

As primary contact for highly innovative companies, we are the interface between research and the business sector, between product ideas, innovation and the marketplace. We design and accompany the process, from the brainchild through to successful market introduction, providing targeted support for the advancement of product-oriented technologies.

In accordance with its Strategy 2030, DLR makes purposeful investments in innovation projects across all branches of the business sector. These projects are implemented together with companies, and small to medium-sized enterprises in particular. In addition, DLR will intensify its support for company start-ups and extend the opportunities for its entrepreneurial involvement in spin-offs.

In this regard, we focus on achieving added value for both sides. As our partner, you receive answers to issues relating to future products and market opportunities. By cooperating with DLR, you will benefit from our competencies and technologies, and will hence have the opportunity to secure a competitive edge by coming in ahead of the market and by licensing industrial property rights. In turn, collaborating with its partners gives DLR the benefit of seeing its technologies successfully positioned in the marketplace and ensuring that feedback flows into its future developments.

Through successful technology transfer, we ensure that research has a clear benefit for the business sector and society as a whole.

A handwritten signature in blue ink, appearing to read "Pascale Ehrenfreund".

Pascale Ehrenfreund
Chair of the DLR Executive Board

A handwritten signature in blue ink, appearing to read "K. Hamacher".

Klaus Hamacher
Vice Chairman of the DLR Executive Board

Science2Business



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FlexIn Heat®

Flexible, inductive heating to bond and repair fibre-reinforced polymers

i Brief description

In the flexible, inductive FlexIn Heat® heating system, an air-cooled induction coil is attached to a flexible backing material, making it particularly suitable for use on curved structures. A wide variety of components made of electrically conductive materials can be heated locally. The system is used for repairing and bonding lightweight materials.

🎯 Aims

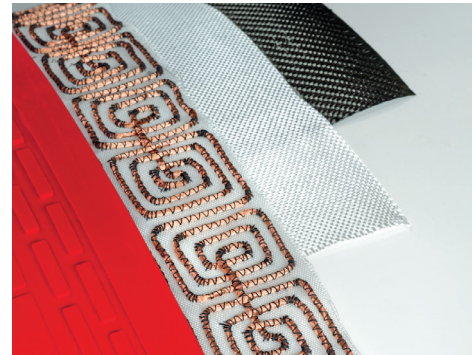
Precise, localised heat generation for efficient process steps in the use of fibre-reinforced polymers (FRPs) in aircraft and automotive manufacturing.

🌍 Applications

Repair of lightweight FRP structures in the aviation, wind turbine, ship-building and the automotive industry.

👁 Outlook

- Flexible, localised heating for bonding fibre-reinforced plastic components to one another or to metals
- Customised process solutions that require flexible, localised heating



👤 Parties involved

DLR Institute of Structures and Design

📄 Facts and figures

- Localised, precise and uniform heating applied to the areas to be repaired
- The heating range can easily be adjusted by changing the metal element
- Temperatures of 400°C and heating rates of over 60°C per minute are feasible.



FlexIn Heat®

Flexible, inductive heating to bond and repair fibre-reinforced polymers

Repair applications

This repair concept, developed at the DLR Institute of Structures and Design in Stuttgart, uses flexible induction coils encased in a silicone vacuum mat. This mat allows both the generation of the required temperature and the application of the necessary pressure. For the heating process, inductively heated metal pressure fittings, foils or grids less than 0.3 millimetres thick are cut according to the size of the repair and placed under the mat. Using vacuum pressure, the metal fitting is pressed against the structure to be repaired, ensuring excellent heat transfer. Under this pressure and temperature, the repair component is joined to the main structure.

Application example – bonding

Hybrid metal-composite materials are finding ever-greater application due to their excellent mechanical properties. One major problem, however, is bonding different components. Most bonding processes require heat to melt either one or both of the parts to be attached, or to melt the joining area. Unlike other kinds of heat generation/transfer, induction heating offers contact-free energy transfer. In the case of fibre-reinforced thermoplastics, only the material in the joining zone is melted and then bonded to the metal after it has cooled. Heating rates of up to 60 degrees Celsius per second and bonding temperatures of up to 400 degrees Celsius also allow the technology to be integrated into a production process with a high cycle rate.

HELMHOLTZ

SPITZENFORSCHUNG FÜR
GROSSE HERAUSFORDERUNGEN

Funded by the Initiative and Networking Fund of the
Helmholtz Association



IPS

Integrated Positioning System



Brief description

IPS is a multi-sensor system for real-time self-location and 3D mapping in unknown environments. With a stereo camera, as well as rotation-rate and acceleration sensors (internal measurement unit, IMU), the human sense of orientation is simulated by sensors. This allows for robust self-locating without the need for an external reference systems such as GPS or Wi-Fi.



Aims

- Real-time location and 3D mapping in unknown in- and outdoor environments without having to switch technologies
- Multi-sensor concept with open interfaces to enable integration of more sensors

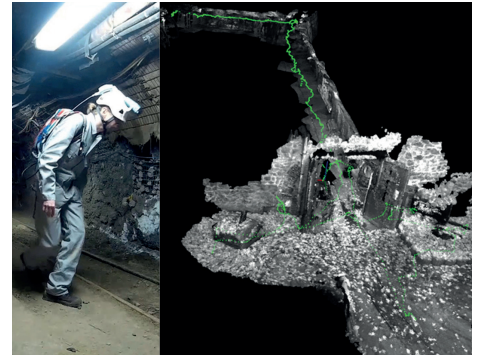


Applications

- Industry 4.0
- Space

Outlook

- Real-time location mapping and guidance during measurement tasks and inspections
- Visual inspection of technical infrastructure with respect to spatial-temporal data as well as digital documentation
- Applicability in navigation systems



Parties involved

DLR Institute of Optical Sensor Systems, DMT GmbH, VINS, Gestalt Robotics GmbH



Facts and figures

Field: Technology demonstration
Characteristics: self-positioning in unknown environments without the need for external positional, 3D mapping of surroundings
Applications: visual inspection and navigation



IPS

Integrated Positioning System

Technology Demonstration – Self-positioning in unknown environments

The DLR Institute of Optical Sensor Systems has developed the technology for the ‘Integrated Positioning System’ (IPS) over the past 10 years. IPS is specifically designed for real-time self-positioning and 3D mapping in unknown indoor and outdoor environments where there is no external positional infrastructure such as GNSS or Wi-Fi. DLR is currently converting the technology to be suitable for commercial use together with its industrial partner Deutsche Montan Technologie (DMT).

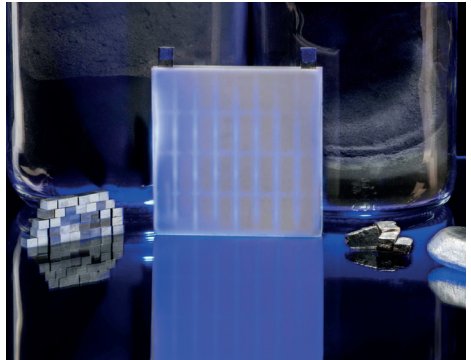
The model for the IPS is the human sense of direction. The human sight and sense of balance are simulated by means of a stereo camera and a (low-cost) inertial measurement unit (IMU). The sensor data are then processed and fused using an extended Kalman filter. The result is the location and position in space, described by the six degrees of freedom of the outer orientation. This data is needed for measuring systems / applications that require a spatial reference with respect to their environment. From the individual measurements, a trajectory, i.e. the distance travelled, is derived from the runtime. The method is resilient against interference, as the physical properties of the sensors ideally complement one another. It provides more accurate results in real time and without external positioning sensors than is possible today with just optically- or inertially-based navigation sensors of the same class, currently an accuracy error of about 0.2 percent of the distance covered can be achieved. The navigational data is further used to generate spatially referenced point clouds of almost any size from the calculated depth maps of the IPS stereo camera data.

IPS is a multi-sensor concept: when required, further external positional sensors as well as other sensors, for example mobile test sensors, can be integrated. Their data is then spatially-temporally referenced by the IPS. This is of great importance for a wide variety of visual inspection and maintenance tasks. IPS is constantly evolving in terms of functionality and performance. For this purpose, the Institute carries out research and development work and cooperates with various industrial partners. As a result, IPS has in recent years become a catalyst for a large number of mobile applications in the context of digitalisation and Industry 4.0.



Thermoelectricity

Thermoelectric generator



Brief description

Thermoelectric generators (TEG) are able to convert thermal directly into electrical energy. In space flight, thermoelectric generators (TEG) are commonly used as long-lasting, reliable sources of electrical power. On Earth, their applications come in the form of secondary energy use in vehicles, self-sufficient heating systems and light-duty power supply. The key to optimised applications lies in the development of highly efficient materials and stable electrical and thermal contacts.

Aims

By directly converting unused heat into electrical power, TEGs reduce primary energy consumption and protect the environment.

Parties involved

DLR Institute of Materials Research, DLR Technology Marketing, aixACCT Systems GmbH, Aachen

Applications

- Self-sufficient sensors in aviation and light-duty power supply systems
- Use of waste heat in mobile and industrial processes
- Use of waste heat in private households

Outlook

- Thermoelectric transducer materials are suitable for use up to approx. 800°C; specific assembly and connection technologies are in development
- Implementation of adapted TEG systems in industrial applications

Facts and figures

- At present, TE modules can be used at a maximum of 250°C (approx. 3–5% efficiency); the aim is a more effective use of waste heat through higher temperature levels (efficiency of about 10% at temperatures up to 800°C)

Thermoelectricity

Thermoelectric generator

By directly converting unused heat into electrical power, TEGs reduce primary energy consumption and protect the environment. Thermoelectric energy conversion is possible over wide temperature ranges, with efficiency levels of 10 percent and over. The key to optimised applications lies in the development of highly efficient materials and stable electrical contacts within the thermoelectric module, as well as specially adapted, efficient heat exchangers.

The main objective is to develop highly efficient thermoelectric generator modules with high long-term stability for source temperatures of 400–800°C. As such, the aim is to set up and test thermogenerator demonstration models in various application scenarios, in conjunction with other institutes and industry partners. In addition to the development of efficient transducer materials for high temperatures, the electrical and thermal contacts within the module present a particular challenge when creating the core element of the TEG – the thermoelectrical module. Depending on the thermoelectric material class, these contacts have to be adapted specially in order to withstand the required temperatures and thermal and mechanical loads. The development of specialised measuring methods for thermoelectric materials and systems is therefore necessary in order to determine the effectiveness in each application scenario.

There are many possible uses for TEGs. They can provide electrical energy where it is required, for example for process-monitoring sensors, thus avoiding long supply lines. By using TEGs in the automotive industry, for instance, or in energy-intensive industrial processes, it is possible to save fuel and make the process more efficient as a whole.

Waste heat from a flue or pellet stove, for example, can be used to provide additional electrical energy, depending on the application. The provision of electrical energy can also be used to save batteries. Rechargeable batteries can be recharged for certain applications, eliminating the need for conventional batteries altogether, such as for the electric ignition of gas burners.



Drop tower

The 'Physics in microgravity conditions' student experiment

i Brief description

The 'Physics in microgravity conditions' experiment is a software-supported demonstration of various physical effects and phenomena that enables a range of tests in microgravity conditions. The mini drop tower gives students and teachers the opportunity to conduct interactive experiments and to explore interesting aspects of space research.



Image: Enlighten Sciences GmbH

🎯 Aims

To draw attention to experiments in weightlessness on the ISS and to make visitors aware that humanity is far from possessing complete knowledge of all phenomena in microgravity conditions.

👤 Parties involved

Enlighten Sciences GmbH,
DLR_School_Lab

🌍 Applications

- Educational experiment for Physics and Astronomy in grades 7 to 13
- University and extracurricular education

👁 Outlook

- Contextual learning about physical principles
- Provision of authentic science teaching
- Independent experimentation
- Applicable across different disciplines
- Interactive concept

📄 Facts and figures

Development and operation: Enlighten Sciences GmbH (previously DLR)
Area: School-based, extracurricular and university education
Features: Software-supported control, measurements (real time & slow motion)



Drop tower

The 'Physics in microgravity conditions' student experiment

The experiment is a software-supported demonstration of many physical effects and phenomena in microgravity conditions. Enlighten Sciences GmbH runs the experiment and develops it in conjunction with the German Aerospace Center.

Origin of the experiment

The 'Physics in zero-gravity conditions' experiment came about in the course of research at the Zentrum für angewandte Raumfahrttechnologie und Mikrogravitation (Centre of Applied Space Technology and Microgravity; ZARM), conducted on parabolic flights and on board the International Space Station (ISS).

Functionality

After a short preliminary talk, students assemble various small probes in a drop capsule, which constitutes the most important element of the experiment. Together with an experiment object that can easily be changed to cover a range of topics, the capsule contains a sturdy camera designed for use in sports (an 'action cam'), which provides high-resolution images with a high frame rate. The drop capsule also contains sensors for measuring gravitational acceleration or air pressure. After making these preparations, one of the students hangs the capsule at the top of the tower and retreats to a safe distance. The experiment is started by a simple click in the software, whereupon the sensors and video recording are activated and the retaining lock on the drop capsule opens. The drop capsule goes into freefall and thus a state of weightlessness. After landing, the data is transmitted wirelessly to the PC and can be played back in slow motion.

Special uses and work in schools

This mini drop tower gives students the opportunity to observe in minute detail how the small probes behave in microgravity conditions. By assembling the objects themselves and carrying out the experiment, they have hands-on involvement and are able to experiment interactively during class time. The 'Physics in microgravity conditions' experiment teaches physics principles in an exciting way within the context of current science and space research. Many interesting Physics topics can be covered here, such as adhesion, cohesion, the capillary effect, magnetism, heat convection, conservation of momentum, accelerated motion, air friction, thread pendulums, centrifugal and pseudo forces, and, of course, gravity and weightlessness.

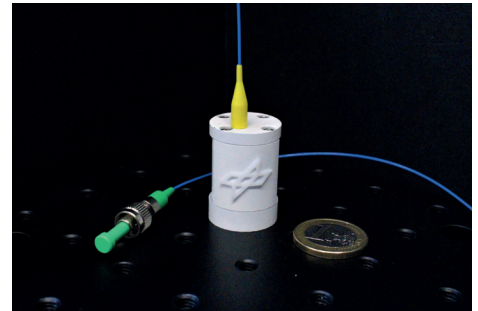


OMIS

Optomechanical inertial sensors

Brief description

The optomechanical inertial sensor (OMIS) is one of the world's most sensitive acceleration sensors, and its unique technology makes it resistant to electromagnetic radiation. As a primary standard, this sensor can be used to calibrate conventional sensors or be used directly as a self-calibrating sensor.



Aims

Self-referencing inertial measurement and the development of primary and secondary standards for acceleration and force measurements with portable sensors.

Parties involved

DLR Institute of Space Systems, SensTek GmbH

Applications

- Energy
- Aerospace
- Transport
- Metrology and instrumentation
- Scientific applications

Outlook

- Vibrometer insensitive to strong electromagnetic radiation
- Navigation and positioning control
- Microvibrations
- Ground support equipment
- Navigation complementary to GPS
- Autonomous driving
- Road safety
- Primary and secondary standard for calibrations
- Gravitational field measuring

Facts and figures

- Resistant to electromagnetic fields
- Extremely high sensitivity (up to 10^{-11} g/√Hz)
- Very compact, portable design
- Sensors can be adapted to the application: Measurement sensitivity and bandwidth
- The measured value is traceable to the SI unit system
- Portable primary and secondary standard for acceleration
- Optional self-calibration with long-term stability options



OMIS

Optomechanical inertial sensors

SensTek GmbH is a high-tech spin-off of the German Aerospace Center and focuses on the development and commercialisation of unique optomechanical technology for acceleration and inertial measurements. One of the unique selling points of the technology is a proprietary measuring principle for self-referencing inertial measurements using highly-compact, portable optomechanical sensors. The optomechanical inertial sensors (OMIS) are able to perform continuous broadband measurements and exhibit extremely high micro-g bias stabilities over long timescales, without interference from electromagnetic fields.

OMIS can be used as a portable primary and secondary standard device for acceleration and force measurements. This means that the products provide measurements that are directly traceable to the international system of units (SI), without the need for an external, costly and time-consuming calibration procedure.

In addition, these products open up new possibilities for both terrestrial and satellite-based navigation. These innovative measurement systems have applications in the automotive and transport technology sectors, as well as the renewable energy sector (for example wind power plants or even conventional power plants) and the aviation, shipping, space travel and defence industries. OMIS are particularly advantageous when applied to autonomous vehicles that use intelligent systems, smart sensors (smart industry process – Industry 4.0) as well as positioning and time-referencing systems (GPS/next-generation Galileo systems) for inertial navigation. SensTek is developing the OMIS to cover several sensitivity ranges and measurement bandwidths. As such, OMIS offer considerable advantages as gravimeters and gradiometers for geoscientific purposes like the identification of reservoirs in the minerals and oil industry. In terms of navigation, these compact inertial measurement systems are particularly useful in environments where GPS/Galileo signals are unavailable, for example on submarines or in environments where GPS or Galileo signals are intentionally blocked or scrambled.

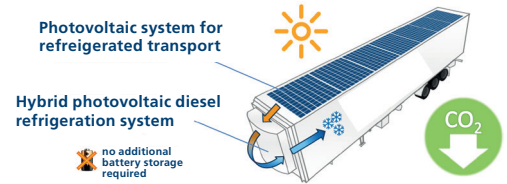


PVThermoTruck

Photovoltaic diesel cooling-system technology for transport vehicles involved in temperature-controlled logistics

i Brief description

Self-sufficient energy systems can be optimised in both environmental and economic terms through the combination of conventional and renewable energy sources. The PVThermoTruck deploys a hybrid energy approach to photovoltaic diesel refrigeration systems for goods transport. Tests are also being carried out to determine whether diesel fuel can also be saved in this way.



🎯 Aims

An ideal combination of photovoltaic and refrigeration systems on sunny days, when there is a greater need for refrigeration in goods transport.

👤 Parties involved

DLR Institute of Networked Energy Systems, Oldenburg

🌍 Applications

- Users: Companies that use temperature-led logistics
- Potential use of the technology in 100,000 refrigerated lorries in Germany
- Potential savings of approx. 1500 litres of diesel fuel and approx. 2600 – 5200 kg of CO₂ within a one-year cycle for each refrigerated semitrailer (40t) in Europe

👁️ Outlook

- Contribution to achieving climate protection goals, in line with the '2020 Climate Protection Action Plan' [BMBU]
- Reinforcing green logistics by reducing CO₂ emissions, in line with DIN EN 16258
- Boosting the image of the logistics sector
- Outlook: Sector coupling in public traffic

📄 Facts and figures

- First-time development of a well-founded yield prognosis for mobile photovoltaic systems
- 'Energy storage by lowering the system temperature' control technology submitted for a patent
- Advantages: Robust hybrid cooling system with improved cost-effectiveness
- Reduced CO₂ compared with conventional refrigerated truck systems: up to 30 %



PVThermoTruck

Photovoltaic diesel cooling-system technology for transport vehicles involved in temperature-controlled logistics

Technology demonstration – hybrid refrigerated truck systems

Since 2014, researchers at the DLR Institute of Networked Energy Systems have been working intensively on a concept for mobile photovoltaic systems in the field of temperature-led logistics. A market analysis of the logistics sector was carried out as part of a master's thesis, among other research, with a view to assessing the potential pertinence and marketability of such technology. This revealed strong relevance to new innovations aimed at reducing energy consumption, and the willingness of companies to opt for greener logistics. Visible efforts to reduce CO₂ can help to win customers over the competition and have a positive impact on a company's image.

A new yield prognosis model has been created to estimate the savings that could potentially be achieved by opting for photovoltaic-based refrigeration systems for goods transport. This can be used to predict the average annual energy yield for every existing transport route when using the mobile PV system. The calculated results are based on real telemetric data and show that, for routes within Europe, approx. 1000–2000 litres of diesel fuel can be saved every year by using such a refrigeration unit. This equates to a saving of around 30–40% diesel for refrigerated goods.

Feeding photovoltaic energy into the existing refrigeration system is key to the feasibility of the concept. This was analysed with the help of a new model to illustrate refrigeration units, taking all possible disturbances into account. One key finding was the identification of an optimised regulatory structure. This enables the integration of an optimum amount of photovoltaic energy in both economic and environmental terms, without the use of additional intermediate electrochemical storage (batteries).

The findings suggest a dual setpoint control, which the DLR Institute of Networked Energy Systems has secured in the form of a patent application. The operating principle is as follows: with sufficiently high electrical power provided by the photovoltaic system, the system-cooling function is regulated at a lower temperature setpoint. The energy obtained via this method is stored in cold form and has the advantage of allowing the user to dispense with conventional battery storage, which is expensive and high-maintenance.



Kinfinity Suit & Glove

Kinfinity technology

Brief description

Kinfinity technology makes it possible to record human movement data and direct it to a computer for further processing. This enables the programming of robots by reproducing the movements of humans, as well as the possibility of training and repairs in VR / AR in the context of Industry 4.0.



Aims

New generation of multimodal control instruments that detect and process the movements of the user's fingers, arms and legs through sensors in textiles.

Parties involved

DLR Institute of Robotics and Mechatronics, Kinfinity

Applications

- Robotics
- Production process
- Medicine
- Industry 4.0

Outlook

- Telemanipulation
- Training und repairing in Virtual / Augmented Reality
- Simple programming of robots
- Training of complex finger movements (surgery and manufacturing processes)
- Extension of design processes
- Manipulation of objects in Virtual Reality

Facts and figures

Degrees of freedom: > 20
Size: different standard sizes, possibility of customisation
Databus: USB, Ethernet, Bluetooth, Wi-Fi, RS422
Data rate: 1 kHz
Supply voltage: Battery or USB
Controller: Controller available on request for various robots, robot HMI and VR / AR applications



Kinfinity Suit & Glove

Kinfinity technology

Kinfinity technology has been developed for a new generation of multimodal control instruments. This textile technology makes it possible to capture and process simple and complex movements of the user's fingers, arms and legs. The user can thus control robot arms with simple arm movements, record the motion and visualise them as often as desired. This allows programming of simple and complex robots within a very short time without prior knowledge.

Kinfinity technology takes the user's virtual experience to another level of intuitiveness and accuracy. It gives the user the power to manipulate objects, train workers and accurately perform any movements without the need to learn new control methods. The user's recorded movements can be used to achieve a better result and reduce costs – even when repairs are being made. This is particularly relevant during surgical procedures or manufacturing. The smallest motions are reproduced into the visualisation software with no delay. Thanks to this smart software, the user can adapt and can control each joint position.

The focus for the development of the technology was directed towards 'Industry 4.0', in order to enable a high level of technical assistance and a reduction of costs, as well as simplifying the production process.

The Kinfinity technology provides a highly accurate position of the fingers, arms and legs in real time. Depending on the user's needs, it provides the possibility of switching seamlessly between the wireless and wired solution. Thanks to the user-friendly interface integrating a smart calibration tool, the system is ready to be used by a new user within minutes. The high performance of the Kinfinity technology is achieved through the combination of several patented sensor technologies.



David

Humanoid robot

i Brief description

The anthropomorphic robot David is a DLR research robot. It has joints with variable stiffness actuators, which have a mechanically adjustable flexibility in the drive train. One goal in its development is to get closer to human capabilities – especially in terms of dynamics, dexterity and robustness. Not only does David have a size comparable to humans, but he also has a similar range of motion. All joints of the fingers can be controlled individually and thus give the system an extraordinarily high dexterity.

🎯 Aims

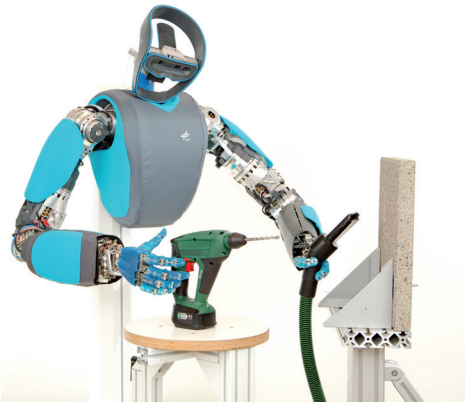
The robot will operate in an environment designed for human operations. Its humanoid shape should enable intuitive operation and programming.

🌍 Applications

- Telepresence
- Novel drive concepts
- Artificial Intelligence

👁 Outlook

- Assistance system for human-machine interaction
- Support in dangerous situations
- Maintenance tasks
- Better understanding of humans
- Unstructured environments
- Methods for better grasp planning
- Increase of efficiency



👤 Parties involved

DLR Robotics and Mechatronics Center

📄 Facts and figures

Size: adult human
Weight: approx. 26 kg
Degrees of freedom: 41
Actuation: 76 brushless dc current motors
Sensors: 165 position sensors
Speed: comparable to humans
Working environment: similar to that of humans



David

Humanoid robot

The robot David is continuously being expanded into a complete humanoid robot. He currently has two arms, a neck and a head. David is to be employed in an environment suitable for humans. For this the robot should resemble a human as much as possible in terms of size, strength and flexibility. David's mechatronic concept is based on powerful and efficient brushless motors combined with highly integrated power and digital electronics. The high-performance hands are slim and light, as their drives are built into the forearms.

David should be able to operate safely in an unstructured and dynamically changing environment. Collisions with objects and obstacles can occur in unknown terrain during normal use. Fast impacts during these collisions often cause damage to the structure or drivetrain of conventional rigid humanoid robots in many situations. This can sometimes lead to the complete cancellation of the mission.

To minimise this risk, in David all 41 degrees of freedom are integrated through variable stiffness actuators (VSAs) with real mechanical springs. These variable stiffness actuators have a high mechanical elasticity. The inherent stiffness in the joints can, like in humans, be infinitely varied by co-contraction of the muscles. The high elasticity in the robot's joints can buffer the collision energy. The spring acts as a mechanical low-pass filter between the gearbox and the output, which reduces torque peaks / force peaks at the output. This leads to increased mechanical robustness.

Another motivation for the development of David is to be able to perform human-like highly dynamic movements. The springs in the VSAs act as energy stores that allow very fast movements to be performed – even faster than the maximum speed of the engines. In addition, the energy efficiency for certain cyclical movements can be increased. With skilful stimulation of the natural vibration behaviour of the system, most of the movement takes place in the springs. The motors and gearboxes, which tend to have high energy losses, must move at a lower speed and deviation than the robot joints. This results in a more efficient overall movement.



COPRO[®] technology

Continuous Preforming of Composite Profiles

i Brief description

COPRO technology[®] offers customised production solutions for lightweight components made of fibre composites. As a DLR spin-off, COPRO Technology GmbH develops customer-specific automation concepts right through to efficient series production. Its services include concepts, CAD design and the construction of production facilities, as well as lightweight components and related services.



🎯 Aims

Cost-effective production of fibre composite profiles through continuous roll-forming processes, a high level of process robustness, component complexity and cycle rates.

👥 Parties involved

COPRO Technology GmbH, DLR Institute of Composite Structures and Adaptive Systems, Helmholtz Association

🌍 Applications

- Efficient, easy-to-adapt solutions for all areas of composite profile preforming
- Aeronautics
- Automotive manufacturing
- Transport
- Wind energy
- Industry
- Construction

🔮 Outlook

- Structural profiles for aircraft fuselage, wings and tail units
- Frame profiles
- Structural profiles for lorries, trains, boats and caravans
- Wind turbine rotor blades
- Frames, trusses, gripper arms, linear tracks
- Support structures, bridge and roof frames

📄 Facts and figures

Patented roll forming technology for composite profile production

Advantages: greater productivity and cost-effectiveness; up to 35% cost-saving potential

Partner: DLR

Project partners: BMW, Airbus

Scientific support: DLR Institute of Composite Structures and Adaptive Systems



COPRO® technology

Continuous Preforming of Composite Profiles

COPRO® (Continuous Preforming of Composite Profiles) technology is a unique process for the efficient production of lightweight components via roll forming. It represents an economical alternative to the established winding, braiding and pressing process. Even complex 3D-variable fibre composite profile geometries can be continuously manufactured and fed into established processing procedures. The technology is protected by DLR via an appropriate IP portfolio, which covers COPRO Technology GmbH.

COPRO® technology ensures higher productivity and economic efficiency in comparison with established production technologies. It is flexible and allows continuous remodelling from textile semi-finished products to profile preforms in an efficient process that is easy on materials. As part of the RTM process chain, COPRO® technology enables the consolidation of multiple process sequences into one production step. As such, cycle rates are increased, production and changeover times shortened, and investment and maintenance costs reduced. The preforming process step has a cost-saving potential of up to 35%.

A proof of concept, a demonstrator model and two industry-oriented production plants for aviation and automotive components have been created for COPRO® technology. From the very outset, the technology has been developed for, and in conjunction with industry partners. As such, in view of its expertise in industrial research, COPRO Technology GmbH has been commissioned to develop a production plant for the production of hybrid profile components. In addition to successfully negotiate a collaboration with BMW, a research project with Airbus and a development agreement with another major aviation company, COPRO Technology GmbH is in constant dialogue with OEMs and suppliers, including companies from the transport sector.

COPRO Technology GmbH constructs and commissions production plants, as well as manufacturing pilot and small series of profile preforms and composite profiles. With its range of services, COPRO Technology GmbH is looking to become a reliable partner for industrial companies in the field of composite profile production and as a supplier of profile preforms and components.



VibroTac

Vibrotactile wristband for information output

Brief description

The **VibroTac** wristband contains six vibrating motors that provide the user with various kinds of information. The new **VibroTac S** prototype is also equipped with 'time of flight' distance sensors that detect the user's close environment. It communicates the direction and distance of detected objects intuitively, providing the user with an additional source of sensory perception.



Aims

- Versatile information output** through a wide variety of vibration patterns
- Innovative environment detection** with intuitive feedback of detected objects

Parties involved

DLR Institute of Robotics and Mechatronics, DLR Technology Marketing, SENSODRIVE GmbH (Marketing of VibroTac)

Applications

- Automotive timing** processes and drawing attention of employees
- Healthcare** Assistance for the blind and visually impaired
- Virtual Reality & Gaming** Collision feedback for increased immersion

Outlook

- Telerobotics:** Efficient work through force and collision feedback
- Training with Augmented Reality:** improved learning through the use of intuitive movement commands

Facts and figures

- Actuators: six cylindrical vibrating motors for position- and direction-specific output of information
- Distance sensors for simultaneous detection in several directions up to about one metre
- Technology transfer 2012 to the company SENSODRIVE (www.sensodrive.de)
- Awards: DLR Innovation Award 2012, M2M Challenge 2012/2013, among others



VibroTac

Vibrotactile wristband for information output

VibroTac (vibrotactile wristband for information output) and VibroTac S (equipped with additional sensors for detecting objects in the user's immediate environment)

The VibroTac is an innovative wristband that uses vibration to communicate a wide range of information to humans. Several elastically interconnected vibrating modules – with signal paths that allow them to be separately controlled – generate stimulation patterns that can be unambiguously interpreted by the user. This enables intuitively comprehensible location and direction information.

The patented concept allows the wristband to be used ergonomically, with different arm diameters, while the wireless communications interface and the rechargeable battery enable unrestricted freedom of movement. The range of functions, and thus the versatile applications of the device, have been extended by the integration of distance sensors for the detection of obstacles within the user's immediate environment. The special feature here is the simultaneous detection of several areas in different directions, as well as the intuitive feedback of the distance and direction of detected objects. As such, the vibrotactile VibroTac S sensor wristband can be used as an electronic aid to guide the blind and visually impaired, and assist them in their day-to-day lives, for instance. This system can prevent more collisions and injuries than the classic cane, which is not suitable for detecting obstacles at head or chest height (e.g. open windows or low-hanging branches).

User studies of different applications – such as force and collision feedback from virtual-reality programs and telerobotics; directing awareness in complex work areas; innovative training concepts with Augmented Reality; navigational applications; and assistance for the visually impaired – attest to the successful use of the patented device.



C.R.O.P.®

Combined Regenerative Organic Food Production



i Brief description

The DLR C.R.O.P.® process is a purely biological method for the production of fertilisers from biological waste and waste water high in nitrogen content. The environmentally friendly recovery of nutrients as well as the emission and water protection of Earth are at the foreground of this technology.

🎯 Aims

Recovery of nitrogen and phosphate as fertiliser granules from manure and nitrogen-containing waste water, as well as removal of drug residue.

👤 Parties involved

DLR Institute of Aerospace Medicine, DLR Technology Marketing

🌍 Applications

- Processing of the problematic livestock manure into a biological fertiliser
- Processing of fermentation residues from biogas plants for the recovery of nitrogen and phosphate
- Detoxification of xenobiotics-contaminated wastewater from hospitals and nursing homes

👁 Outlook

- Complete system for the recovery of all nutrients from manure and wastewater
- Increasing the efficiency of manure trade
- Use in urban centres
- Coupling with plant cultivation

📄 Facts and figures

- Purely biological system
- No use of additional chemicals or hazardous substances
- Proven detoxification of ibuprofen and diclofenac by up to 99.9%



C.R.O.P.[®]

Combined Regenerative Organic Food Production

Technology demonstration

The agriculture of the future varies between the much needed improvement in sustainability and the equally important increase in productivity. Future agricultural systems must therefore meet several conditions.

These should

- find a balance between intensive cultivation with high yield per unit area for effective food production and extensive land use for the conservation of natural resources,
- put a stop to the consumption of finite resources for fertilisation,
- and reduce emissions of greenhouse gases and environmental toxins.

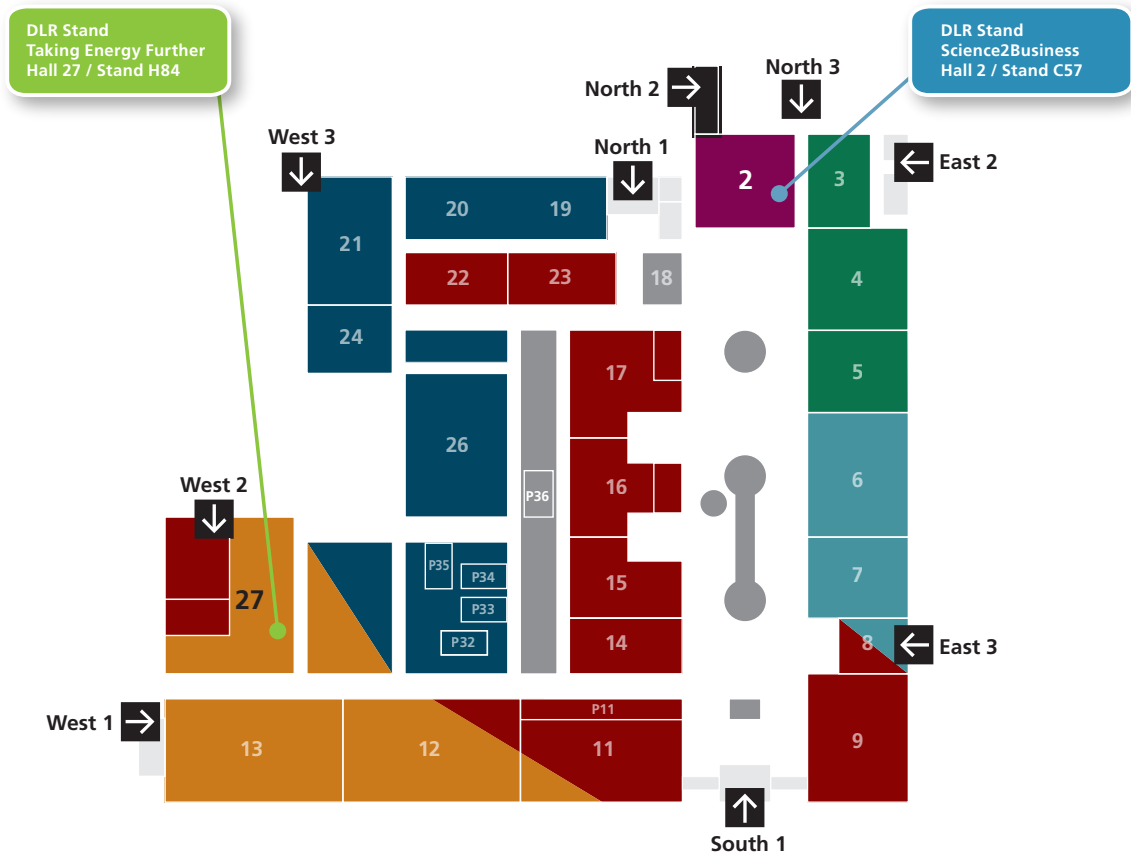
The idea of sustainable and low-emission crop cultivation using high-yield cultivation systems is quite similar to the concept of bioregenerative life support systems in space. In both cases, waste is considered to be a valuable raw material and is put to further use.

The C.R.O.P.[®] project combines knowledge from aerospace and the agricultural sciences to develop an agricultural system that optimises existing material flows and uses them more sustainably.

Livestock generate large quantities of manure, which is spread on a farm's own land or used as fertiliser. Slurry spreading is a well-known source of pollution and therefore regulated by law. C.R.O.P.[®] aims to reduce emissions through the use of advanced microbial filter technology. The project includes a cascade in which the manure is first used as an energy source in a biogas plant. In the second step, the liquid fraction is separated from the digestate and further processed in an aerobic biofilter unit (C.R.O.P.[®] filter). This process creates a nutrient-rich solution that, after sterilisation and concentration, is transformed into a high-quality fertiliser.



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