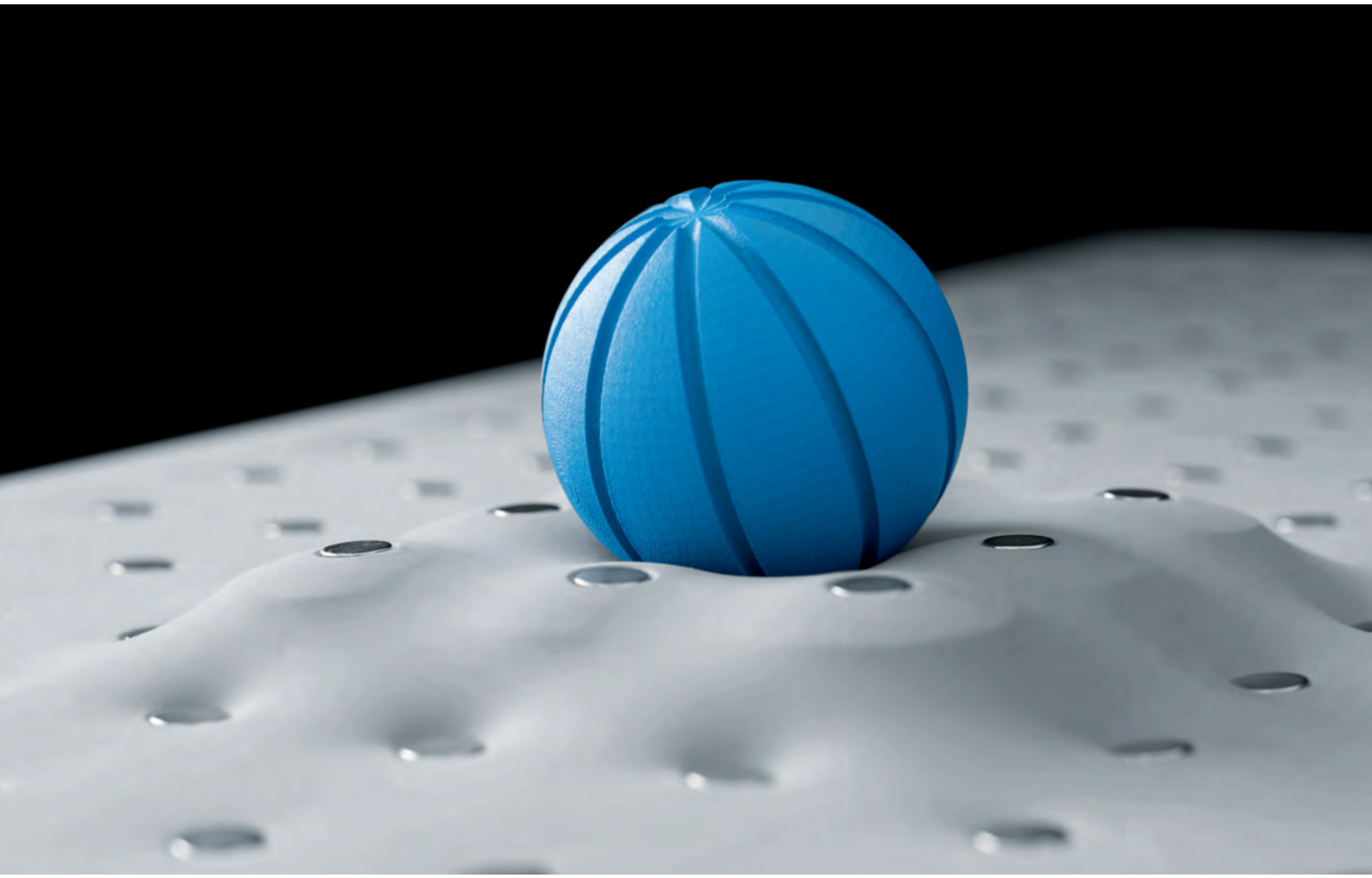
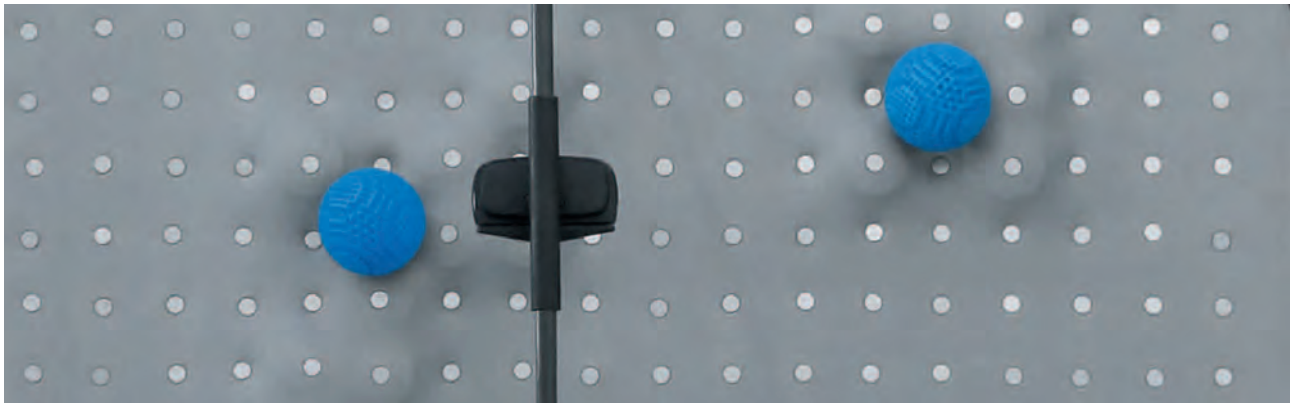
WaveHandling

FESTO



Conveying and
sorting in one

Modular conveyor with intelligent subsystems



The WaveHandling system from Festo is a pneumatic conveyor for the targeted transportation and simultaneous sorting of objects. It consists of numerous bellows modules that deform the surface, creating a wave motion that transports the objects in a targeted manner.

Connect and get started

The individual modules can be connected as required and are self-configuring. This means that the system can be made operational quickly and without programming, no matter what the layout is. The integrated sorting function means that an additional handling unit is no longer absolutely necessary.

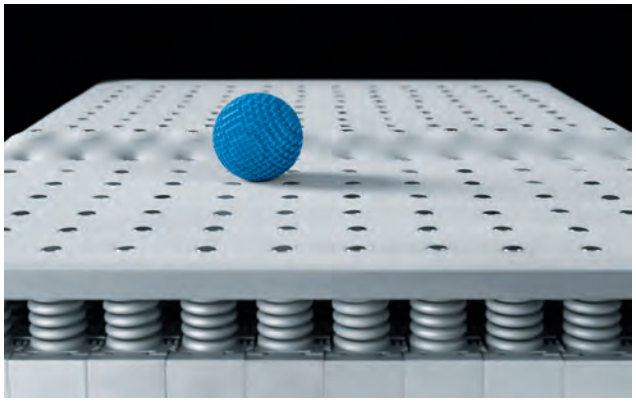
As a technological leader in its industry, Festo's core business is helping to shape the production and working environments of today and tomorrow. Each year, the company develops around 10,000 custom-made solutions for its customers. This ability to innovate comes from applying the latest knowledge to product development. Bionics is an exciting source of new knowledge and future technologies.

That is why Festo has spent years working on applying natural principles to technology in the Bionic Learning Network. All Future Concepts were developed to provide new ideas for industrial applications and possible future standard products. It also supports Festo's goals of inspiring young people to take an interest in technology and finding and encouraging new talent.

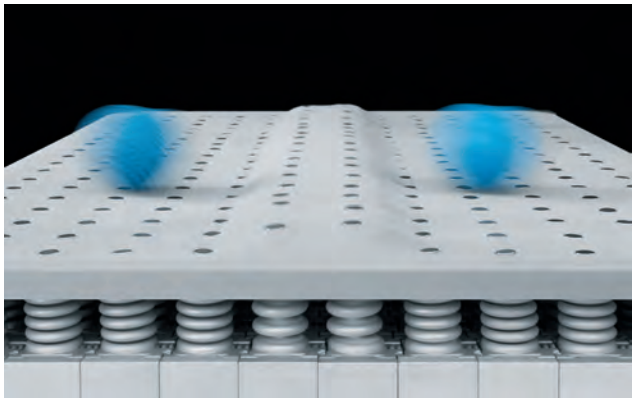
The WaveHandling system was therefore primarily developed by students who designed everything from the mechanical system and electronics to the software for actuation.

New inspiration for the automation of tomorrow

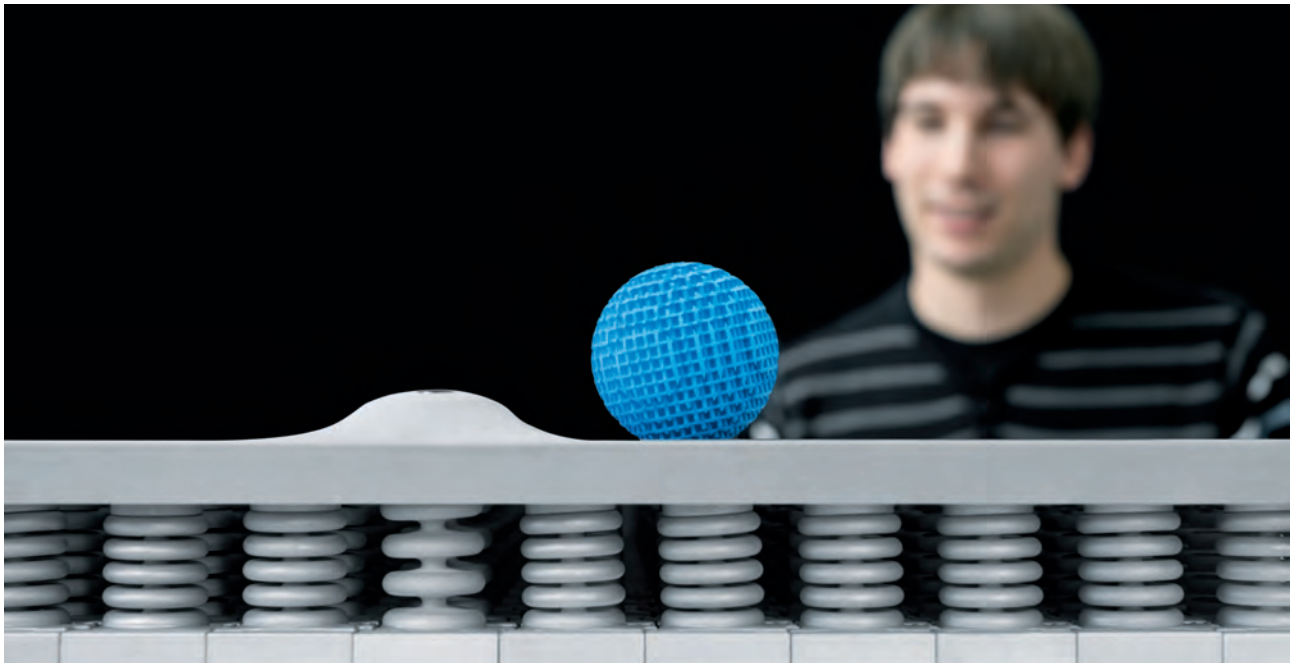
A potential application of the platform is in the food industry, for automatically transporting delicate items like fruit and vegetables and sorting them for the next process. The WaveHandling system could be positioned in the centre of a conveying unit to distribute the goods to the next conveyors on the left or right. The principle of self-configuration opens up new opportunities in applications where subsystems need to be quickly and flexibly integrated into production sequence.



Integrated functions: WaveHandling unites conveying …



… and sorting in one system – with no additional handling unit



Rolling it out: by expanding the bellows, the wave pushes the transported goods over the surface

The principle of the natural wave
If there were no tides or wind, the sea would be as smooth as glass. The movement of the wind over the smooth surface of the water produces small ripples that grow as they are pushed by the wind.

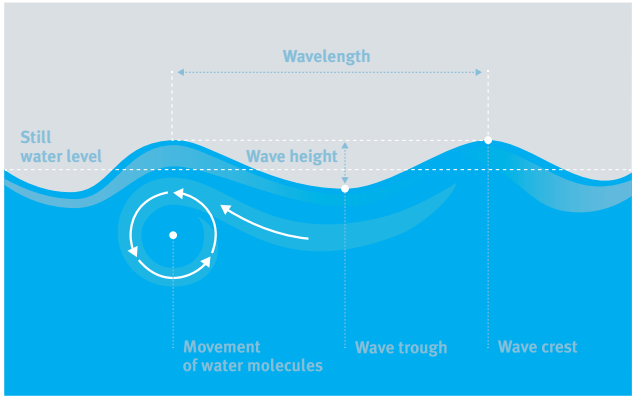
However, what is being moved by the waves is energy, not water. The water molecules within a wave move up and down in a circular motion, but remain in roughly the same place. Yet the wave rolls over the surface of the sea.

Targeted movement with pneumatic actuators
The WaveHandling system behaves in a similar way: while each individual bellows only advances and retracts in place, a wave moves over the surface of the conveyor. The WaveHandling system starts out flat. The first crest forms when one or more bellows is pressurised. An object that was previously stationary starts to roll down the wave until it comes to a stop before the next crest. The system's intelligent controller uses this principle to form a ridge that moves across the entire field and pushes the goods along.

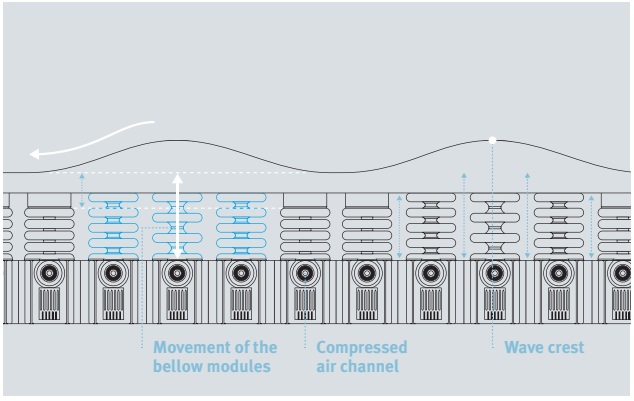
The actuators, comprising 216 connected pneumatic bellows modules, are attached underneath the covering that forms the surface of the conveyor. Each module consists of bellows kinematics on top, an integrated standard valve MHA1 from Festo and the appropriate electronics for actuating the valve. The bellows structure is pneumatically driven and can expand and contract by around 1 to 2 cm. The conveyor is supplied with power and control commands by a compressed air channel and an electrical cable running through all the modules.

Flexible bellows structure based on a biological model
The modules are manufactured using a selective laser sintering process. Wafer-thin layers of polyamide powder are applied one after the other. A laser fuses each new layer with the layer below, and hardens it only in those places specified by the control program.

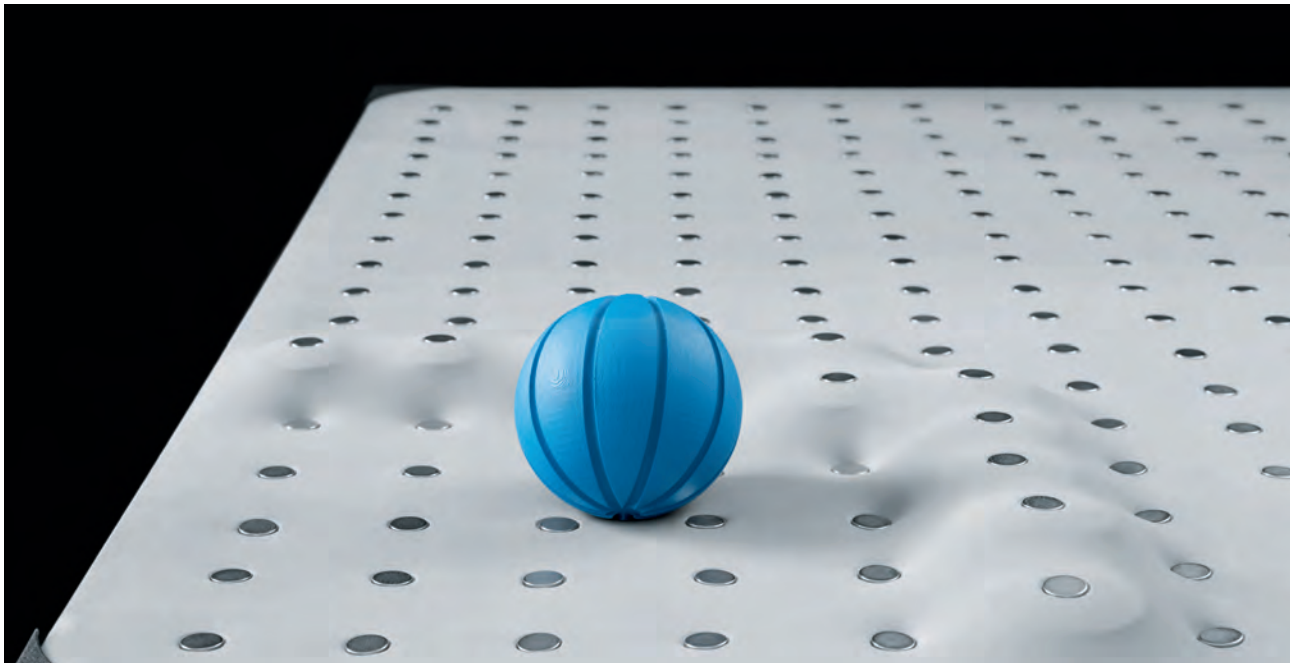
This generative production technology has already formed the basis for the resilient bellows structure of the Bionic Handling Assistant, which was modelled on an elephant's trunk.



Inspired by nature: the circular path of the water molecules in the sea ...



... serves as the model for the pneumatic conveyor belt



Uniformly controlled: targeted conveying across the entire layout of the individual modules

Intelligent networking of the bellows electronics
Each module has an electronic board with an integrated microcontroller. By connecting the boards, the spring contacts on all four sides establish an electrical connection between the boards that distributes both the bus system (CAN bus) and the voltage across the entire system.

Integrated control of the individual modules
Mounted above the handling system is a camera system that senses the objects on the conveyor. The camera transmits the images to a computer that processes them and actuates the conveyor via software developed specifically for this purpose. In the bellows modules, the microcontroller receives the commands via the CAN bus and forwards them to the valve. The respective bellows structure expands when the valve is switched, which causes the surface to arch at this point.

The end result is a control circuit that moves objects on the surface in a targeted manner, enabling it to take over the sorting action in the process.

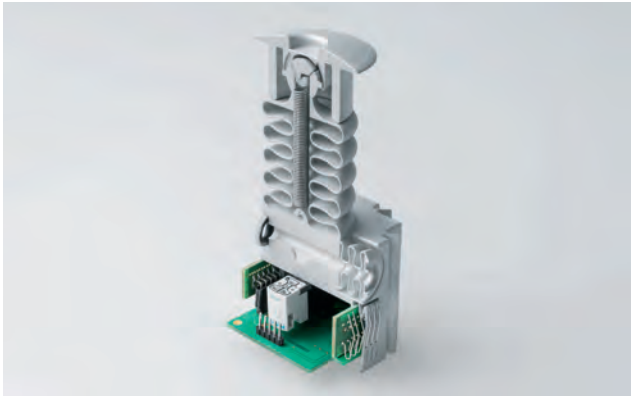
Self-configuration thanks to an enumeration process
The project team developed a converter module to enable the entire system to be computer controlled. It is connected to the computer via USB and provides access to the CAN bus for the WaveHandling system. The converter is also the central starting point of the 2D daisy chaining enumeration process.

This process enables the layout of the individual bellows modules to be automatically configured and the modules to be assigned unique addresses for identification.

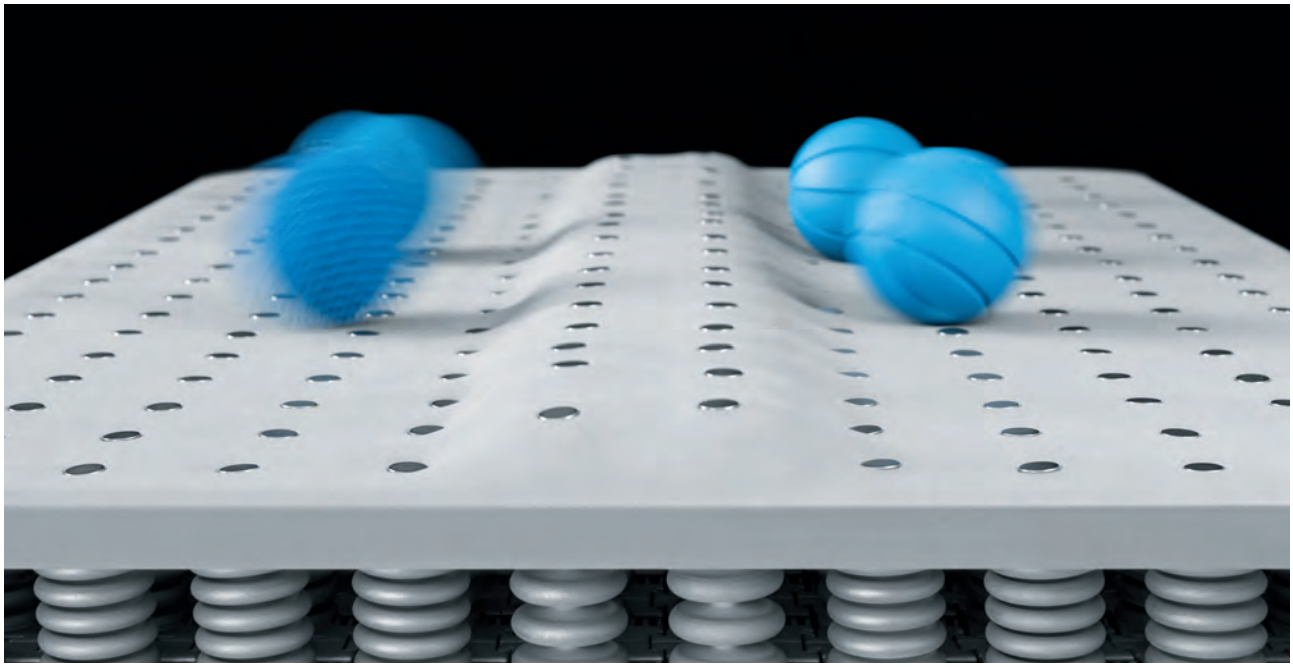
Immediately operational in any layout
The system detects itself how the individual bellows modules are connected. The computer creates a virtual map of the layout. Once the individual modules have been detected, the conveyor is ready for operation.

The time and effort needed for installing the conveyor is reduced since neither an additional handling unit nor a deflector, pusher or air blast device is required for the sorting process.

Laser-sintered: the flexible polyamide bellows structure ...



... with the integrated electronics and valve technology in the substructure



Visionary: adaptability and decentralised intelligence of WaveHandling provide new perspectives for tomorrow's automation

The evolution of the factory
Networking will play an even bigger role in the production of the future: centralised plant control will continue to develop and, at the same time, greater use will be made of the opportunities afforded by decentralised self-organisation. The individual subsystems, components and workpieces communicate with each other in real time and exchange information, commands and diagnostic values. This distributed intelligence enables sub-tasks to be processed autonomously, without a central computer having to control them.

In the future it will be possible to leave the configuration to the system itself. The decentralised intelligence of the individual components will mean an end to previously intensive steps such as manual adjustment and programming.

Concepts for the production of the future
With the WaveHandling system, Festo is already demonstrating how configuration of a system will be handled by the individual modules themselves in the future.

Maximum flexibility and transformability
The fast networking of the subsystems not only prevents errors, but also saves time. The principles of modularity and expandability guarantee high system flexibility. Efficiency in the sense of the factory of the future also means being able to adapt to meet individual customer wishes in the short term – without much additional effort.

Whether it is decentralised intelligence, high transformability or plug and produce, the principles of the factory of tomorrow are already playing an important role in today's products.

The Tripod EXPT shows how a mechatronic system can be quickly and reliably commissioned, despite its complexity, using predefined parameters and an intelligent master. All the customer has to do is establish the electrical connection between the kinematics and the control program, and then get started with programming the application. The modular automation platform CPX already enables decentralised control of the entire production sequence.

Self-configuring: the independent address recognition of the modules ...

... guarantees the rapid networking of the entire system

Technical data

- Height: 11.5 cm
- Length: 93.6 cm
- Width: 62.4 cm
- Surface material: Latex film in pearlescent colours
- Design: 216 bellows modules (12 × 18)

Bellows modules:

- Height: 11.5 cm
- Length: 5.2 cm
- Width: 5.2 cm
- Stroke size: 1–2 cm
- Material: Polymer
- Valve: Standardised solenoid switching valve MHA 1
- Electronics: Microchip PIC18F45K80 microcontroller

- Camera: Logitech C615
- Enumeration method: 2D daisy chaining
- Interfaces: CAN bus system and USB

Project participants

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54817 en 4/2013