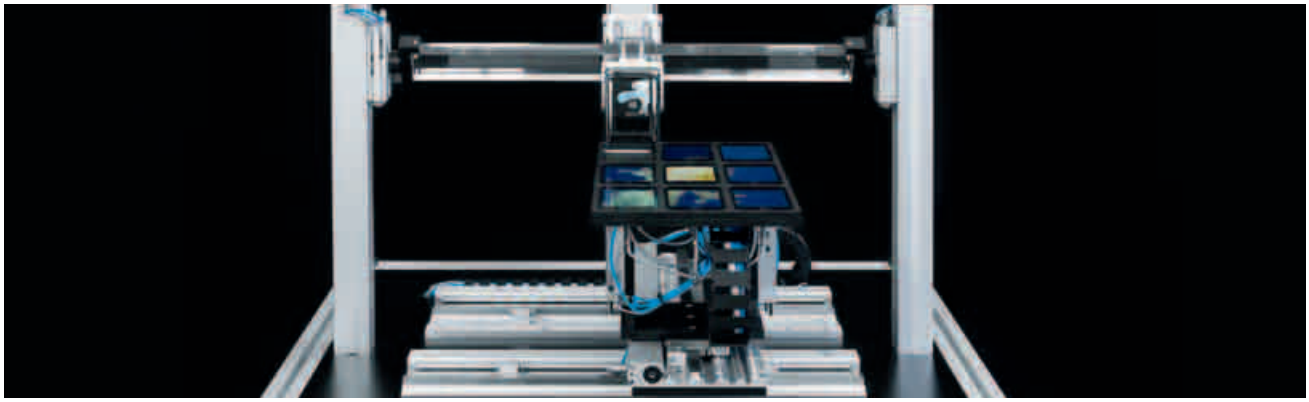
NanoForceGripper

FESTO

Energy-efficient
grasping based on the
model of the gecko

A new gripping concept for smooth, sensitive surfaces



With the NanoForceGripper, smooth-surfaced fragile objects such as drinking glasses or display modules can be grasped with almost no expenditure of energy. This new technology thus supplements existing grasping technologies based on pneumatics and can be used as required for specific applications.

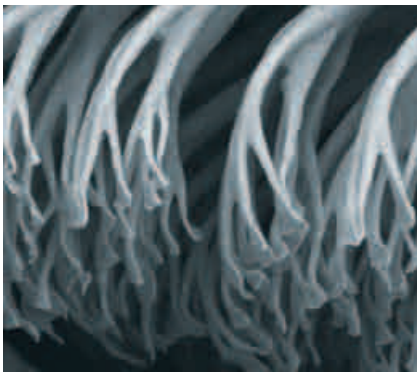
Gecko® Nanoplast® foil: a structure modelled on nature
The key component is a foil on the underside of the gripper with 29,000 adhesive elements per square centimetre. These sucker-like elements, based on the natural model of the gecko, adhere securely and permanently to the surfaces of the object to be handled. This effect is due to extremely small intermolecular forces of attraction – so-called van der Waals forces.

As part of the Bionic Learning Network, Festo has made use of this effect in devising the new, energy-efficient gripper. In collaboration with development companies, renowned universities and institutes – in this case the Zoological Institute of the University of Kiel – Festo has set out to transfer efficient principles from nature to automation technology.

Energy-free gripping and energy-efficient grasping
Energy-free gripping and energy-efficient grasping are entirely new features for grippers that operate with a push-push mechanism. Holding objects without expenditure of energy has not been possible before. A grasped component can then be permanently held in place by the gripper, without the need for energy input. The intermolecular so-called van der Waals forces, which allow secure, permanent, residue-free gripping of a workpiece, do not require a supply of energy to establish a connection. Only the disengagement of this bond, which is necessary for depositing the workpiece, must be effected by means of a corresponding opposing force; “peeling” the nanostructure from the surface of the grasped workpiece has proven highly suitable here.

Gentle removal thanks to a structure with Fin Ray Effect®
This peeling process is effected by means of a structure with the Fin Ray Effect®, which is modelled on a fish’s tail fin. When a force is applied, the flat structure is deformed into a curved surface. The effective foil-coated gripping surface becomes increasingly small, and the gripped component is gently released.

The gecko at the focus of the researchers’ attention: secure adhesion to any smooth surface



A reptile up close: the gecko’s nanohairs in 22,000-fold magnification

The gripper under the microscope: the nanostructure of the foil magnified 400 times

Alternately grasping and depositing: two NanoForceGrippers used in tandem

Depositing objects without additional actuators
A push-push mechanism within the gripper automatically displaces the adaptive structure when the gripped part is deposited, without the need for any additional actuators or control components. This principle functions in a similar way to the locking and release mechanism commonly found in ball-point pens. Maintaining a grip on the component held by the NanoForceGripper consumes absolutely no energy.

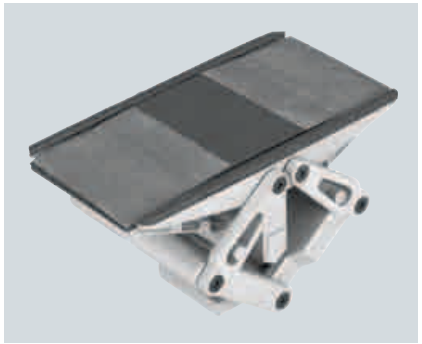
An extremely small amount of energy is required, only in order to pick up and release an object. This involves upward displacement of a few millimetres from the origin along the lifting axis (Z-axis), which allows either the necessary contact pressure to be applied in order to grasp an object, or the fin-ray structure to be deformed in order to release it.

A potential supplement to existing gripping technologies
With the NanoForceGripper, Festo has developed a gripping device whose advantages lie above all in energy savings and in dispensing with the need for actuators and control devices.

An energy-efficient concept for the future
This new gripping concept shows what energy-efficient automation of the future could look like and demonstrates that there is still a great deal of energy savings potential even in existing automation components such as grippers.

Cost reductions for sustainable management
Also in terms of durability, acquisition costs and moving mass, the new gripper technology is by no means inferior to conventional systems. At a time when energy costs are constantly on the rise and price increases are difficult to implement on the market, the energy-efficient gripper could help reduce costs for our customers and thus contribute to market success.

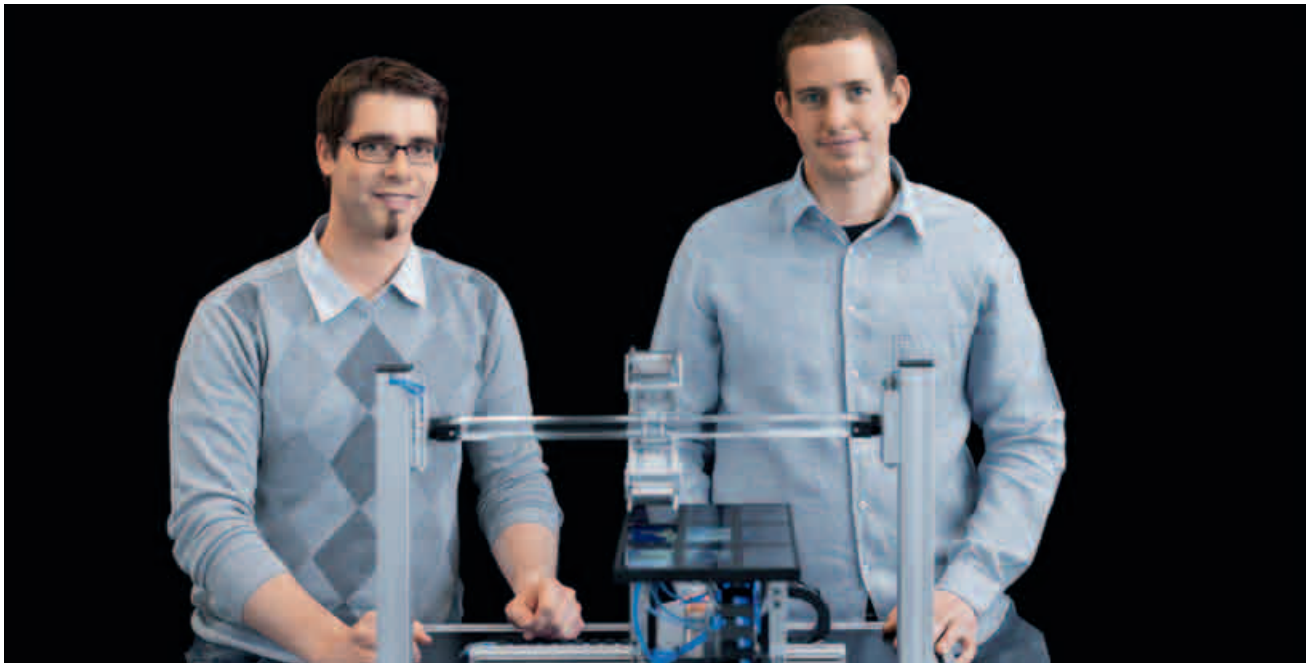
Saving compressed air and conserving the environment
With the NanoForceGripper, the consumption of compressed air can be significantly reduced in comparison to other suction systems. This makes for considerable energy savings potential, especially in the field of vacuum suction technology. The gripper is made from pure, recyclable nylon.



Gecko® Nanoplast® foil on the underside for energy-efficient grasping and energy-free gripping

Push-push mechanism: the structure is activated without additional actuators or control components

Gentle detachment of the film from the gripped object by deformation of the structure with Fin Ray Effect®



Technical data

- Length: 110 mm
- Width: 66 mm
- Height (workpiece gripped): 54 mm
- Height (workpiece released): 78 mm
- Mass: 91 g

Fin Ray Effect® is a trademark of Evologics GmbH, Berlin
Gecko® Nanoplast® is a trademark of Binder GmbH, Holzgerlingen

Project partners

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