BioGrip: Fin Ray gripper with integrated sensor technology through combination of 3D and functional printing

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Abstract

Transporting objects from A to B is one of the most common tasks in industry, be it in the automotive, manufacturing or food industries. The task includes safe gripping and holding and is easy to realize especially for objects with a well-defined position, size and shape. However, these conditions are not fulfilled when it comes, for example, to space debris tumbling uncontrollably through orbit, biological samples in the sea or dumped munitions waste, just as they are not fulfilled for sensitive groceries such as eggs or raspberries.

The BMBF project "BioGrip" demonstrates an additively manufactured gripper, which was upgraded by functional printed sensors for the measurement of touch, deformation and the holding force. The gripper mechanism was inspired by the skeletal structure of fish fins, which allows the grippers to snuggle up to the object to be gripped.

In the project, the 3D printing process for the production of grippers for an apple-sized object was investigated for different materials (TPU with different shore hardnesses). Gripper designs were evaluated and different sensor principles were compared in terms of their relevance and printability. Finally, strain, contact and force sensors were implemented.

The printed sensors were connected via ribbon cable to the meassuring electronics integrated in the gripper, which adds additional sensor values about the spatial position and sends the data wirelessly via a gateway to a cloud environment. There, the current measured values can be viewed via any computer or smartphone and the parameters of past gripping processes can also be analysed in detail.

It was successfully demonstrated that printed sensor technology can be integrated into the Fin Ray® gripper to increase functionality. The combination of the three aspects, namely the FinRay effect®, 3D printing technology and sensor technology, resulted in an innovative solution that can be used in various fields of application.