Slip sensor for easy and safe slip detection during gripping process

TLB
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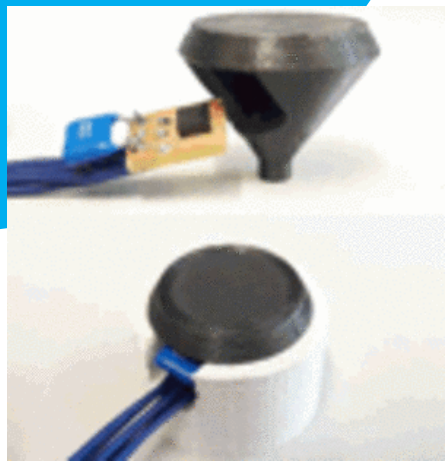
The sensor system implemented in the gripper (e.g. in hand prostheses or robot gripper arms) is characterized by its small design and, among other things, by reliable detection of slipping through of objects during the gripping process.In addition, the minimum mass of the object to be gripped can also be estimated.

- Slip detection during the gripping process
- Small design
- Data on the movement of the gripper is included in the evaluation
- The minimum mass of the object to be grasped can be estimated



Fields of application

Detection of slippage, for example in robotic grippers or hand prostheses

Background

Grippers are used in many areas in order to pick up, hold and move objects in a controlled manner. Examples include robots in the field of automation technology or prosthetic hands. Gripping systems should allow for reliable object grasping and early slip detection.

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Development Status

TRL3 - Proof of function

Patent Situation

DE102019210090 A1 granted
US2022/0362942 pending
EP 3996885 B1 granted
EU Unitary patent (UP) granted

Reference ID

18/096TLB

Service

Technologie-Lizenz-Büro GmbH has been entrusted with exploiting this technology and assisting companies in obtaining licenses.

Problem

Various techniques are known for monitoring the grasping of an object with a gripper, which is equipped with one or more sensors for slip detection. Examples of such techniques include measuring forces and/or vibrations or detecting a change in heat transfer at the gripping surface.

Solution

The gripper's sensor system (e.g. prosthetic thumb) consists of at least one uniaxial accelerometer (better: biaxial or triaxial) for detecting the relative movement (= slipping due to the tangential force $F_{T,X}$) between the sensor and the object to be grasped. The accelerometer is integrated into a cone-shaped base body, for example, which can oscillate tangentially to the holding force when an object slips ("elastically" mounted) - the corresponding (oscillation) frequency depends, among other things, on the geometry of the base body (cf. figure). Data fusion of different sensors (force and acceleration) makes it possible to detect and evaluate the grip force and the relative movement between gripper and object (slip). Added value is provided by the possibility of detecting the movement of the gripper and being able to assess the minimum mass of the object to be grasped. *Basic idea of the "slip sensor": Frequency-selective evaluation method is used to detect the slipping of an object to be grasped.*

The movement of the gripper can also be derived from the evaluation of the sensor values, so that it can be better controlled or regulated. By means of a force sensor, e.g. at the contact point of the base body, the holding force $F_{N,Z}$ can be determined in order to carry out a further plausibility check. This helps improve slip detection even further. With the help of the holding force $F_{N,Z}$ and the orientation of gravity it is also possible to assess the minimum mass of the object to be grasped.

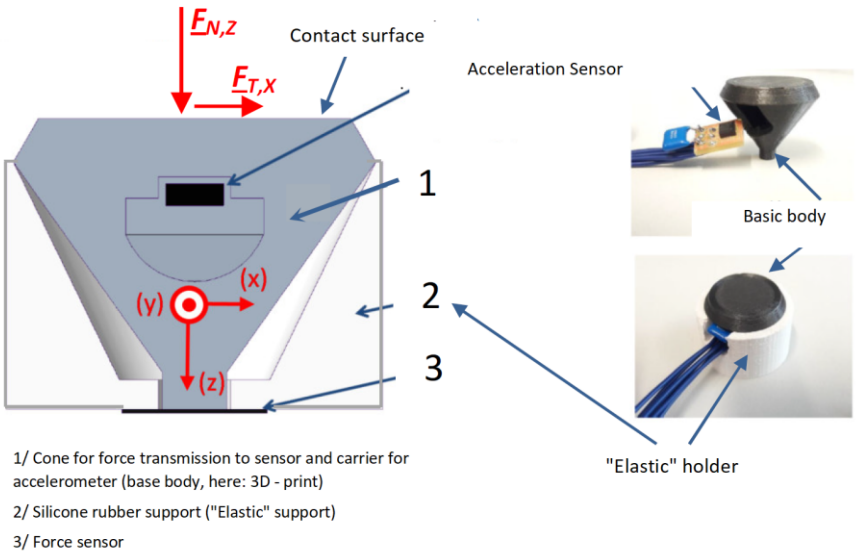

Figure: Exemplary design of the sensor with base body (cone-shaped) and sensors [Fig: Karlsruhe University of Applied Sciences].