THE GRIP-STABILISING-SENSOR 'AN EXAMPLE FOR INTEGRATING MINIATURIZED SENSORICS INTO A MYO-ELECTRIC HAND'

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The idea of using an autonomous controller to sense the grasping status of objects has long been the focal point of R&D but has failed until now due to measuring problems. Our concept relies on measuring forces that occur during grasping. The system differentiates between forces that make grasping possible and forces that could be responsible for slippage.

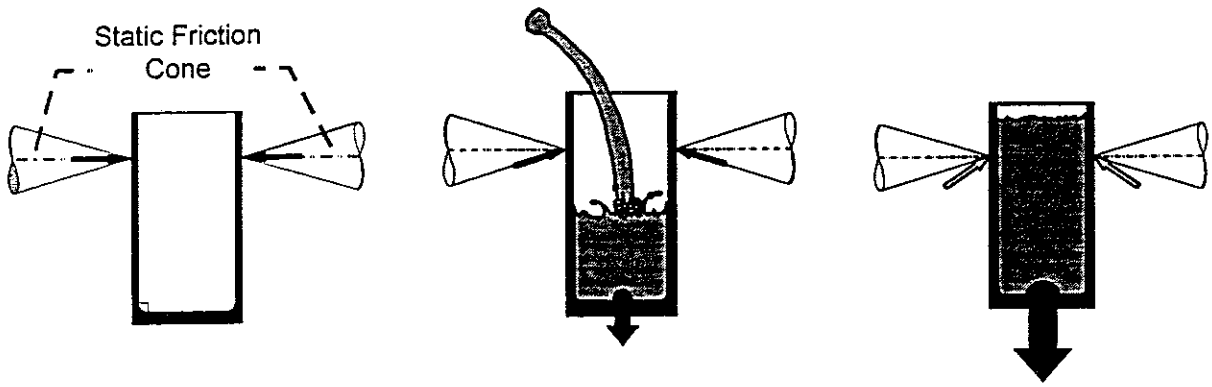

Figure 1: Forces at work

Above is a schematic representation of the forces at work. When the glass is empty the forces are horizontally aligned and are within the so-called static friction cone that represents the static friction sector. As long as the forces are within this cone a stable grasping status is maintained.

If a fluid is filled into the glass the angle of the resulting forces changes due to the weight of the fluid. The forces are no longer horizontally aligned.

As the weight increases the force vector moves outside of the static friction cone and therefore the force is no longer sufficient to hold the glass, allowing it to slip from the hand.

The only way to sustain a stable grasping status is to tighten one's grasp. The fluid's weight remains constant but grasp force increases. Tightening one's grasp moves the force vector back into the static friction cone area and a new balance is achieved as shown in Figure 2. This is the effect that takes place in the Electro Hand with SUVA-Sensor.

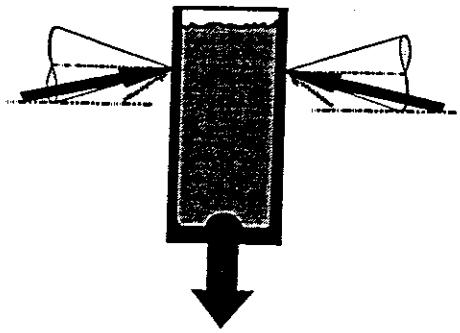

Figure 2: Grasp tightened to achieve balance

The SUVA-Sensor is mounted into the tip of the thumb. The Sensor itself is composed of three single sensors. Each of them arranged at 120° on a flexible foil board and on one made of black pressure sensitive material. For the system to function a second sensor is necessary - the bow sensor which principally consists of a strain gauge device. It is situated between thumb and finger group and measures the real grip force, i.e. the force with which the object (glass) is held. During the development of the sensor, special attention was given to optimal tuning between the sensor's mechanics and its sensitivity element. Further construction demands included: mechanical overload protection, protection from aggressive fluids (sweat), simple and cost-conscious assembly, longevity of function, modularity and ease of replacement. The Grip-Stabilising control function is integrated into the existing Dynamic Mode Control (DMC). As a result, the patient does not have to get accustomed to any new functions. The following three modes are available:

The Fully Automatic Mode needs one electrode for voluntary opening. Closing and grasp force build-up take place automatically - of advantage to high level amputees.

The Semi-Automatic Mode is controlled by two electrodes and is a unique function of the SUVA Hand. Opening and closing can be controlled at will by the patient and as soon as grasping occurs the system switches to automatic, i.e. the hand senses and controls the grasped object independently.

The Supervising Mode consists of a DMC with active Grasp-Stabilising-Control. This mode allows the patient the total freedom of voluntary grasping during which the Grasp-Stabilising-Control permanently checks the grasping and only takes action when unstable conditions are sensed.