Sensory Robot Gripper

Humans have the ability to use tools and to manipulate different kinds of objects without much effort. In order to ensure proper and optimal contact with the objects, they use their sense of touch. The sense of touch plays a major role also in exploration of the environment, as it provides information regarding shape of the objects, stiffness, texture or temperature. By rubbing the finger against the surface of an object, cracks, bumps or edges can be easily discovered. In order for robots to do similar tasks, they could use an artificial sense of touch. This may be regarded as an *artificial skin* that would provide the robot information about what it touches.

This project presents the development of an artificial sense of touch, in the form of a sensor to be mounted on different robotic fingers or grippers. It's characteristics are inspired by the properties of the human sense of touch (spatial resolution, sensitivity, dynamic range). In order to easily mount it on robotic fingers, it needs to be flexible and thin, but also needs to be easy to manufacture and affordable. Similar to the human sense of touch, our developed sensor addresses two sensing modalities: static stimuli, like pressure and dynamic stimuli, like gentle touch or slip. The layer for static stimuli is based on flexible piezoresistive rubbers and the layer for the dynamic stimuli is based on piezoelectric thin films.

The resulted prototype has a number of 512 tactile cells (or taxels), a spatial resolution of 3 square millimetres between them and can sense forces as low as 10 grams. Dedicated electronics are used to scan the sensor array and provide this data to a computer, where it can be visualized in the form of tactile images.

A few applications of the sensor are proposed as well. The first application considers a robot palpating a range of different rigid and soft objects (fruits, vegetables, household items). The robot is able to recognize what object was touched, only based on the tactile images provided by the sensor. This is done automatically because the robot has learned from previously touched objects. Another application deals with detecting grasping events like contact or slip. This is important because slip can cause objects to drop from the robot fingers. Other applications propose recognizing touched objects based on the contact shapes that can be seen in tactile images. Of course, many other applications are possible. A few of them include exploration of unknown objects, slippage avoidance, dexterous manipulation, reactive grasping or service robotics.