A New, Universal, Automatic Manipulation System for Fabrics

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Handling of flexible materials is one of the most challenging problems occurring in the field of manipulator robots. Because the shape and the properties of the textile product can widely vary, the construction of the gripper must also be different, in order to meet the various requirements.

The objective of our work is to design a new universal system to handle pieces of cut fabrics. This system should firstly have the ability to handle single and/or multiple panels of varying shapes and sizes without material distortion, deformation and/or folding, and should secondly enable an easy integration of the device with commercially available manipulator robots.

The automatic handling of flexible or soft sheet materials has been the focus of much research over the past twenty years, most of the work being focused on applications for the textile industry. So, first step of the work was to identify the various manipulation systems already and to list and compare the most reliable. The study showed that none of the devices is able to handle every type of textile materials, which means that each material should have its own specialized device to ensure precise and reliable handling. For these reasons, the design of a universal gripper will require to associate several manipulation devices in a compact shape to avoid gripper exchange during use.

The developed device (Figure 1), according to previous analysis, is a combination of three systems, i.e., pinch technology (mechanical system), vacuum technology (pneumatic system), and intrusion technology (mechanical system).

The functions of this automated manipulation device are:

- Taking a single layer from a stack of fabrics;
- Handling and transferring the fabric layer to the next station;
- Releasing the layer at defined spot.

Two types of validation of the elements constituting the gripper developed were successfully performed. First, a static validation was achieved using a bracket and second, a dynamic validation using a robot arm. These validation procedures have put in evidence the limits of our new gripper in terms of gripping capacity, compressed air consumption, characteristics and limitations of the flexible materials handled. An automated selection program of the gripper, depending on the material being handled, has also been developed and implemented.