DIFFERENT TYPES OF GRIPPERS

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Abstract

This paper is dedicated to different types of end parts of (effectors) of industrial robots and manipulators that can be movable arm terminated by the type of applications that are performed by the device. The variety of effector (gripper) also depends on the type of the manipulated object and the actual method of control effector. For a particular type of gripper is made simulation analysis of its activities.

Keywords: robot, effector, gripper, micro-gripper, manipulator.

1 Introduction

An important part of industrial robots and manipulators of the terminal, which is dependent on the application for which it is used. In some cases, the possibility that it is carried out the automatic exchange of the terminal equipment (effector) by type of operation. In this case it is necessary that such an exchange occurs within the shortest time and must, where possible, application, connection (electric, pneumatic, hydraulic, etc.).

Table 1 *Distribution effectors manipulated by applications using robots* [1]

Type of operation handling robots	Percentage usage
Handling operations	38 %
Welding	29 %
Assembly operations	10 %
Dosage (paints, adhesives, etc.)	4 %
Materials processing	2 %
Other operations	17 %

Industrial robot and the manipulator is carried out, it depends on the design, but in general, translational (sliding) and rotary movements. To arm the flange representing a link between the head and the grip manipulator arm. Part of the gripping head may include an actuator (APU), which controls arms (tentacles) effector. Electrical control may be (some kind of a suitable electric motor), by means of pneumatic or hydraulic retractable plunger. Object handling process, which means the part which is gripped by the tentacles effector into account that the process of grasping and manipulation carried out correctly. Therefore, they must take account of external conditions such as temperature, environmental cleanliness, security, the existence of other objects. In terms of handling properties of the object is mainly about this (the actual shape of the object, dimensions, weight, center of gravity location, surface, material). Further, in carrying out the handling operation has not be taken into account the characteristics of the movement, and the handling of tolerance.

By effector geometry and size of the gripping force depends percentage execution handling operations facility. The grip size of this force depends on the mass of the manipulated object itself and the coefficient of friction.

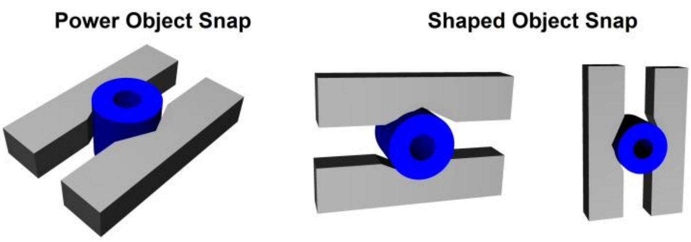

Fig. 1 *Power and shaped object snaps*

We recognize the power and grip shape, which are shown in the following figure 1. It is further possible their combination. Power grab envisaged clamping jaw strength, and largely depends on the coefficient of friction, which in contrast to the shaped gripping jaws are in a position where it is impossible shave when using lower grip strength. It is believed that the form-fitting gripping force to be developed by 25 % smaller as the force grip. A method of gripping a manipulated depends on the properties of products.

2 Division of effectors

Grippers, that is, end effectors can be classified according to the way in which they are in contact with the manipulated object. Most often in handling object used mechanical type effector.

Mechanical type of effector to be their capacity to control the use of different kinds of propulsion such as electric, pneumatic, hydraulic, as shown in Figure 2.

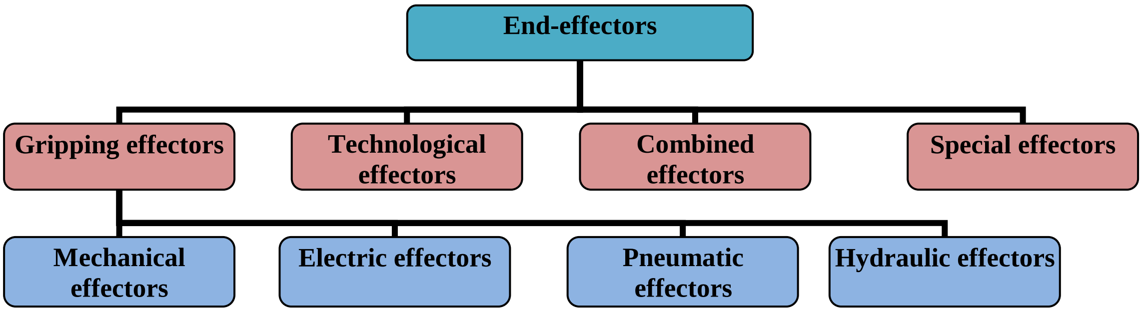

Fig. 2 *The distribution of end effectors*

The gripping effectors can be as mechanical grippers with rigid or flexible finger (jaw). Another possibility is the vacuum gripper (shown in Fig. 3), which are used in the vast majority of operations to handle the sheet of metal, glass objects, but can be used for the porous and non-uniform surfaces of objects transmitted. The act of grasping is done by creating a vacuum in the suction cup evacuated.

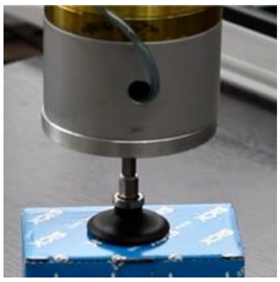

Fig. 3 *Vacuum suction gripper* [2]

Another type of electromagnetic grippers are used when handling objects that are made of ferromagnetic materials. The gripper may be passive, in which permanent magnets are used (with minor manipulation of objects) or active, wherein the electromagnet is employed, shown in Fig. 4.

Fig. 4 *Effector consists of an electromagnet* [3]

Technological effectors are designed for various technological operations such as welding, spraying, cutting, painting and so on.

Special effectors may be used for gripping and moving fabric, where the freezing is used. The process is carried out by spraying the fabric with water, followed by the laying of the effector to such a fabric there is a process of adhering, handling is subsequently carried out, e.g. relocation and ultimately release from effector fabric.

There is also a universal gripper who can grab different items and different shapes and sizes. The gripper is made of ground coffee in the latex package. Pick up an item is done by placing the gripper to the subject and it is deformed by its shape. Then comes the process air removal from the balloon, thereby strengthening occurs, then grasping the object shown in Fig. 5.

Fig. 5 *Universal gripper* [3]

Combined effectors associated only mentioned earlier, which is a combination of a certain type grip (ie handling process) and technological operations. In this way it is possible to achieve savings in terms of time, thus reducing production time duty cycle and can also achieve simplification work.

3 Miniaturization effectors

In practice, there are also applications where miniaturization is required robot system; it is particularly the positioning systems and grippers. This covers an area of mechatronics named as MEMS (Micro-Electro-Mechanical System). Difference compared to conventional robotic mechanism is that energy is spent to perform the requested movement while still also performed deformation work. In the design of micro-grippers apply flexible mechanisms and namely the flexible joints. The materials used for their production as metals (steel, aluminum, titanium), plastics, and also used other materials such as composite materials, and other elastomers. As the materials in the flexible mechanisms perform elastic deformation, so in the actual design of micro-gripper is used a solution based on the finite element method. [6]

The different types of micro-grippers are shown in Fig. 6.

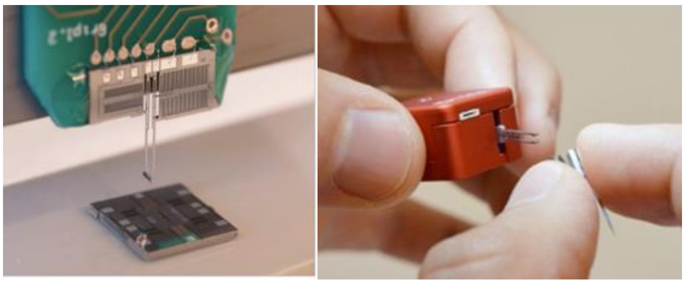

Fig. 6 *Universal grippers* [7, 8, 9]

4 FEM analysis of miniaturization gripper

Simulation analysis was performed micro-gripper, whose parameters have been Young’s modulus 1.65 GPa, Poisson ratio 0.34, density 930 kg/m^3 and Yield strength is 48 MPa. The dimensions of model mechanism without actuator mounting part are: width 80 mm, height of gripper 100 mm, thickness of flat material 3 mm, min. thickness of flexure joint 1 mm, distance of fingers 4 mm, material is polyamide PA2200. Micro-gripper is shown in Fig. 7. [10, 11, 12]

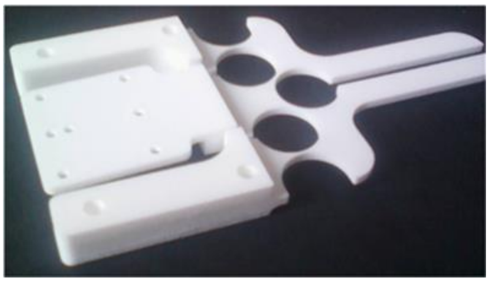

Fig. 7 *Universal grippers* [7, 8, 9]

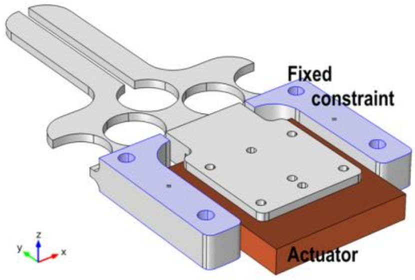

Fig. 8 *The gripper mechanism with the actuator* [10]

The Fig. 8 is a model of micro-gripper with actuator. There is shown a result of deformation in the Fig. 9, and a misses stress is shown in the Fig. 10.

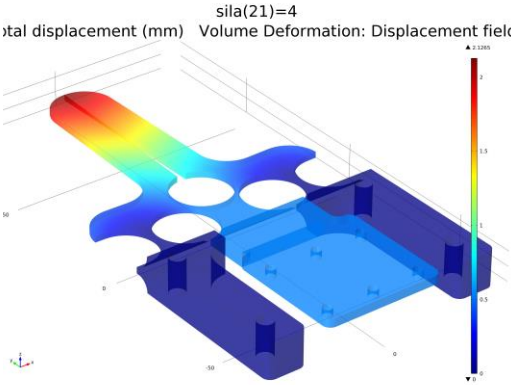

Fig. 9 *Deformation of micro-gripper* [10]

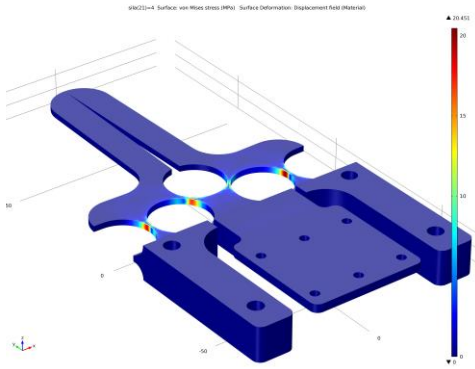

Fig. 10 *Distribution of stress in micro-gripper* [10]

The simulation was performed for the material parameters Young's modulus 2.62 GPa, Poisson ratio 0.34, density 1120 kg/m^3 and Yield strength is 103.65 MPa.

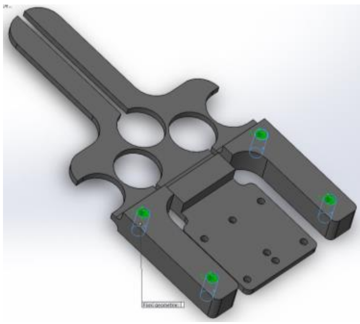

Fig. 11 *Fif of gripper*

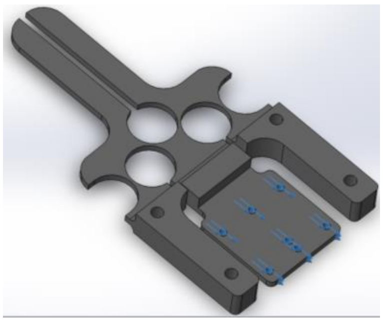

Fig. 12 *The force application*

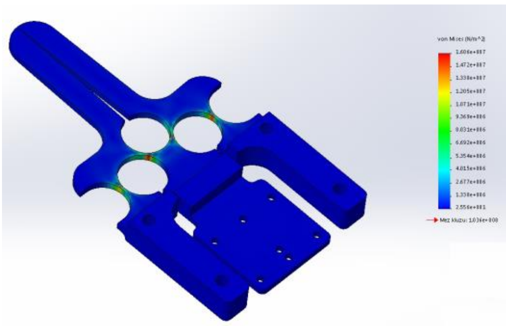

Fig. 13 *Misses stress for force 1 N*

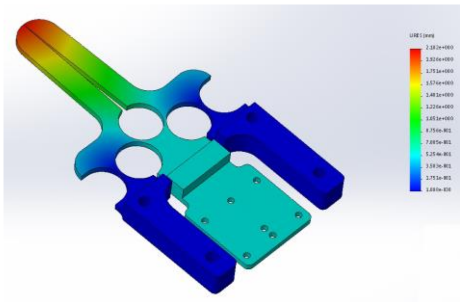

Fig. 14 *Deformation of gripper for force 1 N*

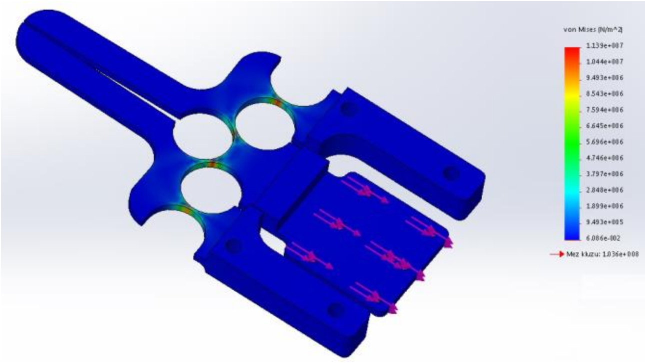

Fig. 15 *Misses stress for force 0.5 N*

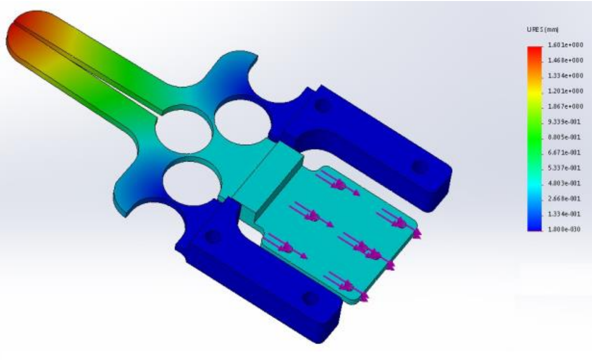

Fig. 16 *Deformation of gripper for force 0.5 N*

5 Conclusion

This post discusses the different types of grippers which are end-effectors for their use for different types of applications and their control. It is also mentioned gripper and miniaturization which represents the area of mechatronics abbreviated to MEMS. FEM analysis is performed and comparing it to a specific type of micro-gripper. The simulation was carried out for different sizes of the load force. The deformation of the different materials was the value of 2.1 mm. The difference between misses stress is the value of 4.39 MPa due to the use of materials with different parameters of Young's modulus, density and Yield strength.

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