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TENSOSENSORS AS A MEANS OF ROBOT SENSIBILITY

The creation of physical equivalents of human sense organs is one of the most difficult problems facing the specialists in robotics and automation of production processes.

The created sensors and systems reacting to external influences can turn industrial robots, which while acting purely mechanically, into machines that have the ability to adapt, able to independently respond to environmental changes and make simple decisions.

The need to use operational information often appears when the robot is dealing with objects that are not oriented in space in various sizes and shapes, with fragile articles that can not be strongly compressed, but can not be dropped, and also need to be moved from place to place and so on.

In order to perform this function robots need a tens sensor systems. They are sensory devices that provide the measurement of the components of the force vector and the moment vector of the forces developed by the robot in the process of interacting with the product in the projection onto a certain coordinate system. Such systems are built on the basis of tens sensors.

The principle of the tens sensors is very simple; it is based on the dependence of the electrical resistance of a metal wire on its length and cross-sectional area. It is such that when the wire is stretched, its resistance increases, since the length increases and the cross section decreases. A tens sensor is a very thin wire, repeatedly bent to increase the length, or a thin foil, which are glued to the surface of the test piece or to the elastic plate of the torque sensor. When the part (plate) is bent, the length of the wire (foil) increases, which leads to an increase in the resistance in the electrical circuit into which the tens sensor is connected. Modern electronic technology allows recording the slightest changes in electrical voltage and current caused by a change in resistance, and, accordingly, changes in deformation of the tens sensor.

One of the most common tasks for robots in production is the articulation of parts. When a robot needs to connect two bodies or insert one into another, for example: a cylinder into a circular hole, even if there is a gap between them, and therefore a problem appears, since there is always an error in the relative positioning and orientation of the mating parts, due to for example the angular skew, or the movement of the cylinder from the mouth of the hole into the interior is difficult, or the parts generally become wedged, as is usually the case with automated assembly, with the help of a non-sensed robot.

If the positioning errors of the parts prove to be more than admissible, the adaptive robot of the stress-strain sensing system knows the direction of the action of the forces arising from the contact of the mating bodies, knows in which direction it is

necessary to move its gripping device with the part clamped in it, so that the reaction forces becomes zero or not exceed a predetermined value.

Basically, tens sensors are used for this purpose. They are installed between the last link of the robot and the gripping device or tool, in order to control the direction of movement of the manipulator arm; or on fingers, in the place of direct contact with the detail, in order to control the capture of the object and its strength.

The robot with a tens sensor system leads the cylinder exactly to the mouth, then, after determining the direction of the center of the hole after contact with the reaction forces, begins to move the cylinder toward it, not tearing the contact, gradually leveling and inserting it inward until the assembly is absolutely completed. The ability of a sensitized robot to determine the direction to the center after the contact of the cylinder with the usually wider inlet part of the hole makes it possible to almost 10 times reduce the requirements for the positioning error and the orientation of the assembled parts.

The tens sensors used for such tasks must have a high sensitivity to deformation, therefore, the best option is thin-film or foil strain gauges. Such sensors have a lattice of rectangular cross section with a very large ratio of width to height. And due to the large ratio of the perimeter of the section of the flat strip to the area of cross section, the susceptibility to deformation and the accuracy of its measurement improve. Due to the increased cross-section of the ends of the foil and foil grilles, the reliability of soldering (or welding) of the sensor leads increases. Also, due to the large contact area of the conductive strips of the sensor with the component, good heat transfer conditions are ensured.

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