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DESIGNING THE TWO-WAY SLIP SENSOR

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ABSTRACT The quality of the prehension is given by the degree of sliding between the prehenst object and the prehensor slides. The paper presents the structure of a roller sliding sensor. The emphasis on the slip is highlighted by force sensors. As a result of the sliding of an object in prehensor, the rollers rotate by acting on the force sensor attached to the prehensor. The command size generated by the controller acts on the action element that will gather the object in prehensor. This attraction of the object is limited by the reference magnitude of the force that acts on the object. The roles can be replaced with spheres that allow you to determine the sliding in two directions

KEYWORDS : robotics, sensors, slipping, gripper.

INTRODUCTION

The object mobility, as part of the grippers represents all important parameter for gripping evaluation. As it is known, more impose the gripping quality factors, namely: material nature of the object, that it follows to be manipulated; the weight of the gripped object; the displacement velocity from the kinematics pairs of the robot; the answering velocity and the efficiency of the braking systems that equip the command system; the type of slipping detection from the grippers.

The primary clement, that can sense the slip, has an important place as part of a sensor. The most known slipping detectors are those with rollers and spheres [4], [5]. The slipping sensors with rollers can only determine the slipping of the gripped object on the rotation axis of the rollers, so on one direction, as part of a gripper, there can be used spheres of rollers. The paper presents a slipping sensor with rollers (with spheres), with rollers and with tensometer detection of the slipping, that allows the slipping detection on two directions as part of the gripper.

The object mobility will induce the rotation or the rolling of the roller or of the sphere, with out slipping. The amplitude of the motion defines the slipping proportion of the object in the gripper [3], [5].
The use of tensometer detection at slipping was possible thanks to the control and adaptation techniques of force sensor. The utilization or the tension sensor (for the emphasizing of the slipping) offers) a great sensitiveness to the dipping, that imposes their utilization.

CONSTRUCTION OF THE SLIPPING SENSOR

In specialists opinion, the gripper of: robot must be easily programmed so that to emphasizes the object slip and to prevent this slip. The ability of the robot gripper achieved by rapid programming - depends mainly on the sensory system that equips the gripper. The emphasis of the slip and its quality allow a more ef1icient gripping of the: objects that arc' manipulated. Sensitiveness has an important role for a slipping sensor.

The use of the force sensors for the achievement of slipping sensors cancontribute to the obtaining of a high Figure 1 presents the kinematics scheme of a slipping sensor with tensometer detection of the slip [4], [5]. The main elements of the slipping sensor with detection tensometer - that are presented by this paper - are (fig. 1): 1 - the cylindrical rolls, 2 -the shafts equipped with driving forks; 3 - the elastic clement oh the stress sensor; 4 -the fixing element of the stress snsor; 5 -the gripped object; TER 1 ... TER4 -the tensometers.

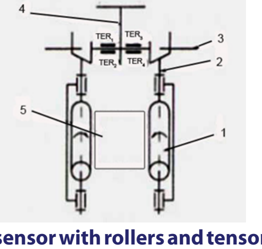

Figure 1: Slipping sensor with rollers and tensometer diction

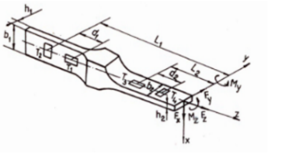

Figure 2: Sensitive element for the displacement determination on two direction

When the gripped object slips, it takes place the rotation of the rolls 1 that determines the shafts 2 rotation. According to this, the terminal forks stress the elastic element J of the stress sensor, that is fixed in the support 4. The stress sensor has an elastic element - an elastic segment - on what four elect resistive transducers TER_1 …TER_4 are soldered.

The stress sensor has an elastic element - an elastic segment - on what four electoresistive transducers TER_1...TER_2 are soldered, the four transducers achieve the Wheatstone (fig. 3). An important role in the frame of the slipping sensor presented in fig. 1 - it is represented by the sensitive element 3 of the tension sensor. Figure 2 presents the constructive form of the sensitive element that allows slipping determination on two directions of the gripped object, [1], [4] The elecroresistive transducers of the sensor presented in fig. 2, are grouted in two tensometer semi bridges, being sensible to the bending stress of the elastic elements. The determining of the connection matrix is relatively simple, the elastic structure being presented as a determined static structure fixed at one end.ihe1formal tensions determined by -TER are:

$$\varepsilon_1 = \frac{F_y l_1}{W_z} \cdot 1 = \frac{6 l_1 F_y}{b_1 h_1^2} \quad \varepsilon_2 = \frac{F_x l_2}{W_z} \cdot 2 = \frac{6 l_2 F_x}{b_2 h_2^2} \quad (1)$$

The relation between the relative elongation of the elastic elements given by TER and the interaction stress, it is achieved by means of the connection matrix:

$$\begin{bmatrix} \varepsilon_1 \\ \varepsilon \end{bmatrix} = \frac{6}{E} \begin{bmatrix} 0 & \frac{l_1}{b_1 h_1^2} \\ \frac{l_2}{b_2 h_2^2} & 0 \end{bmatrix} \begin{bmatrix} F_x \\ F_y \end{bmatrix} \quad (2)$$

This sensor is also stressed by moment after the X and Y-axis. The answers of the sensor are correct if these moments are not interfere; but in a contrary case, there can be distinguished the effects of the force F_y comparatively with those of the M_x and the effects of the F_y comparatively with those of M_x. The relative elongations of TER, determined by the components M_y or M_x, are mainly equal regardless of the distance from the application point of the force; the elongation due to the components F_x or F_y are different. The effect detection assumes a series of mathematical calculations of the signals frOil1 the tensometer bridges. If we extract the values of ε_1 and ε_3 from the relations of relative elongations of the tensometers, it can be written:

$$\varepsilon_1 - \varepsilon_3 = \frac{l}{E} \frac{6 d_1}{b_1 h_1^2} F_y \quad (3)$$

respectively, the problem at the level of electrical signals becomes:

$$V_1 - V_3 \approx \frac{l}{E}\frac{6d_1}{b_1h_1^2}F_y \quad V_1 - V_3 \approx \frac{l}{E}\frac{6d_1}{b_1h_1^2}F_y \quad \frac{V_1}{m_x} \approx V_1 - \frac{V_3}{F_y} \qquad (4)$$

TENSOMETERS CONNECTING IN A WHEATSTONE BRIDGE

Figure 3 presents the connection bridge of the tensometers. The bending force - that stresses the elastic element - causes the structure bending sensitive of these. The following relation gives the bending moment value Mx is given by the flowing relation:

$$M_x = \frac{VW}{K}\left[\frac{\Delta V_0}{V}\right] \qquad (5)$$

The change of the output tension ΔV0 proportional to the stress of the elastic element of the sensor. In this way the slip can by written:

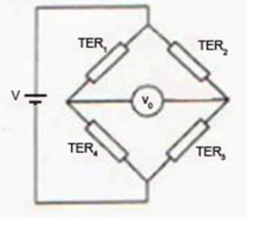

Figure 3: the Wheatstone bridge

$$\Delta V_0 = \frac{VK}{2}\left(\frac{N}{l}\right)(1+\mu), \qquad (6)$$

$$Stres = E \cdot Tension = E\frac{\Delta l}{l} \qquad (7)$$

The rotation (2) can be written:

$$\Delta V_0 = K \cdot Stress, \qquad (8)$$

where :µ - represents the Poisson ratio; Δl / l - the elongation of the elastic element of the sensor. The equation (7) shows that the output tension change ΔV0 is bigger than the basic tension.

The slipping sensor, by its construction, allows the slip detection in both rotation senses of the rolls (spheres).

CONCLUSIONS

The slip sensor allows you to cause an object to slip in a prehensor during handling. The sensor uses the principle of a force sensor. By replacing spool rollers, two-way sliding can be achieved. During sliding, the Wheatstone deck is unbalanced which, depending on the amplitude of the slip, requires the action of the prehensor

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