TACTILE SENSORS OF ROBOT MANIPULATOR

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Abstract: *for interaction with objects and the environment, robots are equipped with a various type of sensors. It is like human senses. A tactile sensor gives the robot the ability to respond to the forces or contacts that arise between the sensor and the object. It can also determine the size and shape. All these possibilities are very useful for robots in the industry, they make production more qualitative and accurate.*
Keywords: *manipulator, sensors, tactile sensors, ultrasonic sensors, human tactile sensation.*

Today, robots have penetrated almost all areas of our activity. Industry, scientific research, energy, medicine, entertainment, military operations and even outer space - modern automatic or remotely controlled mechanisms are used very widely and even gradually replace human labour. Nowadays more and more automatic applications have been observed in agriculture. In developed countries, handling robots have already been widely used in food, fertilizers and other industry [1].

The development of robots moves in several directions: the improvement of mechanisms and drives, the improvement of algorithms, the introduction of self-learning control systems (weak artificial intelligence). In the modern industry conditions, special attention is paid to minimizing the risk of occupational injuries, and in this respect an important role is played by the robot manipulator. It is able to replace a person when performing many operations. Not so long ago, for these purposes, various armor suits and spacesuits were used, but their use also implied the direct participation of the worker performing certain industrial operations. The development of cybernetic science makes it possible to reduce the importance of direct human participation in the certain tasks solution. In certain industries, various robots are used, equipped with manipulators to perform a variety of functions. The most important design feature of the robot is the ability to perform work in conditions that are inaccessible to humans in principle. The development of robots capable of operating in unstructured environments or intended to substitute for man in hazardous or inaccessible environments, demands the implementation of sophisticated sensory capabilities, far beyond those available today. Cues from the human tactile sensing system can be helpful in bringing the level of tactile sensitivity and acuity that humans possess, to the manipulators and to other human/machine interfaces. In addition, industrial robots and manipulators can significantly increase the overall level of quality and complexity of manufactured products, as well as reduce the cost of manufacturing it. Moreover, thanks to the use of such machines, the productivity of labour in the enterprise increases substantially.

Sensors and actuators are an integral part of the manipulator. They function as converters, devices through which the planning, coordination and management systems interact at a high level with the hardware components that make up the working cell.

Human tactile sensation was the starting point for tactile perception of robot sensors in robotics. Some design parameters are discussed later for robotic tactile sensors. However, although the human tactile sensation was a reference point for a robotic tactile sensation, the way to determine the tactile sensitivity is determined in robotics. Most often, a robotic tactile sensation is associated with the detection and measurement of forces only in a specific area. The tactile or cutaneous sensation is associated with the detection and measurement of contact parameters [2].

Tactile sensors directly realize the bionic function of touch and are designed for geometric recognition of the environment during contact interaction.

Tactile sensing systems of the robot solve the following main tasks: detection of the instrument's contact with the object, determination of coordinates and area of the contact spot, measurement of the grip compression force, determination of the orientation of the object in the gripper, detection of slippage and displacement measurement, recognition of objects by their tactile image. As follows from the list of basic tasks, tactile devices realize either the simplest functions (such as tangency), or more complex (analysis of data arrays). The same applies to sensors: in the first case, they are built using the simplest primary converters, and in the second - based on complex information devices that require the use of recognition algorithms. Structurally, the tactile system is a combination of hardware and software modules [3].

Acoustic ultrasonic sensing is yet another technology that has been used for the development of tactile sensors. Ultrasonic sensors consist of a microphone (allows to fix sound, voice and noise), a rangefinder, which is a sensor that measures the distance to the nearest objects and other ultrasonic sensors. Ultrasound is

widely used in almost all branches of robotics. The operation of the ultrasonic sensor is based on the principle of echolocation. Here's how it works: Ultrasonic Sensors generate an ultrasonic wave by means of a piezo element in the front part of the housing. The wave spreads in the atmosphere in accordance with the laws of physics. The same piezo element can detect and measure the sound reflected by an object. Therefore, it functions alternately as sender and receiver (transceiver). Microphones are known to be useful for detecting surface noise that occurs at the onset of motion and during slip. The sensor is reported to be very effective in detecting slip and surface roughness during movement. Tactile sensors based on ultrasonic approach have fast dynamic response and good force resolution [4].

Since the main trend in the development of tactile sensors is the reproduction of the tactile properties of human skin. This tendency is most satisfied by tactile devices of matrix type, since each cell of the matrix, which is a microelectronic force (or strain) sensor, provides specific information, and all together allow one to form a holistic view of the form of the object. The design and technological development of tactile sensors are developing quite actively. Robots increasingly have to interact with objects, the capture of which must mimic the human.

To date, robots can very well identify similar textures, it is not yet able to find out what a person needs. Scientists say that the technology of the touch robot can be used in prostheses or to assist companies where specialists are needed to evaluate consumer goods or even human skin.

References

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CAMERAS IN ROBOTICS

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Abstract: *this article describes the device of analogue cameras and the process of image visualization. This paper describes the principles of analogue cameras and image visualization. The authors of the article consider various kinds of getting information. The special attention is given to such a visual sensor as an analogue camera. The principles of different cameras operation were described. Matrix CCD and CMOS were studied.*

Keywords: *analogue camera, robotics, image acquisition, image processing, CCD, CMOS, machine vision.*

Every day more and more modern advanced robots are invented, «but engineers have not come to a consensus on what the vision of robots should be» [1]. In this article we discussed vision of robots and cameras. To provide robots with good interaction with the environment, new, more advanced cameras are being developed which can almost instantly read the image and transfer it to robot's processor. Cameras have been used in robotics for a long time. The earliest analogue cameras were on magnetic tape, recording analog signals on cassettes for video tapes. In 2006, digital recording became common: the tape was replaced with storage media, such as mini-HD, micro-DVD, internal flash memory and SD cards. Analogue cameras have some advantages over other sensors, they can broadcast a video signal at a great distance, easy to install on a robot, reliable, the quality of shooting does not depend on the failures in the robot processor. For example, the Mars rover Curiosity «uses three cameras: MARDI, MAHLI and MastCam» [2]. Analogue cameras also have