INDUSTRIAL ROBOTS IN FMS

Part I

An industrial robot is a reprogrammable, multi-functional manipulator designed to move materials, parts or tools through variable programmed movement to accept a variety of tasks.

It is important to note that robot applications and programming methods have progressed far beyond merely handling components since their controllers and sensors have developed the capability to communicate with other intelligent devices. Sensors particularly have been the focus of much development in recent years.

Robots are able to provide information not only about their arm position but also about the part being handled and about the gripper or more complex robot tool. They are capable of seeing, hearing, smelting, detecting and analysing force, torque, heat, pressure, colour and other environmental changes or conditions.

Sensors can provide information about the presence of a part in a buffer store, in a robot tool or in the chuck of a lathe, and they can, for example, interact with the robot controller and modify the programmed sequence in real time. More sophisticated sensors such as force and torque sensors, send stress measurement values. Vision systems use special purpose image processors and image data base which are interfaced with the control program of the arm.

Distributed sensory feedback processing makes robots more intelligent, more reliable and more flexible, and these important trends are not to be ignored when designing the FMS.

It is necessary to stress that industrial robots have a very wide range of potential applications in FMS because they are reprogrammable flexible devices themselves. The increasing power of their sensory feedback processing system allows them to work at a high level of intelligence. However, robots are not yet capable of solving most materials handling assembly or inspection tasks in FMS. A relatively low proportion of robots are capable of communicating at a high level with other robots and computers and their sensory systems are usually expensive compared with their performance.

Part II

The major application area of industrial robots include pick and place type of operations.

An example can be given of a robot which ensures smooth product flow in an FMS.

The cell, which includes two drilling machines, was developed to produce 300,000 magnet housings a year on a three-shift opera­tion. It was, therefore, essential to maintain a smooth flow of components into, through and out of the cell. To achieve this product flow the robot was fitted with a pneumatically operated triple gripper to handle raw material, part machined and fully fin­ished components in turn.

Having a repeatability accuracy of 0.25 mm at maximum speed, the robot is able to maintain a handling transfer and location program whereby one magnet housing is picked by the triple gripper and moved to the first twin chuck machine. The empty grippers grasp a component from each chuck of the machine, remove the part and advance one step to load the chucks again.

A finished part is thus removed from the machine, a part-machined component is progressed to the second chuck, and a new component is loaded into chuck one. The robot returns to the unload pallet and deposits the finished part. It then repeats the handling sequence for the second machine, and so on, according to the computer program.

15. Find in the text examples describing the main possibilities of industrial robots. What are the functions of robots in FMS?

16. Give a short summary of the text

UNIT 4. CONTROL SYSTEM. SOFTWARE

1. Read the following terms and memorize their meaning.

**chip** *п —* кристал; чип; мікросхема; інтегральна схема

**computer** *п —* комп'ютер; **supercomputer**— супер ЕОМ; **mini-supercomputer** — суперміні ЕОМ; **mainframe computer** - велика ЕОМ

**cost savings** — зниження витрат (виробництва), економія витрат

**data** *п р1* от **datum** — (вихідні) дані; факти, інформація; **d. base** — база даних

**facility** *п* —пристрій; засіб; устаткування

**hardware** *п —* апаратне устаткування (ЕОМ)

**layout** *п. —* схема розташування; планування; схема організації робіт; програма

**manage** *v —* управляти, керувати; **management** n — управління (планування, контроль)

**monitor** *v —* контролювати; керувати; **monitoring** n – контроль

**in real-time** — у реальному масштабі часу

**simulate** v — моделювати; **simulation** *п —* моделювання

**software** *п —* програмне (математичне) забезпечення

2. Read the following word combinations and translate them.

1. cost savings; equipment utilization; cost estimator; error conditions; production schedule; actual and forecast performances; plant management
2. to rearrange production processes for maximum cost savings; to enable engineers to make changes or corrections; to control the flow of information; to determine the exact physical location in the system; to perform the correct sequence of operations; to forecast system needs at due time; to compare actual and forecast performances

3. Read the text and give a short characteristic of control system software.

CONTROL SYSTEM

Computers have revolutionized manufacturing. They have given manufacturing engineers control over events in the factory. With this information, processes can be reorganized for maximum efficiency and production steps can be rearranged for maximum cost savings. You can know what is occurring on the floor now.

Because of computers tasks are done more quickly and accurately. It enables engineers to make changes or corrections that will utilize equipment and people optimally.

An important quality of computers is that they are flexible. Change the program and you have a "new computer".

**Software.** Computers cannot run without software; that is, without some instructions on what to do. Software controls the flow of information in a computer system. The software makes a computer a specific device — a calculator, a designer, a programmer, a cost estimator, an expert.

Simulation software is another type of software, which is now becoming quite popular. This type of software lets you see your proposed factory layout at work "on paper".

Simulation software helps in the design and development of automated work cells, manufacturing systems and factories such as FMS.

An FMS without software is not flexible, has little use in manufacturing and is not even a system.

The main problems that FMS software should solve are as follows:

Keep track1 of the materials being manufactured, determine the exact physical location in the system and perform the correct sequence of operations.

Prevent the different operations from interfering with2 each other.

Determine error conditions and minimize their impact on the system.

Keep management informed on parts, production, part programming, system status.

Determine the best production schedule to meet due data and maximize machine utilization.

Forecast system needs at due time—fixtures, tools, lubricants and coolants.

Direct in real-time the operations of people in charge of3 the above facilities. Compare actual and forecast performances.

Inform the plant management with the required data from FMS, for production planning and control, accounting and reporting.

Thus, the FMS control system manages the total combination of devices in the system that contributes to the automatic operation of the production process. This includes the machine-tool controllers, the material handling system, the system monitoring devices, the system communications, and finally the system computer. Computer software supplies all the control management and monitoring functions that enable the system to achieve high utilization.

The control system is easily visualized4 by considering all the elements of the system in a structured arrangement according to its function. This structure and how each function of the structure relates to the overall system performance will be discussed later.

Vocabulary notes:

**1. keep track (of)…** — стежити за (перебігом, розвитком чого-н.)

**2. interfere with...**— заважати, бути перешкодою

**3. people in charge of smth...** — відповідальні за що-н.

**4. visualize** — уявляти

4. Find in the text English equivalents of the following Ukrainian words and word combinations.

відбуватися (мати місце); програмне забезпечення; моделювання; вирішувати проблему; виконувати належну послідовність операцій; графік основного виробничого процесу; у свій час (своєчасно); необхідні дані; звітність; сприяти автоматизації виробничого процесу; автоматизована транспортна система; функції управління та контролю

5. Complete the following sentences from the text:

1. It is necessary to say that one of the important features of computers is that ... . 2. The significance of simulation software is that ... . 3. As is known FMS software should solve a lot of problems, for example ... . 4. Summing it up, one must say that the FMS control system ... . 5. The task of FMS computer software is to ... . 6. It is necessary to say that we can understand the FMS control system easily if we consider ... .

6. Answer the following questions:

1. What is the task of FMS computer software? 2. What problems should FMS software solve? 3. What is the role of computers in FMS? 4. What can you say about simulation software? 5. What does the FMS control system manage?

7. Make a short summary of the text.