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METHODS OF ON-LINE AND OFF-LINE PROGRAMMING IN THE PRODUCTION PROCESS

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МЕТОДИ ОН-ЛАЙН І ОФЛАЙН ПРОГРАМУВАННЯ У ПРОЦЕСІ ВИРОБНИЦТВА

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МЕТОДЫ ОНЛАЙН И ОФЛАЙН ПРОГРАММИРОВАНИЯ В ПРОЦЕССЕ ПРОИЗВОДСТВА

In conditions of strict monitoring of costs it is necessary to verify the possibilities of planning systems and find innovative and successful solutions. Requirements for changing technological or organizational issues already brings with it certain risks. Simulation programs help us to limit these risks by enabling working environment model and simulate the consequences of different decisions. The result is a greater degree of confidence that the proposed solution is to organize it properly even before proceeding to its implementation. Among the world-class companies is no that would not benefit from predictive technology as a standard management tool.

Keywords: *on-line, off-line, CAD, PTP.*
Fig.: 5. Bibl.: 6.

В умовах суворого моніторингу витрат необхідно перевірити можливості систем планування і знайти інноваційні та успішні рішення. Вимоги щодо змін технологічних або організаційних питань спонукають на певні ризики. Програми-симулятори допомагають обмежити ці ризики, дозволяючи робочому середовищу моделювати і симулювати наслідки різних рішень. Результатом є більш високий рівень впевненості в запропонованому рішенні організувати його належним чином, навіть перш ніж приступити до його реалізації.

Ключові слова*: он-лайн, офлайн, CAD, PTP.*
Рис.: 5. Бібл.: 6.

В условиях строгого мониторинга расходов необходимо проверить возможности систем планирования и найти инновационные и успешные решения. Требования об изменениях технологических или организационных вопросов побуждают определенных рисков. Программы-симуляторы помогают ограничить эти риски, позволяя рабочей среде моделировать и имитировать последствия различных решений. Результатом является более высокий уровень уверенности в предложенном решении организовать его должным образом, даже прежде чем приступить к его реализации.

Ключевые слова: *онлайн, офлайн, CAD, PTP.*
Рис.: 5. Библ.: 6.

Introduction. Robot it operates according to the program prepared in advance. The sequence is defined as commands that lead to the execution requested. Robot programming is defined as the compilation and production program on the basis of constructed algorithm.

According approach to program design divided programming:

– On-line programming (programming with the robot through the pendant).
– Off-line programming (programming outside of the robot on the PC).

1. On-line programming. Online programming is performed directly by the operator via the robot-guided handling required points. The robot is controlled manually from the panel programming, guidance to individual points that are registered in the control system memory. As a second step follows the logic of programming management Gripper and peripherals. This section also enter the speed of movement of each robot path. The advantage of this programming will work in the real environment while we perform programming and functional test. Procedures of on-line illustrated in pic. 1.

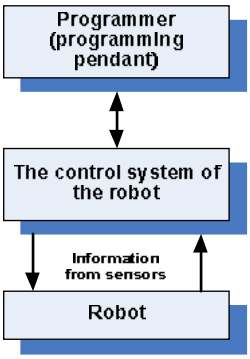

Fig. 1. Process on-line robot programming

Nowadays, modern programming units are already built PC based. The controls are easy through function keys. The display has the ability to view multiple windows for visual display robot functions or technology program and its parameters. Built-in color display allows the operator directly through programmed I / O their activities. Some programming unit (Comau Robotics) are capable of transmitting data to the control system of wireless technologies, pic. 2.

Fig. 2. Programmer OTC Daihen robots and Comau Robotics

The disadvantage of online programming is quite a long time, the physical demands of the programmer when programming complex handling movements and long cycles. Another disadvantage is that the whole body is losing on the production, only in rare cases during the programming of the robot some devices may work or limited work.

Programming method of Play-back. In the case of simple inexpensive device on the precision of the movement, for example, robots for spraying, it is first of all the whole technological movement of arm robot driven by an operator manually records this movement control unit that is entered in the data memory of the position and orientation of 20ms every spray gun. When you run the automatic operation of the robot plays the recorded activity. Repeat the motion path is not entirely accurate, because the robot arm is in the repetition of the movement in the opposite direction than in the lead after the desired track wear. Tolerances defined in clearance and the flexibility of the structure have the opposite orientation. Another disadvantage of this method is the presence of the operator, which can make big problems, however, in small spaces creating a program is fast.

Teach-in programming. When programming a progressive learning robot arm using the buttons on the operator being gradually is the counterpart to the individual positions (in which it is to be transferred in any action, such as grasping, or tool), and the coordinates of these exactly adjusted positions, and orientation of the tool are stored in memory, pic. 3.

Fig. 3. Teach-in programming

In automatic operation, the robot then uses the data from the memory. The important points and the orientation of the tool in the following sections are for the teach-in automatically entered according to the manual. Other features of the robot are programmed using a PC or directly in the programming of the unit. A description of the features of the selected programming unit-counterpart is in pic. 4.

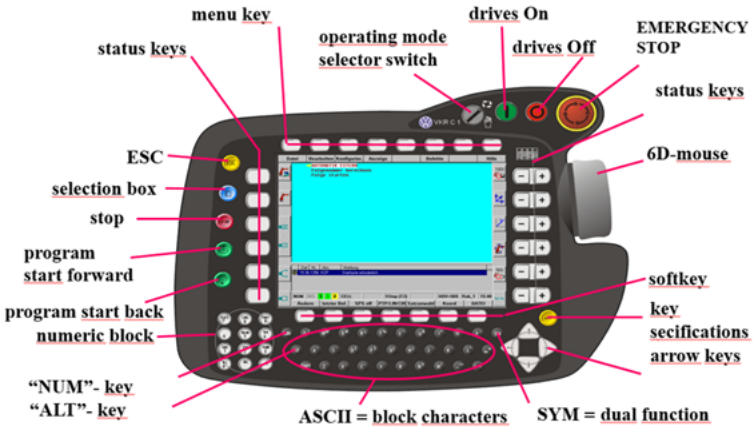

Fig. 4. Programming unit - pendant for robot programming

Programming units enable the monitoring I / O and system information, writing programs in the editor, allow access to production data (average cycle time, the number of production cycles, etc.), setting operating parameters for example welding directly from the counterpart modern units have analysis functions for optimizing their robot.

2. Off-line programming. Off-line programming is carried out in a computer model of a real production cell including its surroundings in 3D presentation. Programming is done in advance, the system allows you to directly import objects from different CAD systems. The disadvantage is that this approach requires additional investment outside the robot, but on the other hand, the results, for example or robot to cover all devices and so on are known before physical implementation. Off-line programming of the robot is based on a computer model of production cells, pic. 5.

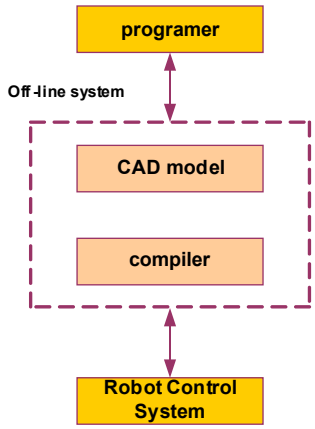

Fig. 5. Procedure for off-line programming of robots

Typically used non-standard programming languages, which requires the browser to create a program for a particular robot. When off-line programming is preferred 3D modeling. Each virtual robot model has three parts: the model manipulator, controller and model program. Manipulator model is a 3D solid model, the controller includes a real robot controller and program specifies the role that the robot will perform. For other devices, such as NC machines, plant, truck etc., it can be formed as a model of the robot. Communication between the elements of the model conforming connections between models. Data exchange between the models of the production system and CAD / CAM supported standard STEP. The library includes models of robots, NC machines, peripherals, which are then imported into the simulation model. The simulation can be performed in real time in the 3D simulation. Evaluation model is implemented based on the simulation results. After reaching the optimal

alternative program it is translated into the language of the robot and imported into the real system.

Off-line programming allows the use of interpolation PTP, LIN and CIRC. Off-line programming allows detailed 3D simulation systems which can detect the collision situation and verify changes in the future to test the feasibility of handling points. This allows users to search not only the optimum deployment of equipment in a production cell, as well as optimum handling their operating cycles. Many off-line programming systems follow a realistic timing of the operation of the robot, encourage the selection of appropriate tools or the parameters of the technological process. An important task to get the real program is to make a "true" model of the physical system and its critical properties and behavior.

Off-line preparation programs is further achieved by:

- minimizing the time of disclosure,
- maximizes the producibility,
- reduce the errors in the program,
- reveal the feasible and dangerous situations.

Graphic presentation of the "real" programming panel gives the possibility of programming online, which is used as a training tool for teaching programming online. Systems off-line programming have an event table, which is an ideal tool for verifying the program structure, logic functions and I / O status. Each method has its advantages and disadvantages. Taking advantage of both these methods of programming techniques, we can achieve optimal solutions. Generally, such programming is referred to as hybrid. Robot program consists mainly of two parts: the location (position), the program logic (communication, calculations). The program logic can be effectively developed off-line because there are available effective debugging and simulation capabilities. The greater part of the movement commands can be generated off-line again using data from CAD interaction with the programmer. Movement commands to locate places on a workpiece robot cells are then programmed online. In this way, they may take advantage of both methods. Use hybrid programming is very convenient way to increase flexibility in production and thereby increases the effect of robotic production.

3. Simulation in virtual reality. Simulation is experimenting with computer models of real production system in order to optimize the production. It can be used when synchronizing flows. The simulation experiment with a model of the production system on the computer. When designing and operating complex logistics and production systems raises a number of problems and risks. A large number of variants and the complexity of evaluation do not give a classical instrument in the designer or responsible at the choice of the optimal solution. This is the so-called local optimization effect, which occurs not only in the operation of logistics and production systems, but also in the project. This problem is particularly difficult when we realize that the optimization we should talk not only on the production system or workshop, but that should be followed in terms of optimization of corporate objectives. Normally it happens that these systems projects based on the following criteria and narrow view. If the project is too expensive to make his adjustments so that it cannot implement. When the uncertainty of future production requirements, under time pressure, the limitations of funding and unavailability of modern projection tools can be difficult to talk about the overall optimization of the system parameters. It often happens after the project is already in the system are deficiencies that do not allow full use of all its possibilities. During operation, it is then necessary to solve the problems of additional adjustments to the system, which is usually associated with a further increase in costs. To solve the above problems is a very appropriate use of computer simulation. Simulation allows you to advance your "play" behavior of the system after the implementation of measures to look into the future and so in advance

"scavenge" any problems. As can be seen, the simulation is in many cases appropriate support tools for designers and for managers. Using simulations obtained senior official assurance that the job will be scheduled in a given time frame actually implemented, with animation during the manufacturing process can help illustrate clarify and better understand the process. It is thus possible to identify shortcomings production plan prior to its implementation. Computer simulation of production is actually "test manufacturing plant" in your computer that helps, for example, to study the effects of different management strategy.

Conclusion. Use simulation programs enable us to verify the system behavior under various conditions and detect the bottlenecks. Bottleneck becomes an element that disrupts the continuity of the production process and reasons for the stoppage or the extension of continuous production time. It may be a machine, a robot, conveyors, bins or human. Establish an adequate model of the production system and the implementation of the required number of simulation runs are obtained statistical indicators characterizing its behavior. Use 3D models simulating real situations is now applied in all industries. By introducing simulation programs in the industry reduces the time, minimize costs and deployment time administrative machinery in operation.

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