Industrial cyber-machines remote control method

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Abstract. The cyber-environment configuration is being transformed significantly today. The new approach advantage is to use cyber-machines (CM) united into the industrial net segments for multi-disciplinary product production. A set of CM is several times more efficient than a classical horizontal machine pool. The CM target orientation, which function in the self-regulating mode is provided with the master-system by remote control channels. There is a scheme proposed how to control the CM remotely to support the wide spreading technologies of address high level and low-level data exchange. The wide-spreading technology controls the CM group simultaneously. The address technology uses one time access to each CM. The high-level technology programs CM functional capabilities. The low-level technology controls the CM physical elements. The master-system allows for the provision production chains adaptive control and has some intellectual potential of the industrial development. An effective CM inter-operation interaction surely justifies the investment attractiveness of the material production sphere.

1. Introduction
The Industry 4.0 technological definition cybernetics base created a new problem of cyber-machines (CM) remote control deployed in an industrial company and working in groups in difficult conditions [1, 2]. To apply CM into a regulated production cycle is a promising approach of fantastic ideas in our real life when the product is manufactured in fully automated mode [3, 4].

The CM remote control is an inner company solution to provide administrating remote android systems which perform the production function of higher difficulty [5, 6]. The remote control mechanisms support day-by-day technological processes with protected protocols of tele-monitoring [7, 8].

The CM production environment is dangerous for humans and formed with physically isolated from each other stationary android systems having some space degrees of freedom [9, 10]. CM are united into non-trivial configurations with the net commutation mechanisms. The CM remote control transforms them into devices being controlled with discrete conditions and net connections [11, 12].

The intellectual master-system is a tool of the CM control highly reliable mechanisms, which is capable to tele-monitor [13]. A master-system session with a CM provides the controlling program with a capability to evaluate the condition and to control the android resources remotely. A clever combination of control tools and net solutions allows the master-system to coordinate remotely in
continuous mode the separate CM and some functional groups [14, 15].

The production system control includes the master-system global access each CM registered on the net and configures their operational tasks for some particular requirements of technological processes. Operational functionality is an optional property for all CM being set remotely with the master-system [16, 17].

2. The CM environment
Stipulated by the State and the business, the industry re-arrangement position includes the full changes of classical ways and production technologies for the new ones borrowed from the administrative practices of the global successful companies. The new production foundation is a group of CM with inter-operational synchronization by an artificial intelligence.

CM adaptive capabilities changes the situation acceptance high level, which constantly appears in the production environment. CM technologies application is actual for solving production tasks, which cannot be done by the convention technological infrastructure objects, which is a part of the program numeric control (CNC).

In the innovation economy border the CNC machines capabilities can be applied if all hybrid production advantages are preserved in the industry. In the Industry 4.0 new economic model the CNC machines are not viable because the fragment approach to in-capitalize the innovations into the production environment is not already efficient today.

The industry traditional format used technological processes static models and production structure components where the tasks distribution among the machines were done with the line planning system. Analytical connections of CM operation processes allows today preventing or minimizing inter-operational components of the delay volume for non-finished production, which are to be processed because of necessary equipment temporal occupation.

The absence of specialist’s necessary attention to the optimization problem of production chains nullifies the company development innovative potential and in the end leads to the industrial segment stagnation.

The CM groups initializing is done with the tools of dynamically formed net segments, which correspond the typical sequences of item processing. The number of repeating operational tasks is a part of CM basic settings. The control mechanisms of master-system support the technology of «master-slave» in the CM interaction. The master-system designates the operation processes order. The operations which require a lot of resources may use a group of CM.

The transportation ways and content of the packages being transported by the CM define the inner company net solutions, which provide the master-system constant access to the equipment. The selection way of net technologies influences the production net productivity and is based on the production mechanization way and CM infrastructural capabilities.

3. The CM remote control mechanisms
The CM remote control technologies are used for completing the direct actions of the master-system based on the following principles:

- wide spreading control which is used to transfer operational tasks and other structural content of CM functional groups;
- address control which is for operational tasks translation for a particular CM, which is in the maintenance mode;
- high-level control which is for the CM optional functional configuration;
- low-level control which is for the CM construction units physical conditions tele-monitoring in the technical support mode (a non-functioning period).
The CM remote control mechanism is given in figure 1. The remote control is based on the inner company security concept to describe the technologies of full and sanctioned master-system access to the android resources. All net elements inner connections are commutated with the secured connection channels and the traffic coding. The true state of each package is verified properly to reduce the control connections vulnerability.

The CM inner commutation forms the autonomous sub-net, which excludes the external company net interaction. The CM resources access is provided through the terminals only registered in the sub-net. The inner company security politics prohibits any application of cross platform solutions to unite autonomous and global nets. The remote translation of controlling packages from the external sources are not supported technically.

The master-system detects and blocks any unsanctioned devices connection attempts, which are capable to control remotely the CM. Equally, they exclude the sub-net access categories, which use adapters or providers mechanisms. The master-system functional control is restricted and concentrated significantly only with some support of the production cycle stable completion by CM resources.

4. The CM remote control technologies
The wide spreading remote control provides the CM connection with the content translation environment, which control operational applications. The wide spreading control tools may realize the functions:
- operational applications remote installation into CM file system;
- CM re-setting and operational application initiation based on its calculator;
- CM net re-configuring in symmetrically and equally loaded technological chains and other.

The address remote control supposes a local interaction of CM and master-system. The local interaction necessity appears if some processes get significantly more complicated without any necessary changes into an objects group general technological cycle. The address control tools may realize:
- master-system connection to the operational efficiency options of any CM (to regulate the technological level of an item processing);
- CM disconnection (blocking) from the electricity system because of a fault or item processing quality reduction (when the processing parameters are out of the valid range);
- evening of calculation and technological CM load after the item processing processes completion and other.
The high-level remote control is applied in the master-system direct access mode to some CM functional capabilities. The high-level control necessity appears when they need to restore or support into a particular level the CM operation functionality characteristics. The high-level control tools may realize:

- the CM load sequence control when it permits to apply into the technical support mode or its operational functioning;
- updating of CM program utilities to provide the more perfect stabilization of the item processing production processes;
- an increased organizing and reliability of the item processing processes completion with CM and other.

The low-level remote control is applied in the master-system direct access mode to the CM physical constructional elements, which are in the range of the program control. The low-level control is used to diagnose the android system with net applications. The master-system low-level control tools may realize:

- the CM physical infrastructure faults detection engaged in the item processing processes;
- the CM material and tools stock replenishment being depleted in the item processing processes;
- the CM basic settings configuration which is a part of radio and electronic elements load optional codes for memory, which is energy independent.

5. Conclusion
One of the new approaches in the material production sphere is to implement the CM electronic interaction system into technological processes. The item manufacturing organization format is based on the technology borrowed from the best foreign practices applied in the machine environment. A complex production equipped with CM forms a technological development center with high intellectual potential of growth.

The CM model range has a chain location in production sites which is high precision equipment functioning in the self-regulating mode. CM inter-operation interaction provides address and wide spreading objectives, adaptively generated and remotely translated with the master-system. Tasks fixation for CM is done by electronic tools of inner company environment, which organize production net segments of the feeble structure.

The CM control unclear models are antagonism models of formal business logic, which is a hidden reserve to increase efficiency and production volumes. The machine environment structural reconstruction displaced significance aspects of industrial net as the production auxiliary elements. The cyber-production primary element is the data processing adaptive master-system.

The production transaction control increases the business competitive state several times, including the CM net technological capabilities to manufacture an item. The entire system implementation of cyber-production advanced problems justifies the new ways search to develop the industrial technologies, which substitute with a good pace the low-efficient pragmatic solutions in the market.

As much as the CM itself and technologies, the specialists’ competence is an equal impetus to provide the industry new economic models development. The nutrient environment allows one to raise the new specialists generation, which is the technological development center ecosystem to accumulate the knowledge vital for the Industry 4.0.

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