A Multiagent-based Distributed Control Platform for Industrial Flexible Production Systems

Ronald Schoop  Ralf Neubert  Armando W. Colombo

Development Central Department
Schneider Automation Business
Schneider Automation GmbH
Steinheimer Str. 117
D-63500 Seligenstadt, GERMANY
ronald.schoop, ralf.neubert, armando.colombo@modicon.com

Summary

The recent production technologies reflect a worldwide trend towards both, batches of small and medium size, and part families of increasing variety. This tendency often comes in conflict with the demand on high productivity and on simultaneous improvement of machine utilization. Flexible production systems (FPS) possess the ability to attain efficiency and versatility by producing a wide range of different product families and/or different types of a product with a minimal effort in changing the involved manufacturing environment. These characteristics make FPS also able to increase production flexibility while maintaining high productivity (see Fig. A, [5] and the references therein, [6], [17]). The FPS would be of little use without a suitable supervisory control system. It is this system which has to organize the production and to schedule and synchronize the resource utilization. Moreover, the production system’s reliability and degree of flexibility will not only be conditioned by the reliability and flexibility of its components (workstations, storage, handling and transport systems, etc.) but will also depend fundamentally on the reliability and flexibility of the embedded supervisory control system [5]. It is currently built in a distributed manner [13]. A software agent approach seems to be very suited in relation with the distributed intelligent control and supervision of each production component. Moreover, a multiagent-based software platform can offer distributed control functions with communication, cooperation and synchronization capabilities, among others, that can cover the behavior specifications of the hardware components and also the production specifications to be fulfilled by the production system.

This work proposes an approach that supports the design and the implementation of a distributed supervisory control system of industrial flexible production systems based on a multi-agent based architecture, with functions closely related to the real-time "shop-floor distributed control and dynamic scheduling”. The system has embedded the knowledge about layout and current behavior of hardware components that allows it to perform real-time decision-making processes and to run in a synchronized manner with the real production world. It seems to be very suited in accommodating heterogeneous hardware and software components in both their manufacturing control and information system, in integrating existing/legacy systems, and in adapting new production plans and or schedules to changing environments (Dynamic System Reconfiguration).