Cyber-Physical Systems network to support decision making for self-adapting production system

Narjes Alaya*†[1], Baudoin Dafflon[1], Néjib Moalla[1], and Yacine Ouzrout[1]

[1]Université Lumière Lyon 2, Laboratoire DISP – Université Lumière Lyon 2 – France

Résumé

Classical scheduling approaches are becoming insufficient in a real manufacturing environment because of their static nature based on unrealistic assumptions. Manufacturing systems are becoming complex, dynamic and with a wide variety of products, processes and unforeseen disturbances. These disturbances include: the order cancellations, arrival of new orders, changes in order priority, changes in release dates, processing delays, machine breakdowns, etc. (Hall and Potts, 2004). A natural solution is to break the boundaries between the production-physical space and the cyber-information space to integrate the decision-making process. This solution aims to enable dynamic scheduling also called reactive or online scheduling which is closely related to real-time control. In the same context, one of the ultimate goals of the Industry 4.0 consortium (Kagermann et al., 2013) is to implement an on-line system that performs the integrated optimization in real time, but technological enablers remain a serious barrier.

The present work analyzes technological enablers that permit to reach the above objectives. Addressing the integration issue for industrial context usually leads to approach the Cyber Physical System concept. CPSs were first defined by Lee (2006) as an integration of computation with physical processes where embedded computers and networks monitor and control the physical processes. Although CPS seems to present a valuable solution to guarantee the integration between the information and the production systems, added value of CPS can only be considered when implemented among a CPS network. This dimension adds many challenges, especially concerning communication, data sharing, event propagation and negotiation strategy among the network. In this context Multi-Agent Systems for dynamic scheduling are considered for their autonomous, distributed, and dynamic nature that fits the requirements for building flexible, robust, and dynamic manufacturing scheduling (Xiang and Lee, 2008). A MAS is made up of autonomous agents that collaborate and cooperate dynamically to satisfy both local and global objectives (Jennings, 2000). Internet of things technologies are also considered for the effective interaction between physical objects that it offers Li (2012). Finally, Internet of Service is considered as a valuable solution to face interoperability challenges between heterogeneous devices and different data sources Miorandi et al. (2012); Atzori et al.(2010); Da Xu (2011).

A conceptual framework combining the above studies' findings is proposed: It considers CPS networks implementation a manufacturing context. The framework is based on the above sited technological enablers. Finally, the conceptual framework has been instantiated within an industrial use-case dealing with quality control process.

*Intervenant

†Auteur correspondant: