Cyber-physical systems for future industrial systems

Proposal of Open invited track for the 20th IFAC World Congress

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Abstract:

Cyber-physical Systems (CPS) are networks of autonomous entities merging the physical and digital worlds. They are able to interact with their environment in a dynamic way. The integration of CPS in industrial systems offers great perspectives towards agility and sustainability of these systems. The area of research covered by CPS is large and covers many domains such as intelligent manufacturing systems, industrial agents, product-driven systems, service-oriented architectures, cloud computing, big data, machine-to-machine (M2M) or holonic manufacturing systems. The aim of this track is to bring together the wide communities working on different aspects of CPS-based future industrial systems. The development of such systems and their impact on industrial systems is still under study. This track intends to be the place for a crossover between the different topics that are addressed in this objective, from logistics to automation, from Multi-Agent or Cybernetic Systems to human factors.

IFAC technical committee(s): TC 5.1

Detailed description:

Cyber-physical Systems (CPS) consist in the integration of physical systems, including sensors and actuators with digital ones, typically computer-based systems [1]. CPS are composed of intelligent cyber-physical entities (holons, physical agents…) that can cooperate, self-organize, act on their environment and make autonomous decisions. Since they can be seen as a clear breakthrough in industrial organization [2], their integration into the next generation of industrial systems and their interaction with relevant information systems must be carefully addressed [3]–[5]. They are expected to significantly improve industrial performances expressed in terms of agility, efficiency and reconfigurability [6]. CPS constitute a megatrend in international research roadmaps that requires a lot of research efforts in the next few years in many domains that constitute the background of the topic: computer science, mechatronics, automation, human factors to name a few... This track is mainly focusing on the control aspect of CPS and their integration in the collaborative context of future industrial systems.

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CPS need cognitive abilities in order to acquire and treat information about themselves (sensors) or other CPS (network) and extrapolate its future behavior based on next decisions to make and to apply (actuators) [7]. Furthermore, a wide range of research is currently rising with the development of highly productive web and cloud technologies (service orientation, cloud manufacturing…) [8]. This development accelerates the shift from industrial automation to integration of classical computer science or web technologies in near real-time control platforms of manufacturing. Prior to the recent development of CPS, some research efforts have been done with the objective to propose decision-making process models or optimization models that were integrated into innovative architectures such as Holonic Manufacturing Systems (HMS) and Product Driven Systems (PDS) [9], [10]. CPS could logically gain from the experience capitalized from these prior works. Finally, the sustainability aspect of the integration of CPS in manufacturing is a great concern, from the energy delivery of factories through newly developed grids to the management of energy throughout the production shop floor [11], [12].

The track will cover all topics related to design, control and performance evaluation of CPS for future industrial systems, including (but not limited to) the following:

- Architecture design of CPS in manufacturing
- CPS in distributed manufacturing
- CPS in cloud manufacturing environment
- Service-orientation in industrial control
- Design of safe CPS and safety studies of CPS based industrial systems
- Integration of CPS for manufacturing
- Retrofitting strategies for cyber-physical production systems integration
- Control of cyber-physical production systems
- Self-X properties
- Smart ICT for CPS
- Communication Pattern and interoperability considering new and/or legacy systems
- Information acquisition and processing
- CPS acceptability and efficiency for human-machine cooperation in manufacturing
- CPS for sustainable manufacturing
- Benchmarking of cyber-physical production systems
- Industrial applications of CPS in manufacturing
- Case studies on CPS in manufacturing
- Best practices of CPS in industry

Internet links to additional material:

http://www.nist.gov/cps/

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503286

https://ec.europa.eu/digital-single-market/en/cyber-physical-systems

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