IFAC 2017 World Congress

Toulouse, France, 9-14 July 2017

Open invited track

"Assembly System 4.0": From workstation to assembly line design, from part logistics to information flow management for smart assembly systems in the Industry 4.0 era

Abstract

The radical changes which distinguished the market during the last decade force to configure assembly systems as flexible assembly lines able to face demand fluctuation, high volumes and continuous customer driven development of new products. Thus, the optimal design and management of assembly systems is crucial to achieve production efficiency, product quality and customer satisfaction. A remarkable opportunity to target these goals and to develop a brand new generation of assembly systems is represented by the current trends in automation, information and communication technology and virtualization of manufacturing processes, known as Industry 4.0 (the fourth industrial revolution).

The implementation of Industry 4.0 principles to assembly processes determine the here defined "Assembly System 4.0". These novel assembly systems are modularly structured with cyber physical systems, as "smart assembly stations" and "smart part logistic". These system elements communicate and cooperate with each other and with humans in real time, monitoring physical processes and creating a virtual copy of the physical assembly process to enable quick and decentralized decisions. Beneficial effects are a significant improvement of flexibility and speed of the whole assembly system, that enables to achieve more customized products, an efficient and scalable production and a high variance in production control. Last but not least, proper optimization models, control algorithms, automation technologies and management methods have to be developed to allow the aforementioned smart cyber physical systems of self-optimization, self-configuration, self-diagnosis and intelligent support to workers in their increasingly complex tasks.

This Open invited track seeks original manuscripts to investigate the design and management of "Assembly systems 4.0" exploiting mathematical models and methods, automation technologies, management techniques and approaches as well as industrial case studies.

Detailed Description of the Topic

Assembly represents the last phase of production processes. Thus, assembly operations manage the whole product differentiation and customisation. The radical changes and novel trends which distinguished the market during the last decade force to configure assembly systems as flexible assembly lines able to face demand fluctuation, high volumes, rapid changes in product mix and continuous customer driven development of new products, components and features, namely mass customization.

Thus, nowadays assembly systems have to simultaneously manage hundreds of different product models distinguished by different assembly cycles, dimensions and components, as well thousands of different parts, hundreds of tools and equipment and several workers. The optimal design and management of these system features is crucial to achieve assembly efficiency, product quality and customer satisfaction. A remarkable opportunity to achieve these goals and to develop a brand new generation of assembly systems is represented by current trends in automation, information and communication technology and virtualization of manufacturing processes, known as Industry 4.0 (the fourth industrial revolution).

Industry 4.0 revolution suggests four features that should distinguish the Factories of the Future, namely interoperability, information transparency, technical assistance and decentralized decisions. The first feature represents the ability of machines, devices, sensors, and workers to connect and communicate with each other via the Internet of Things and the Internet of People. The second feature is the ability of information systems to create a virtual copy of the physical production process by enriching digital plant models with sensor data. The third characteristic deals with the ability of cyber physical systems to physically support workers by conducting a range of unpleasant and complex tasks. The last feature represents the ability of the aforementioned cyber physical systems to take decisions on their own.

The implementation of Industry 4.0 principles to assembly process determine the here defined "Assembly System 4.0". These novel assembly systems are modularly structured with cyber physical systems, as "smart assembly stations" and "smart part logistic". The elements of these systems communicate and cooperate with each other and with humans in real time, monitoring physical processes and creating a virtual copy of the physical assembly process to enable quick and decentralized decisions. Beneficial effects are significant improvement of flexibility and speed of the whole assembly system, enabling to achieve more customized products, efficient and scalable production and a high variance in production control. Last but not least, proper optimization models, control algorithms and management methods have to be developed to allow the aforementioned smart cyber physical systems of self-optimization, self-configuration, self-diagnosis and intelligent support to workers for their increasingly complex tasks.

This Open invited track within the IFAC 2017 World Conference seeks original manuscripts to investigate the design and management of "Assembly systems 4.0", with a particular focus on "smart assembly stations" and "smart part logistics", for several production systems classified by the assembled product, the handled parts, the used tools and equipment as well as the workforce skills. Novel, high-quality papers investigating "Assembly System 4.0" should include, but are not limited to, mathematical models and methods, automation technologies, management techniques and approaches as well as real industrial case studies.

Possible topics of this Open invited track include but are not limited to:

- Smart assembly station design and management.
- Smart part logistics design and management.
- Self-optimization models for assembly systems, including innovative assembly line balancing and sequencing models able to quickly reconfigure the system.
- Self-configuration and self-diagnosis methods and technologies for assembly systems, including equipment and components configuration and control.
- Intelligent support systems to assist workers in their increasingly complex tasks.
- Innovative automation and robotic technologies to enhance the human-robot co-working.
- Virtualization and simulation techniques for decision making in the assembly process environment.
- Novel industrial and real world case studies to test and spread the adoption of "Assembly system 4.0".

Time schedule

31 October 2016	IFAC-standard papers submission deadline
20 February 2017	Notification of acceptance
31 March 2017	Final paper submission (papers can be uploaded only after the payment of the registration fee)
9-14 July 2017	20th IFAC World Congress

Manuscript Preparation

For Manuscript Preparation please look at http://www.ifac.papercept.net/conferences/support/support.php
For Manuscript submission please look at https://ifac.papercept.net/conferences/scripts/start.pl

For any further information please contact the Open invited track Technical Committee

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