

SPECIAL ISSUE

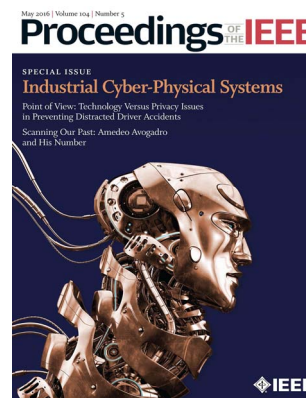
INDUSTRIAL CYBER-PHYSICAL SYSTEMS

Edited by A. W. Colombo, S. Karnouskos, Y. Shi, S. Yin, and O. Kaynak

- 904 Formal Verification of Fault-Tolerant Startup Algorithms for Time-Triggered Architectures: A Survey**
 By I. Saha, S. Roy, and S. Ramesh
|INVITED PAPER| This paper surveys various formal verification approaches for checking the correctness of the startup algorithms in three time-triggered platforms: TTA, FlexRay, and TTCAN.
- 923 MixCPS: Mixed Time/Event-Triggered Architecture of Cyber-Physical Systems**
 By J. Yao, X. Xu, and X. Liu
|INVITED PAPER| In this paper, a CPS architecture that can facilitate both time- and event-triggered approaches is motivated and a mixed time/event-triggered architecture called MixCPS is proposed to make CPS applications work in an integrated and optimized manner.
- 938 Using Smart Edge IoT Devices for Safer, Rapid Response With Industry IoT Control Operations**
 By M. W. Condry and C. B. Nelson
|INVITED PAPER| This paper presents a model that combines the capabilities of smart IoT devices with control system gateways using real-time challenge response for secure control operations.
- 947 Integration of Classical Components Into Industrial Cyber-Physical Systems**
 By T. Bangemann, M. Riedl, M. Thron, and C. Diedrich
|INVITED PAPER| This paper reviews the integration tasks used for bridging the gaps between technologies, tools used across the enterprise and alongside the value chain, and the state-of-the-art technologies as they are used in today's automation industry.
- 960 Compositionality in the Science of System Design**
 By S. Tripakis
|INVITED PAPER| The advent of CPSs has urged researchers to rethink systems and system design. This paper presents some challenges in the science of system design, expanding on the key principle of compositionality.
- 973 Engineering Methods and Tools for Cyber-Physical Automation Systems**
 By R. Harrison, D. Vera, and B. Ahmad
|INVITED PAPER| This paper considers the industrial context for the engineering of CPSs. It reviews engineering approaches that have been proposed or adopted to date and introduces a component-based CPS engineering toolset.
- 986 Empowering User Interfaces for Industrie 4.0**
 By T. Pfeiffer, J. Hellmers, E.-M. Schön, and J. Thomaschewski
|INVITED PAPER| A central question in Industrie 4.0 is how to empower users to understand, monitor, and control the automated process. This paper discusses flexible but powerful methods for usability and user experience engineering in the context of Industrie 4.0.

DEPARTMENTS

- 896 POINT OF VIEW**
 Technology Versus Privacy Issues in Preventing Distracted Driver Accidents
 By S. Schober
- 899 SCANNING THE ISSUE**
 Industrial Cyber-Physical Systems
 By A. W. Colombo, S. Karnouskos, Y. Shi, S. Yin, and O. Kaynak
- 1155 SCANNING OUR PAST**
 Amedeo Avogadro and His Number
 By R. Williams
- 1159 FUTURE SPECIAL ISSUES/SPECIAL SECTIONS**



On the Cover: This month's cover image of a 3-D robot highlights one of the many emerging applications of industrial cyber-physical systems.

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SPECIAL ISSUE: Industrial Cyber-Physical Systems**997 Systems Engineering for Industrial Cyber-Physical Systems****Using Aspects**

By I. Akkaya, P. Derler, S. Emoto, and E. A. Lee

[INVITED PAPER] This paper shows how to use aspect-oriented modeling techniques in model-based design as a systematic way to segregate domains of expertise and cross-cutting concerns within the model.

1013 Real-Time Wireless Sensor-Actuator Networks for Industrial Cyber-Physical Systems

By C. Lu, A. Saifullah, B. Li, M. Sha, H. Gonzalez, D. Gunatilaka, C. Wu, L. Nie, and Y. Chen

[INVITED PAPER] Despite their success in industrial monitoring applications, wireless sensor actuator network (WSAN) technologies face significant challenges in supporting control systems. This paper surveys recent advances in real-time WSANs for industrial control systems.

1025 Industrial Wireless IP-Based Cyber-Physical Systems

By T. Watteyne, V. Handziski, X. Vilajosana, S. Duquennoy, O. Hahm, E. Baccelli, and A. Wolisz

[INVITED PAPER] This paper introduces emerging standards for low-power wireless IP-based industrial communications. Major issues under discussion and future aspects to be addressed in this area are also outlined.

1039 The Cybersecurity Landscape in Industrial Control Systems

By S. McLaughlin, C. Konstantinou, X. Wang, L. Davi, A.-R. Sadeghi, M. Maniatakos, and R. Karri

[CONTRIBUTED PAPER] This paper surveys the state of the art in industrial control system (ICS) security, identifies outstanding research challenges in this emerging area, and explains the key concepts and principles for deployment of cybersecurity methods and tools to ICSs.

1058 Smart Grids: A Cyber-Physical Systems Perspective

By X. Yu and Y. Xue

[INVITED PAPER] This paper presents an overview of challenges for smart grids in the context of CPSs, outlines potential contributions that CPSs can make to smart grids, and points out the implications of current technological advances to smart grids.

1071 Aggregation and Charging Control of PHEVs in Smart Grid: A Cyber-Physical Perspective

By M. Liu, Y. Shi, and H. Gao

[CONTRIBUTED PAPER] Using plug-in hybrid electric vehicles (PHEVs) to provide ancillary services is an emerging technique in current smart grid. In the context of CPSs, this paper presents a low-cost PHEV aggregation model and a high-performance charging control algorithm for the valley-filling service.

1086 Smart Agents in Industrial Cyber-Physical Systems

By P. Leitão, S. Karnouskos, L. Ribeiro, J. Lee, T. Strasser, and A. W. Colombo

[CONTRIBUTED PAPER] This paper surveys and analyzes the current state of the industrial application of agent technology in CPSs, and provides a vision on the way agents can effectively enable emerging CPS challenges.

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SPECIAL ISSUE: Industrial Cyber-Physical Systems

- 1102 Intelligent Seven-DoF Robot With Dynamic Obstacle Avoidance and 3-D Object Recognition for Industrial Cyber-Physical Systems in Manufacturing Automation**
By R. C. Luo and C.-W. Kuo
|INVITED PAPER| This paper presents a service-oriented multiagent system for the control and analysis of the CPSs in manufacturing automation utilizing a noncontact dynamic obstacle avoidance 7-DoF robot arm.
- 1114 A Vertical and Cyber-Physical Integration of Cognitive Robots in Manufacturing**
By V. Krueger, A. Chazoule, M. Crosby, A. Lasnier, M. R. Pedersen, F. Rovida, L. Nalpantidis, R. Petrick, C. Toscano, and G. Veiga
|INVITED PAPER| The potential of cognitive robots has not been fully exploited due to the lack of vertical integration with existing IT infrastructures. This paper reports on considerations and findings from a research project that is developing such a cognitive CPS and applying it to an automotive industry case.
- 1128 Cyber-Physical Control of Road Freight Transport**
By B. Besselink, V. Turri, S. H. van de Hoef, K.-Y. Liang, A. Alam, J. Mårtensson, and K. H. Johansson
|INVITED PAPER| This paper reviews how modern information and communication technology supports a cyber-physical transportation system architecture. It also presents a CPS approach toward the control and coordination of a large-scale transportation system.
- 1142 Cyber-Physical Systems for Open-Knowledge-Driven Manufacturing Execution Systems**
By S. Iaroyvi, W. M. Mohammed, A. Lobov, B. R. Ferrer, and J. L. Martinez Lastra
|INVITED PAPER| This paper describes and illustrates an approach for designing open-knowledge-driven manufacturing execution systems on top of CPS that controls robot workstations and conveyor-based transportation system of a pallet-based production system.

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