

SPECIAL ISSUE

DESIGN AUTOMATION FOR CYBER-PHYSICAL SYSTEMS

Edited by Q. Zhu, A. Sangiovanni-Vincentelli, S. Hu, and X. Li

1484 Codesign Methodologies and Tools for Cyber-Physical Systems

By Q. Zhu and A. Sangiovanni-Vincentelli

|INVITED PAPER| In this paper, the authors propose to codesign cyber and physical components of CPSs in a holistic environment. They present a number of codesign approaches in modeling, simulation, synthesis, verification, and validation. They also discuss open challenges in CPS codesign and possible future directions for addressing them.

1501 Model and Tool Integration Platforms for Cyber-Physical System Design

By J. Sztipanovits, T. Bapty, X. Koutsoukos, Z. Lattmann, S. Neema, and E. Jackson

|INVITED PAPER| In this paper, the authors address the heterogeneity in CPS model libraries and design tools with two integration platforms. The model integration platform enables precise representation of semantic interfaces among modeling domains, while the tool integration platform features automated design space exploration and formal verification.

1527 A Component Architecture for the Internet of Things

By C. Brooks, C. Jerad, H. Kim, E. A. Lee, M. Lohstroh, V. Nouvellet, B. Osyk, and M. Weber

|INVITED PAPER| This paper addresses heterogeneity in those CPSs that leverage internet technology for interactions between the cyber world and the physical world. It presents a design pattern called accessors to serve as proxies for heterogeneous components and services, and a design environment CapeCode to compose accessors and facilitate the system design.

1543 Platform-Centric Self-Awareness as a Key Enabler for Controlling Changes in CPS

By M. Möstl, J. Schlatow, R. Ernst, N. Dutt, A. Nassar, A. Rahmani, F. J. Kurdahi, T. Wild, A. Sadighi, and A. Herkersdorf

|INVITED PAPER| This paper addresses the challenges in managing the continuous change and evolution of CPSs and their operation environment. It presents two frameworks, controlling concurrent change (CCC) and information processing factory (IPF), for building self-aware CPSs that have the capabilities of self-modeling, self-configuration, and monitoring.

1568 Building a Hybrid Systems Modeler on Synchronous Languages Principles

By A. Benveniste, T. Bourke, B. Caillaud, J.-L. Colaço, C. Pasteur, and M. Pouzet

|INVITED PAPER| In this paper, the authors present a modeling language that combines synchronous language constructs with ordinary differential equations and zero-crossing events, to support the modeling of both discrete time and continuous time in hybrid CPSs.

1593 Real-Time Decision Policies With Predictable Performance

By H. Abbas, R. Alur, K. Mamouras, R. Mangharam, and A. Rodionova

|INVITED PAPER| This paper introduces the usage of declarative streaming languages, in particular StreamQRE, for modeling and analyzing real-time streaming applications. The approach is based on the formalism of quantitative regular expressions. It can guarantee constant memory, runtime, and energy cost per data item, and can calculate the upper bounds on the per-item cost.

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DEPARTMENTS

1471 POINT OF VIEW

Electronic Taste and Smell: The Case for Performance Standards

By H. T. Nagle and S. S. Schiffman

1479 SCANNING THE ISSUE

Design Automation for Cyber-Physical Systems

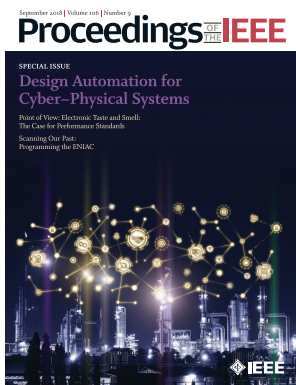
By Q. Zhu, A. Sangiovanni-Vincentelli, S. Hu, and X. Li

1760 SCANNING OUR PAST

Programming the ENIAC

By B. L. Stuart

1771 FUTURE SPECIAL ISSUE/SPECIAL SECTIONS



On the Cover: Our cover image this month ties into the theme of the special issue by highlighting the concept of Industry 4.0.

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Design Automation for Cyber-Physical Systems

1616 Layering Assume-Guarantee Contracts for Hierarchical System Design

By I. Filippidis and R. M. Murray

| INVITED PAPER | This paper presents a method to algorithmically decompose system-level temporal logic specifications in CPSs into lower level specifications for individual components, in the form of assume-guarantee contracts. The automated process ensures that the generated component specifications are implementable and simpler for further development.

1655 SMC: Satisfiability Modulo Convex Programming

By Y. Shoukry, P. Nuzzo, A. L. Sangiovanni-Vincentelli, S. A. Seshia, G. J. Pappas, and P. Tabuada

| INVITED PAPER | This paper presents a satisfiability modulo convex programming (SMC) framework that enables efficient reasoning of Boolean and convex constraints at the same time. This capability is particularly important for CPS design and verification, where the system heterogeneity often brings both types of constraints.

1680 Design Automation for Smart Building Systems

By R. Jia, B. Jin, M. Jin, Y. Zhou, I. C. Konstantakopoulos, H. Zou, J. Kim, D. Li, W. Gu, R. Arghandeh, P. Nuzzo, S. Schiavon, A. L. Sangiovanni-Vincentelli, and C. J. Spanos

| INVITED PAPER | This paper presents a platform-based design flow for smart buildings. The proposed flow maps high-level specifications of desired building applications to their physical implementations through three intermediate design platforms, namely the virtual device platform, the module platform, and the implementation platform.

1700 Tools and Methodologies for Autonomous Driving Systems

By A. Bhat, S. Aoki, and R. Rajkumar

| INVITED PAPER | This paper introduces a standard reference architecture for connected and autonomous vehicles (CAVs), and presents a set of methodologies and tools for the modeling, design, development, and testing of CAV systems.

1717 Cyber-Physical Digital-Microfluidic Biochips: Bridging the Gap Between Microfluidics and Microbiology

By M. Ibrahim, and K. Chakrabarty

| INVITED PAPER | This paper introduces a new synthesis methodology for digital-microfluidic biochips, which leverages on-chip integration of sensing systems and uses realistic models of biomolecular protocols to address real-world microbiology applications through cyber-physical adaptation.

1744 Oasis: A Mobile Cyber-Physical System for Accessible Location Exploration

By C.-C. Cheng, P.-C. Hsiu, T.-K. Hu, and T.-W. Kuo

| INVITED PAPER | This paper develops a mobile CPS platform for guiding users to leave “null zones” and “hot zones,” where data rate is not sufficient for delay-sensitive applications, and move to nearby locations with better mobile experience. It brings up the emerging concept of improving mobile user experience by modeling human mentality, wireless signal coverage, and their interplay.

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