Guest Editor Introduction

CYBER physical systems (CPSs) are the new generation of engineered embedded systems in which the sensing, computational, and physical processes are tightly coupled together to interact with the physical world and human operators. Many such CPS are deployed in safety-critical domains with hard real-time constraints, which makes it extremely important to guarantee their timeliness and reliability while maintaining good performance. Given the wide array of applications and their requirements, *Real-Time Technologies in CPS* is a multifaceted research area covering topics, such as data analytics, programming models, systems engineering, distributed computing and communication infrastructures, and systems software.

The first paper of this special issue, written by A. Dubey, G. Karsai, P. Volgyesi, M. Metelko, I. Madari, H. Tu, Y. Du, and S. Lukic, introduces a distributed middleware framework called resilient information architecture platform for smart grid (RIAPS). It is an open application platform that enables the distribution of intelligence and control to local endpoints thereby reducing network traffic and latency, and improving reliability by reducing dependencies on numerous devices. It provides the core component abstractions that ensure uniform operational semantics as well as plug-and-play capabilities across such interactions. A case study in the context of a micro-grid resynchronizer application based on the IEEE C37.118.2 synchrophasor data transfer protocol is also presented in the paper.

The second paper, written by V. Sieh, R. Burlacu, T. Hönig, H. Janker, P. Raffeck, P. Wägemann, and W. Schröder-Preikschat, presents an end-to-end toolchain called NEO that automatically generates worst-case execution time as well as energy-consumption cost models for commercial-off-the-shelf embedded hardware platforms. Automatically generated benchmark programs are executed on the hardware platform as well as a virtual machine. The resulting observations are encoded into an optimization problem to obtain instruction-level hardware-cost models. The paper also includes a case study for the ARM Cortex-M0+ platform.

The third and final paper of this special issue, written by B. Dreyer, C. Hochberger, T. Ballenthin, and S. Wegener, presents a technique to generate execution-time profiles (ETPs) of embedded software using embedded trace units in modern system-on-chips (SoC). Specifically, these trace units are used to emit ARM coresight specification traces which include all control-flow changes with corresponding timestamps. The paper presents an iterative test-driven technique to efficiently size the bins of the resulting execution-time histograms, which are then used to generate the ETPs. A case study based on the DEBIE-1 satellite instrument software for measuring impacts of small space debris, implemented on a Xilinx Zynq XC7Z020 SoC, is also presented in the paper.

In summary, we believe that the contributions of this special issue are truly reflective of the diverse technological challenges faced in real-time CPS. Further, it is worth noting that each of the papers in this special issue contains a case study from a different application domain of real-time CPS.

ARVIND EASWARAN
School of Computer Science and Engineering
Nanyang Technological University
Singapore

Digital Object Identifier 10.1109/LES.2019.2909972

1943-0663 © 2019 IEEE. Personal use is permitted, but republication/redistribution requires IEEE permission.
See http://www.ieee.org/publications_standards/publications/rights/index.html for more information.