Guest Editorial
Special Section on Real-Time Applications and Tools Design

Real-time systems are systems that must respond to external stimuli in a timely fashion. The correctness of a real-time system depends on not only the logical correctness of its tasks but also the timeliness of their executions. The wide adoption of real-time technologies has already resulted in significant impacts on how automated systems are designed and deployed. They are key technologies needed to provide distributed and collaborative industrial environments. Solutions with better intelligence and flexibility are provided at lower cost and more functionality. In this Special Section, six papers are published with excellent results related to task scheduling, real-time control, and critical issues in development tool designs.

The first paper, entitled “Optimization-Based Dynamic Reconfiguration of Real-Time Schedulers With Support for Stochastic Processor Consumption,” proposes scheduling mechanisms to maximize the overall system benefit subject to schedulability constraints. Application modes are characterized by their required processing bandwidth and benefit values. Task execution times are described as probability distributions. Making use of this stochastic modeling one is able to dynamically reconfigure the scheduler subject to probabilistic schedulability guarantees.

The second paper, entitled “Parameter Selection for Real-Time Controllers in Resource-Constrained Systems,” presents a general methodology that integrates control issues and real-time schedulability analysis to improve the control performance in embedded systems with time and resource constraints. The performance increase is achieved by properly selecting task periods and deadlines under feasibility constraints.

The third paper, entitled “Optimizing the Software Architecture for Extensibility in Hard Real-Time Distributed Systems,” considers a set of control tasks that must be executed on distributed platforms so that end-to-end latencies are within deadlines. Authors investigate how to allocate tasks to nodes, pack signals to messages, allocate messages to buses, and assign priorities to tasks and messages, so that the design is extensible and robust with respect to changes in task requirements.

The fourth paper, entitled “Synthesis of Multitask Implementations of Simulink Models With Minimum Delays,” presents an improvement of code generation technology for Synchronous Reactive obtained via a novel algorithm for optimizing the multitask implementation of Simulink models on single-processor platforms with limited availability of memory. The proposed algorithm leverages a novel efficient encoding of the scheduling feasibility region to find the task implementation of function blocks with minimum additional functional delays within timing and memory constraints. The algorithm is applied to an automotive case study with tens of function blocks and very high utilization to test its applicability to complex systems.

The fifth paper, entitled “Time-Aware Instrumentation of Real-Time Programs,” proposes an instrumentation technique for debugging applications with temporal constraints with the purpose of enabling the developer to locate the origins of software misbehaviors. The proposed framework permits reasoning about space and time, and allows composition of software instrumentations. In particular, it introduces a low perturbation by optimizing the number of insertion points and trace buffer size for code size and time budgets. The theory is applied to two concrete case studies: the OpenEC firmware for the keyboard controller of the One Laptop Per Child project and the flash file system.

The sixth paper, entitled “Address-Independent Estimation of the Worst-Case Memory Performance,” presents an analytical model that provides fast, safe, and tight estimations of the worst-case cache performance, which plays a key role in the calculation of the upper bound of worst-case execution times. The main novelty of the proposed approach is that it requires no information about the base addresses of the data structures. This property is very interesting, since base addresses are sometimes unavailable at compile time, and they can change between different executions. The approach is also validated through extensive simulations.

Giorgio Buttazzo, Guest Editor
Scuola Superiore Sant’Anna of Pisa
Pisa 56127, Italy
giorgio@sssup.it

Tei-Wei Kuo, Guest Editor
National Taiwan University
Taipei 106, Taiwan
ktw@csie.ntu.edu.tw
Giorgio Buttazzo (SM’05) received the B.S.E. degree in electrical engineering from the University of Pisa, Pisa, Italy, in 1985, the M.S. degree in computer science from the University of Pennsylvania, Philadelphia, in 1987, and the Ph.D. degree in computer engineering from the Scuola Superiore Sant’Anna of Pisa, Pisa, in 1991.

He is a Full Professor of Computer Engineering at the Scuola Superiore Sant’Anna of Pisa, Pisa, Italy, where he teaches courses on real-time systems and computer architectures. He has authored six books on real-time systems and over 200 papers in the field of real-time systems, robotics, and neural networks. His main research interests include real-time operating systems, dynamic scheduling algorithms, quality-of-service control, multimedia systems, advanced robotics applications, and neural networks.

Prof. Buttazzo has been Program Chair and General Chair of the major international conferences on real-time systems. He is Editor-in-Chief of the *Journal of Real-Time Systems* (Springer), the major journal on real-time computing. He is Vice Chair of the IEEE Technical Committee on Real-Time Systems and Member of the Euromicro Executive Board on Real-Time Systems.

Tei-Wei Kuo received the B.S.E. degree in computer science and information engineering from the National Taiwan University, Taipei, in 1986, the M.S. and Ph.D. degrees in computer sciences from the University of Texas at Austin, in 1990 and 1994, respectively.

He is currently a Professor at the Department of Computer Science and Information Engineering, National Taiwan University, where he was the Department Chairman and a Deputy Dean of his college. He has published over 180 papers in the field of real-time and embedded systems and has six patents in the designs of flash-memory storage systems.

Prof. Kuo received the Ten Young Outstanding Persons Award of Taiwan in 2004, the Distinguished Teaching Award from the National Taiwan University in 2005, and a number of research awards, including the Distinguished Research Award from the Taiwan National Science Council in 2003. He has served on the Editorial Board of many journals, including the *Journal of Real-Time Systems* and the *IEEE TRANSACTIONS ON INDUSTRIAL INFORMATICS*. He was the Program Chair and General Chair of the IEEE Real-Time Systems Symposium (RTSS) in 2007 and 2008, respectively. From 2005 and 2008, he served as the Steering Committee Chair of the IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA). He serves as an Executive Committee Member of the IEEE Technical Committee on Real-Time Systems since 2005, chairs the Embedded Systems Group of the Networked Communication Program Office of Taiwan, and serves on the Director Board of the Genesys Logic and the MStar Semiconductor, leading companies in IC designs for display, smart phones, wireless communication, USB, and flash-memory controllers.