Guest Editorial Special Section on Real-Time and (Networked) Embedded Systems III

EMBEDDED systems are increasingly taking advantage of the opportunities afforded by ubiquitous connectivity and networks to offer new and original functions and solutions. Together with the hard real-time constraints often associated with these applications, the design of embedded systems requires the development of efficient platforms supported by innovative technologies methodologies and algorithms.

This Special Section presents some of the latest developments in the area of real-time and networked embedded systems, covering a broad spectra stretching from software worst-case execution-time analysis, to predictable software synchronization, to frame scheduling on wireless sensor networks, and finally to the design and implementation of a time-critical control system over real-time Ethernet.

The first paper "Transparent Synchronization Protocols for Compositional Real-Time Systems" presents an implementation of three synchronization protocols based on the stack resource policy (SRP) to support resource sharing in two-level hierarchical scheduling frameworks. The protocols (HSRP, SIRAP, and BROE) are implemented on the widely used real-time kernel uC/OS-II, and provide transparent interfaces that allow programmers to select a protocol during integration time, for which the authors present guidelines based on the estimates of the implementation overheads. Finally, the authors discuss the impact of unknown task-arrival times on the efficiency of the implementation.

The second paper "Multichannel Superframe Scheduling for IEEE 802.15.4 Industrial Wireless Sensor Networks" investigates the problem of beacon collisions in industrial wireless sensor networks in terms of the reliability of cluster-tree networks, and proposes a Multichannel Superframe Scheduling algorithm that avoids the collisions by scheduling superframes over different radio channels. The technique preserves the connectivity, while the results of the simulations show an increase of schedulable clusters. The improvement in performance is also estimated quantitatively using analytical techniques. The algorithm was implemented on TinyOS.

The third paper "Design and Implementation of a Delay-Guaranteed Motor Drive for Precision Motion Control" addresses the problem of designing multi-axis motions control systems. The authors develop a delay-guaranteed motor drive which provides probabilistic guarantees on processing delays, on top of real-time Ethernet, which gives deterministic guarantees on message communication delays. The objective in the paper is to minimize the periods of tasks in each drive using stochastic analysis, giving a minimum possible host cycle time. The experiments show the reduction in cycle time, and the distribution of the actuation deviation, for various requirements on the deadline miss probabilities of the tasks.

The fourth paper "Fast, Interactive Worst-Case Execution Time Analysis with Back-Annotation" presents an interactive approach for analysis of software worst-case execution time (WCET), where the user gets fast feedback on WCET through the usage of back-annotation techniques. The authors present a tool suite implementing this approach with back-annotation for analyzing real-time java programs, combining a timing predictable target architecture with some restrictions on the software. A comparative evaluation of various techniques to perform the WCET analysis in this context is provided. To be specific, it is shown that performing WCET calculations using a tree-based method rather than the more traditional IPET method relying on integer linear programming (ILP) performs better. A well-known benchmark is used for the experiments.

This Special Section is initiated as a result of the IEEE ETFA Conference 2010. We would like to thank all the authors who have submitted papers to the Special Section, we are truly grateful for the efforts and patience of the reviewers whose expertise guarantees the outstanding quality of the journal issue.

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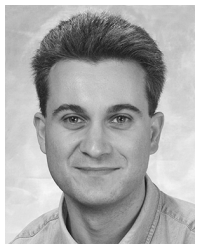

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