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Special issue on practical and robust design of real-time systems

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This special issue features research and engineering topics in the domain of real-time systems, covering efficient, robust, and practical techniques to design and optimize real-time systems. In particular, the current issue features four papers:

- Profile-driven Memory Bandwidth Management for Accelerators and CPUs in QoS-enabled Platforms.
- Design Optimization for Real-Time Systems with Sustainable Schedulability Analysis.
- Robust and Accurate Regression-Based Techniques for Period Inference in Real-Time Systems.
- A Comprehensive Survey of Industry Practice in Real-Time Systems.

The first paper by Parul Sohal, Rohan Tabish, Renato Mancuso, and Ulrich Drepper deals with the performance bottleneck of the main memory subsystems when considering both CPUs and accelerators. Specifically, this paper combines classical CPU-centric bandwidth regulation techniques with state-of-the-art hardware support for memory traffic shaping via the ARM QoS extensions. This paper addresses both the technological capabilities and limitations as well as the theoretical foundations.

The second paper by Yecheng Zhao, Runzhi Zhou, and Haibo Zeng considers the urgent need for efficient optimization techniques that can handle large-scale systems. By leveraging the sustainability of schedulability analysis applicable for a large class of real-time systems, this paper develops an optimization framework for the design of real-time systems. Specifically, a counterexample-guided iterative procedure is proposed to efficiently learn from an unschedulable solution.

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The third paper by Serban Vadineanu and Mitra Nasr explores periodic interactions with the environment. When the system features aperiodic tasks, release jitters, or runtime variations in the execution time of the tasks, the practicability of a period inference tool highly depends on its accuracy and robustness. This paper utilizes regression-based machine-learning (RBML) methods and provides discussions and investigation on the accuracy and robustness of different families of RBML methods.

The last paper by Benny Akesson, Mitra Nasri, Geoffrey Nelissen, Sebastian Altmeyer, and Robert I. Davis presents a comprehensive survey, conducted from 120 industry practitioners in the field of real-time embedded systems. The survey provides practical information and first-hand insights into the characteristics of the real-time systems being developed today. The survey identifies valuable information both for academics and practitioners and helps avoid divergence between industry practice and academic research. Furthermore, the survey identifies important trends relevant to research and industry for the future.

Preliminary versions of these four papers were presented at the "41st IEEE Real-Time Systems Symposium (RTSS)", which was held virtually on December 1–4 2020. The preliminary version of the first paper received the "Best Student Paper Award" of RTSS 2020, whilst the preliminary versions of the second and third papers received the "Outstanding Paper Award" of RTSS 2020. The preliminary version of the fourth paper stimulated the organization of a panel discussion regarding A Survey of Industry Practice in Real-Time Systems in RTSS 2020. The authors were successively invited to submit extended versions to this special issue.

The papers in this special issue present the latest research towards practical and robust design of real-time systems. They also provide a roadmap for future research directions in the field of real-time systems. We hope that the readers will benefit from these outstanding research results and feel excited to explore related topics.

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