

## Special section

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## Special Section: Integrating Dataflow, Embedded computing and Architecture

The dataflow model of computation with Synchronous Dataflow (SDF) as its primary representative offers a powerful perspective on parallel computations that may be conditioned in terms of data dependencies. It dates back to the nineteen sixties and has applications in the design and analysis of real-time stream-processing systems, especially in the area of digital signal processing. The dataflow model of computation fits the characteristics of embedded and cyber-physical systems, with a strong emphasis on both the functional and temporal aspects of data processing. Dataflow is gaining renewed popularity, stimulated by the trend towards multi-core and multi-processor architectures.

This special section is the result of an open call for papers, followed by a thorough review process. From ten submissions, in four review rounds, five submissions were accepted.

Following the multi-processing trend, the paper “Worst Case Response Time Analysis of a Synchronous Dataflow Graph in Multiprocessor Real-time Systems” by Choi and Ha combines schedule bound analysis and classical response-time analysis to obtain tighter worst-case response time bounds than so far possible. Schedule bound analysis analyzes interference among actors of an SDF graph mapped onto a multiprocessor, whereas response-time analysis is used to analyze interference among different graphs.

Data-processing applications are becoming increasingly dynamic due to varying data-dependent processing workloads. This has led to the development of dynamic dataflow models of computation distinguishing different modes of operation. The paper “Multiprocessor Scheduling of a Multi-mode Dataflow Graph Considering Mode Transition Delay” by Jung, Oh and Ha proposes a scheduling technique for multi-mode dataflow that allows actors to be migrated among processors of a multi-processor system depending on the mode of operation. This allows for an improved resource efficiency compared to a static mapping of actors onto the processors.

Often, not all aspects of a given system are known at design time. The paper “Probabilistic Model Checking for Uncertain Scenario-Aware Data Flow” by Katoen and Wu considers a form of dynamic dataflow, specifically Scenario-Aware Dataflow (SADF), with uncertain information. This paper was already published in Vol 22, Issue 1. It proposes a probabilistic model checking approach for the quantitative analysis of dynamic SADF models with uncertainty about actor execution times and scenario sequences.

Parametric dataflow models of computation provide an interesting trade-off between expressiveness and analyzability. The paper “A Survey of Parametric Dataflow Models of Computation” by Bouakaz, Fradet and Girault provides a comprehensive characterization, overview and comparison of existing parametric dataflow models. This can help designers in selecting a dataflow model of computation fitting their needs.

Symbolic dataflow analysis aims to derive model properties like latency, throughput, and buffer requirements as functions in terms of given model parameters. Evaluation of such functions for specific parameter valuations is very fast, whereas the non-symbolic analysis algorithms for these properties are typically exponential in nature. The final paper in this special section, “Symbolic Analyses of Dataflow Graphs,” also by Bouakaz, Fradet and Girault develops such symbolic analysis techniques. The functions resulting from this analysis are useful in design-space exploration and for run-time optimization.

We thank the authors for submitting their work to this special section. We thank the reviewers, whose careful reviews and valuable suggestions helped to improve the quality of the accepted papers. We thank Naehyuck Chang and Annie Yu for their support in realizing this special section. Enjoy!

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