Resource-efficient implementation of mixed-criticality systems

Department of Computer Science University of North Carolina at Chapel Hill August 2014

Context and motivation

Due to cost and other considerations, there in an increasing trend in safety-critical systems towards supporting functionalities of different degrees of importance (or *criticalities*) upon shared platforms. Such platform integration is essential to make more efficient use of platform resources; however, care must be taken to prevent failures of non-critical components from affecting the behavior of critical components. This project is directed at developing new tools, techniques, and methodologies for deriving mixed-criticality system designs that ensure such isolation, particularly on platforms that utilize multicore processors. The thesis explored in this project is that ensuring both correctness and resource-efficiency in mixed-criticality systems requires the development of fundamentally new perspectives on the modeling of these systems, and different approaches to resource allocation and scheduling.

Methodology

The objectives of the project will be accomplished by devising new models for representing mixed-criticality systems, new metrics for quantifying the effectiveness of techniques for designing such systems, and new methods for performing resource allocation and scheduling upon integrated architectures that support mixed-criticality systems. These new models, metrics, and methods will inform the development of new tools and methodologies for deriving mixed-criticality system designs that are both correct by construction and implementable in a resource-efficient manner. Continuing collaborations with partners in the avionics and automotive industries will enable these results to direct the research agenda on mixed-criticality systems to better address current and future industrial needs.

Project Members

Sanjoy Baruah, Professor
James Anderson, Professor
Zhishan Guo, Graduate Research Assistant

Research Sponsor

National Science Foundation

Selected Publications

Sanjoy Baruah. Implementing mixed-criticality synchronous reactive programs upon uniprocessor platforms. Real-Time Systems 50(3), pp 317-341, 2014

Sanjoy Baruah, Bipasa Chattopadhyay, Haohan Li, and Insik Shin. Mixed-criticality scheduling on multiprocessors. Real-Time Systems 50(1), pp 142-177, 2014

Sanjoy Baruah, Vincenzo Bonifaci, Gianlorenzo D'Angelo, Haohan Li, Alberto Marchetti-Spaccamela, Nicole Megow, and Leen Stougie. Scheduling real-time mixed-criticality jobs. IEEE Transactions on Computers 61 (8), pp 1140-1152, 2012

Sanjoy Baruah and Zhishan Guo. Mixed-criticality scheduling upon varying-speed processors. Proceedings of the IEEE Real-Time Systems Symposium (RTSS 2013), Vancouver, BC. December 2013. IEEE Computer Society Press.

Sanjoy Baruah, Vincenzo Bonifaci, Gianlorenzo D'Angelo, Haohan Li, Alberto Marchetti-Spaccamela, Suzanne Van Der Ster and Leen Stougie. The preemptive uniprocessor scheduling of mixed-criticality implicit-deadline sporadic task systems. Proceedings of the EuroMicro Conference on Real-Time Systems (ECRTS 2012), Pisa, Italy. July 2012. IEEE Computer Society Press.

Sanjoy Baruah, Alan Burns, and Robert Davis. Response-time analysis for mixed criticality systems. Proceedings of the IEEE Real-Time Systems Symposium (RTSS), Vienna, Austria. Nov-Dec, 2011.

Sanjoy Baruah and Gerhard Fohler. Certification-cognizant time-triggered scheduling of mixed-criticality systems. Proceedings of the IEEE Real-Time Systems Symposium (RTSS), Vienna, Austria. Nov-Dec, 2011.

Sanjoy Baruah, Vincenzo Bonifaci, Gianlorenzo D'Angelo, Alberto Marchetti-Spaccamela, Suzanne Van Der Ster and Leen Stougie. Mixed-Criticality Scheduling of Sporadic Task Systems Proceedings of the 19th Annual European Symposium on Algorithms (ESA 2011), pp 555-566, Saarbrucken, Germany. September 2011. Springer-Verlag.

For More Information

Sanjoy Baruah
Phone (919) 590-6103
E-mail: baruah@cs.unc.edu