Applying Modeling and Simulation for Development of Embedded Systems

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Abstract

Embedded real-time software construction has usually posed interesting challenges due to the complexity of the tasks executed. Most methods are either hard to scale up for large systems, or require a difficult testing effort with no guarantee for bug-free software products. Formal methods have showed promising results; nevertheless, they are difficult to apply when the complexity of the system under development scales up. Instead, systems engineers have often relied on the use of modeling and simulation (M&S) techniques in order to make system development tasks manageable. Construction of system models and their analysis through simulation reduces both end costs and risks, while enhancing system capabilities and improving the quality of the final products. M&S let users experiment with "virtual" systems, allowing them to explore changes, and test dynamic conditions in a risk-free environment. This is a useful approach, moreover considering that testing under actual operating conditions may be impractical and in some cases impossible.

In this talk, we will present a Modeling and Simulation-based framework to develop embedded systems based on the DEVS (Discrete Event systems Specification) formalism. DEVS provides a formal foundation to M&S that proved to be successful in different complex systems. This approach combines the advantages of a simulation-based approach with the rigor of a formal methodology. Another advantage of using DEVS is that different existing techniques (Bond Graphs, Cellular Automata, Partial Differential Equations, Queuing models, etc.) have been successfully transformed into DEVS models. We will discuss how to use this framework to incrementally develop embedded applications, and to seamlessly integrate simulation models with hardware components. Our approach does not impose any order in the deployment of the actual hardware components, providing flexibility to the overall process. The use of DEVS improves reliability (in terms of logical correctness and timing), enables model reuse, and permits reducing development and testing times for the overall process. Consequently, the development cycle is shortened, its cost reduced, and quality and reliability of the final product is improved.

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Short Bio

GABRIEL A. WAINER, SMSCS, SMIEEE, received the M.Sc. (1993) at the University of Buenos Aires, Argentina, and the Ph.D. (1998, with highest honors) at the Université d'Aix-Marseille III, France. In July 2000 he joined the Department of Systems and Computer Engineering at Carleton University (Ottawa, ON, Canada), where he is now Full Professor. He has held visiting positions at the University of Arizona; LSIS (CNRS), Université Paul Cézanne, University of Nice, INRIA Sophia-Antipolis (France); UCM, UPC (Spain) and others. He is the author of three books and over 280 research articles; he edited four other books, and helped organizing numerous conferences, including being one of the founders of SIMUTools and SimAUD. Prof. Wainer is the Vice-President Conferences, and was a Vice-President Publications and a member of the Board of Directors of the SCS. Prof. Wainer is the Special Issues Editor of SIMULATION, member of the Editorial Board of IEEE Computing in Science and Engineering, Wireless Networks (Elsevier), Journal of Defense Modeling and Simulation (SCS), and International Journal of Simulation and Process Modelling (Inderscience). He is the head of the Advanced Real-Time Simulation lab, located at Carleton University's Centre for advanced Simulation and Visualization (V-Sim). He has been the recipient of various awards, including the IBM Eclipse Innovation Award, SCS Leadership Award, and various Best Paper awards. He has been awarded Carleton University's Research Achievement Award (2005), the First Bernard P. Zeigler DEVS Modeling and Simulation Award, the SCS Outstanding Professional Award (2011) and Carleton University's Mentorship Award (2013), the SCS Distinguished Professional Award (2013) and Carleton University's Research Achievement Award (2014).