computer languages

Einladung

zum Informatik-Kolloquium des

AB Programmiersprachen und Übersetzer am

Freitag, den 15. April 2016, um 14:00 Uhr c.t.

Hörsaal EI5 Hochenegg, Elektrotechnik, Gußhausstraße 25-29 (Altbau), 2. Stock

Es spricht

Prof. Dr. Albert M. K. Cheng

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über

Functional Reactive Programming for Real-Time and Cyber-Physical Systems: Response Time Analysis, Scheduling and Verification

The use of sophisticated digital systems to control complex physical components in real-time has grown at a rapid pace. These applications range from traditional stand-alone systems to highly-networked cyber-physical systems (CPS's), spanning a diverse array of software architectures and control models. Examples include automobile adaptive braking, industrial robotic assembly, medical pacemakers, autonomous (ground, air, and sea) vehicular travel, remote surgery, physical manipulation of nano-structures, search-and-rescue, and space exploration. Since all these applications interact directly with the physical world and often have humans in the loop, we must ensure their physical safety.

Obviously, the correctness of these embedded systems and CPS's depends not only on the effects or results they produce, but also on the time at which these results are produced. For example, when the driver of a car applies the brake, the anti-lock braking controller analyzes the environment in which the controller is embedded (car speed, road surface, direction of travel) and activates the brake with the appropriate frequency within fractions of a second. Both the result (brake activation) and the time at which the result is produced are important in ensuring the safety of the car, its driver and passengers. In a CPS consisting of a multitude of vehicles and communication components with the goal to avoid collisions and reduce traffic congestions, formal safety verification and response time analysis are essential to the certification and use of such systems.

The benefits of using the functional (reactive) programming (FRP) over the imperative programming style found in languages such as C/C++ and Java for implementing embedded and real-time software are several. The functional programming paradigm allows the programmer to intuitively describe safety-critical behaviors of the system, thus lowering the chance of introducing bugs in the design phase. Its stateless nature of execution does not require the use of synchronization primitives like mutexes and semaphores, thus reducing the complexity in programming. However, accurate response time analysis of FRP-based controllers remains a largely unexplored problem. This talk will introduce a framework for accurate response time analysis, scheduling, and verification of embedded controllers implemented as FRP programs.

Biographie: Albert Mo Kim Cheng is a Full Professor and former interim Associate Chair of the Computer Science Department at the University of Houston (UH). He has pioneered the response time analysis of real-time Rule-Based Systems in 1988, and is now doing the same for Functional Reactive Programming (FRP), which can potentially transform the way we implement next-generation embedded systems. His research interests center on the design, specification, modeling, scheduling, and formal verification of real-time, embedded, and cyber-physical systems, green/power/thermal-aware computing, software engineering, knowledge-based systems, and networking. He is the founding Director of the UH Real-Time Systems Laboratory.

Prof. Cheng received the B.A. with Highest Honors (summa cum laude) in Computer Science, graduating Phi Beta Kappa at age 19, the M.S. in Computer Science with a minor in Electrical Engineering at age 21, and the Ph.D. in Computer Science at age 25, all from The University of Texas at Austin, where he held a GTE Foundation Doctoral Fellowship. He has served as a technical consultant for a number of organizations, including IBM and Shell, and was also a Visiting Professor in the Departments of Computer Science at Rice University and at the City University of Hong Kong. He is a co-founder of ZapThru.com, where he is currently the Chief Strategy and Technology Director.

Dr. Cheng is the author/co-author of over 220 refereed publications in leading journals (including IEEE Transactions on Computers, IEEE Transactions on Software Engineering, and IEEE Transactions on Knowledge and Data Engineering) and top-tier conferences (including RTSS, RTAS, RTCSA, ICPADS, ISLPED, LCN, COMPSAC, PADL, IPPS, IPDPS, and ICPP; several articles received Best Paper Awards or were Best Paper Nominees). He has received numerous awards, including the U.S. National Science Foundation Research Initiation Award (now known as CAREER) and the Texas Advanced Research Program Grant (ranking 12th among 373 funded proposals). He has been invited to present seminars, tutorials, panel positions, and keynotes at over 100 conferences, universities, and organizations. He is and has been on the technical program committees (including many program chair positions) of over 250 conferences, symposia, workshops, and editorial boards (including the IEEE Transactions on Software Engineering 1998-2003 and the IEEE Transactions on Computers 2011-2015). Currently, Dr. Cheng is the Editor-in-Chief of the Journal of Software Engineering.

He has been the Guest Co-Editor of a 2013 Special Issue on Rigorous Modeling and Analysis of Cyber-Physical Systems of the IEEE Embedded Systems Letters, and the Guest Editor of a 2014-2015 Special Issue on Cyber-Physical Systems of SENSORS. He has been the Program Co-Chair of the System, Models and Algorithms Track of the 2014 IEEE International Conference on Embedded Software and Systems (ICESS), the Program Co-Chair of the 2013 IEEE International Conference on Service Oriented Computing and Applications (SOCA), the Program Vice-Chair of the 2008 International Conference on Embedded and Ubiquitous Computing (EUC), and the Program Chair of the 2001 and 2005 IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS) WIP.

He has recently served as the Chair of the First Workshop on Declarative Programming for Real-Time and Cyber-Physical Systems (DPRTCPS) in San Antonio, Texas, USA, December 1, 2015, as well as the Program Chair of the International Symposium on Software Engineering and Applications (SEA), in Marina del Rey, California, USA, October 26-28, 2015. Currently, Dr. Cheng is organizing and chairing the First Workshop on Declarative Cyber-Physical Systems (DCPS) at CPSWeek in Vienna, Austria, April 11-14, 2016. He is the Guest Editor of the 2016 Special Issue on Real-Time and Cyber-Physical Systems of Sensors, and the Guest Co-Editor of the 2016 Special Issue on Real-Time Scheduling on Heterogeneous Multi-core Processors of Microprocessors and Microsystems (MICPRO) - the Elsevier Embedded Hardware Design Journal.

Dr. Cheng is the author of the popular senior/graduate-level textbook entitled Real-Time Systems: Scheduling, Analysis, and Verification (John Wiley & Sons), 2nd printing with updates, 2005. He is a Senior Member of the IEEE, an Honorary Member of the Institute for Systems and Technologies of Information, Control and Communication (INSTICC), and a Fellow of the Institute of Physics (IOP). His recent awards include the Outstanding Leadership Award as Track Chair and the Outstanding Leadership Award as Keynote Speaker at IEEE ICESS 2014, and the 2015 University of Houston's Lifetime Faculty Award for Mentoring Undergraduate Research for his "Exceptional efforts in demonstrating a lasting commitment to undergraduate research." (http://www.cs.uh.edu/~acheng/acheng.html)