Computer Science Seminar

Bringing Predictability Guarantees to Safety-Critical Cyber-Physical Systems

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10:00 - 10:50 am
209 Computer Science Building
Refreshments will be served at 9:45 am outside CS209

To guarantee predictable temporal correctness in safety-critical cyber-physical systems, a difficult problem is to analyze the execution behaviors of tasks that may access heterogeneous resources including both CPU cores and shared resources (e.g., memory or accelerators). A traditional approach is to analyze schedulability from a core-centric perspective. The core-centric perspective is sound for traditional embedded systems where computing resources may be insufficient while the contention on shared resources is often light. However, it is not applicable to many CPS supporting rather resource-demanding workloads. Due to the large number of physical components involved, the operations of CPS include sensing, processing and storage of massive big data. In most CPS, such as the autonomous driving system, shared resources such as memory may become the actual scheduling bottleneck, causing the worst-case latency bound on the shared resource to be rather pessimistic or even impossible to upper bound. Motivated by this observation, we argue that it may be much more viable to resolve this multi-resource scheduling problem from the counter-intuitive shared-resource centric perspective since tasks may experience much lighter contention on CPU cores. Our developed techniques focus on judiciously scheduling tasks that may exhibit parallel execution and self-suspension behaviors on the limited-preemptive shared resource. Our research methodology is counter-intuitive yet efficient: we treat the shared resource as the first-class units and bound the worst-case latency a task may experience on the CPU cores (i.e., treating CPU cores as "I/O").

Bio: Zheng Dong received the B.S. degree in computer science from Wuhan University, Wuhan, China, in 2007, and the M.S. degree in software engineering from the University of Science and Technology of China, Hefei, China, in 2011. He is currently a fifth-year Ph.D candidate in the Department of Computer Science, University of Texas at Dallas, USA. His research interests include real-time and cyber-physical systems, IoT and wireless sensor network. He received the Outstanding Paper Award at RTSS 2017 and the Best Paper Runner-up at RTCSA 2017.

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