SELF-AWARE REAL-TIME WIRELESS COMMUNICATION AND SIGNAL PROCESSING SYSTEMS: *ADAPTATION FOR PERFORMANCE, LOW POWER AND ERROR RESILIENCE*

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ABSTRACT: Real-time systems for wireless communication and digital signal processing experience a wide gamut of operating conditions (signal/channel noise, workload demand, perturbed process conditions). As device bandwidths expand, it becomes increasingly expensive, from a power consumption and reliability perspective, to operate such real-time systems for worst-case (static) performance requirements. In contrast, it is attractive to design "self-aware" algorithms, architectures and circuits that are power-performance tunable and can *adapt dynamically* to the requirements of system-level applications for extended battery usage and device lifetime. Such future systems will feed application level demands to the underlying algorithm-architecture-circuit design fabric through built-in sense-and-control infrastructure (hardware, software). The *sense* functions assess instantaneous application level demands (e.g. throughput, signal integrity) as well as the performances of the individual hardware components as determined by manufacturing process conditions. The *control* functions actuate algorithm-through-circuit level *tuning knobs* that continuously trade off performance vs. power of the individual software and hardware modules in such a way as to deliver the end-to-end desired application level Quality of Service (QoS), while minimizing energy/power consumption. A distributed video sensing system is used as an example to demonstrate the core ideas. Adaptation methods for SISO and MIMO systems are presented and control subsystem design using constrained optimization, fuzzy control and self-learning is discussed.

BIO: Abhijit Chatterjee is a professor in the School of Electrical and Computer Engineering at Georgia Tech and a Fellow of the IEEE. He received his PhD in electrical and computer engineering from the University of Illinois at Urbana-Champaign in 1990. Dr. Chatterjee received the NSF Research Initiation Award in 1993 and the NSF CAREER Award in 1995. He has received six Best Paper Awards and three Best Paper Award nominations. His work on self-healing chips was featured as one of General Electric's key technical achievements in 1992 and was cited by the *Wall Street Journal*. In 1995, he was named a Collaborating Partner in NASA's New Millennium project. In 1996, he received the Outstanding Faculty for Research Award from the Georgia Tech Packaging Research Center, and in 2000, he received the Outstanding Faculty for Technology Transfer Award, also given by the Packaging Research Center. In 2007, his group received the Margarida Jacome Award for work on VIZOR: Virtually Zero Margin Adaptive RF from the Berkeley Gigascale Research Center (GSRC).

Dr. Chatterjee has authored over 400 papers in refereed journals and meetings and has 20 patents. He is a co-founder of Ardext Technologies Inc., a mixed-signal test solutions company and served as chairman and chief scientist from 2000-2002. His research interests include error-resilient signal processing and control systems, mixed-signal/RF/multi-GHz design and test and adaptive real-time systems. He served as the chair of the VLSI Technical Interest Group at Georgia Tech from 2010-2012. He co-leads the Samsung Center of Excellence in High-Speed Design and Test established at Georgia Tech in 2011.