

Real-time and Energy-efficient Hardware Design of Algorithms for Robot Applications

Abstract: Autonomous mobile robots require robust sensing, planning, and control for real-world applications and technological advancement have led to a proliferation of such robots to assist human in a wide range of tasks. These robots have benefited from the use of GPUs to run these applications; however, GPU-based implementations still may not meet runtime requirement and incur substantial energy consumption, limiting their use for battery-constrained applications. Custom hardware designs (e.g., on FPGA platforms) have the potential to improve runtime performance and significantly reduce energy consumption, but naive translation from GPU to FPGA platforms will likely not yield desired performance advantages. Instead, effective translation demands a synergistic approach involving explicit hardware-software co-design. Namely, systematic analysis of algorithm structure, exposure of fine-grained parallelism, and deliberate mapping onto hardware resources under timing constraints. In this talk, I will present our work on implementing scalable, computationally efficient robot algorithms in hardware that can achieve real-time results in an energy efficient manner. I will also discuss future directions in designing scalable and efficient algorithms in hardware more broadly.

Biography: R. Iris Bahar received the B.S. and M.S. degrees in computer engineering from the University of Illinois, Urbana-Champaign, and the Ph.D. degree in electrical and computer engineering from the University of Colorado, Boulder. She is a faculty member in the Computer Science Department at the Colorado School of Mines, where she currently serves as their Department Head. Before joining Mines, she was on the faculty at Brown University for 26 years and held dual appointments as Professor of Engineering and Professor of Computer Science. Her research interests focus on energy-efficient and reliable computing, from the system level to device level. She is the recipient of the Marie R. Pistilli Women in Engineering Achievement Award, the Brown University School of Engineering Award for Excellence in Teaching in Engineering, the 2022 University of Illinois ECE Department Distinguished Alumni Award, and the 2024 IEEE Field Medal in Undergraduate Teaching. Iris is an IEEE Fellow and an ACM Distinguished Scientist.