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Invited Talk

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Cross-Layer Design, Optimization and Runtime Management for Various Power Sources

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Biography

Naehyuck Chang is a Full Professor at the Department of Electrical Engineering, Korea Advanced Institute of Science and Technology (KAIST) from 2014. Before he joined KAIST, he was with the Department of Computer Science and Engineering, Seoul National University from 1997 to 2014. Dr. Chang also served as a Vice Dean of College of Engineering, Seoul National University from 2011 to 2013.

Dr. Chang's research interests include low-power embedded systems and Design Automation of Things. He is a Fellow of ACM and IEEE for contribution to low-power systems. Dr. Chang is the Editor-in-Chief of the ACM Transactions on Design Automation of Electronics Systems. He served for the ACM SIGDA (Special Interest Group on Design Automation) and is currently Past Chair of ACM SIGDA. He is also serving for IEEE CEDA (Council of EDA) for Publications Committee and the distinguished lecture program. Dr. Chang was a TPC Chair of DAC 2016 and ASP-DAC 2016.

Abstract

Low-power design have been mainly focusing on power consumers. However, power sources are non-ideal voltage and current sources, and therefore, layered power management, which does not consider detailed characteristics of the power source, may seriously diminish the potential power gain from the management policy. Nevertheless, system-level design often simplifies power supply characteristics as interruptible/non-interruptible and/or with a limited/unlimited energy capacity and a fixed constant efficiency. Most power sources, on the other hand, have a variable voltage output and a limited power capacity as well, and their lifetime is largely limited. In fact, degradation (aging) is crucial in many real-world power sources.

This talk focus on non-ideal characteristics of power sources as well as the power consumers. We demonstrate how cross-layer power management can enhance the overall system power efficiency and also the lifetime of the power sources. We will introduce i) fuel cell and battery hybrid systems that enhance the fuel efficiency, ii) dynamic reconfiguration of PV arrays against partial shading and PV cell faults, iii) hybrid energy storage systems that exploit the advantages of different types of storage elements and hide their drawbacks, iv) PVS (passive voltage scaling) that dynamically changes the system voltage and frequency by the battery SoC (state of charge), v) storage-less and converter-less MPPT (maximum power point tracking) that performs MPTT without a power converter nor energy storage applying extensive dynamic power management of the target system, vi) and ongoing work on a reconfiguration network for SOFC (solid oxide fuel cells), vehicle energy harvesting with TEG (thermoelectric generators) and electric vehicle conversion for extreme off-road driving application where even high-end Lithium polymer batteries should not be considered as an ideal power source.

Hosted by: Aviral Shrivastava

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