PHYSICAL DESIGN AND SMART HOME CYBERSECURITY: THE MARRIAGE OF CAD AND CYBERPHYSICAL SYSTEM

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ABSTRACT: In this talk, I will begin with the discussion on a CAD problem, namely, the interconnect optimization which is a key process for handling ever increasing interconnect delay in the nanometer VLSI design. I will highlight my experience in tackling a major open problem in the field, namely, the timing driven minimum cost buffer insertion problem. My work designs the first fully polynomial time approximation scheme for this problem, which can approximate the optimal solution within a factor of $1+\varepsilon$ running in $O(m^2n^2b/\varepsilon^3+n^3b^2/\varepsilon)$ time for any $0<\varepsilon<1$. I will then move on to smart home system and cybersecurity. The massive deployment of advanced metering infrastructure and home energy management system has mandated a transformative shift of the classical grid into a more reliable and secure grid. A smart home system is critical as it controls all the end use components of a grid. However, such a system is vulnerable to cyberattacks such as energy theft and pricing hack. For example, we demonstrate that due to the interdependence between utility pricing and customer energy load, a cyber attacker could tamper smart meters for monetary cost loss of users and energy load unbalancing of the power system. I will also discuss the countermeasures for smart home cyberattacks, which are based on the joint optimization using machine learning and power electronic sensor deployment. As an example, I will describe our recent work on a strategic Feeder Remote Terminal Unit (FRTU) deployment optimization technique based on the cross entropy and the conditional random field techniques for detecting smart meter tampering in the power distribution network.

BIOGRAPHY: Shiyan Hu received his Ph.D. in Computer Engineering from Texas A&M University in 2008. Effective September 2014, he will be an Associate Professor in the Department of Electrical and Computer Engineering at Michigan Technological University, where he is the Director of Michigan Tech VLSI CAD Research Lab. He has been a Visiting Professor at IBM Research (Austin) during Summer 2010. His research interests are in the area of Computer-Aided Design of VLSI Circuits and Smart Home System and Cybersecurity, and he has published over 70 technical papers in the refereed journals and conferences. He is a recipient of ACM SIGDA Richard Newton DAC Scholarship (as the faculty advisor), a recipient of Faculty Invitation Fellowship from Japan Society for the Promotion of Science (JSPS), and a recipient of the National Science Foundation (NSF) CAREER award.