Purdue University | Elmore Family School of Electrical and Computer Engineering

Faculty Candidate Seminar – Professor of Engineering Practice

Asst. Professor Noori Kim

Newcastle University in Singapore

Tue., Feb. 22, 2022 ~ 10:30 A.M. ~ Purdue Graduate Student Center, Room 105A & B

Fundamentals of Hearing Measurement Systems

Research Abstract: "Approximately 15% of the world's adult population has some degree of hearing loss; Nearly one-third of people aged above 65 are affected by disabling hearing loss "— World health organization (WHO), 2012

Researchers worldwide have actively studied the impact of ageing on the human auditory system; monitoring and measuring hearing ability are crucial and will become demanding to prepare for our near future. In general, a hearing-aid consists of three parts: a microphone (picks up sound), an amplifier (transforms sound into different frequencies, filters noise, and selectively amplifies each frequency region based on the difference in individuals with hearing loss via multi-band compression), and a receiver (sends the processed signal from the amplifier into the ear). The hearing-aid transducer is ubiquitous in the hearing-aid industry, not only for the hearing aids. For example, the balanced armature receiver (BAR), invented by A. G. Bell, has been used in all telephone earphones because it has the highest output and best frequency response.

Motivated by the transducer model of Kim and Allen (2013), this talk discusses designing a hearing measurement system to perform middle ear diagnostics. It also covers understanding the transducer systems, starting with modelling one of the most popular hearing-aid receivers, a BAR. Ultimately, this presentation strengthens foundational knowledge of anti-reciprocal (electromagnetic) transducer theory and application. Also, it provides essential techniques to evaluate and manufacture hearing measurement devices, in general.

Finite State Machines

Teaching Abstract: Digital Systems consist of two basic circuit types; Combinational and Sequential logic circuits. Finite State Machines (FSM) are one of the great abstracting tools to characterize the behaviour of the sequential logic circuits, independent of its actual circuit implementation.

In this lecture, we learn about the concept of FSM design with Moore and Mealy FSM methods. Both FSM methods are interchangeable and equivalent; any Moore machines can be converted to Mealy machines, vice versa. The fundamental difference between the two methods lies in their output generation dependency to inputs and current state.

A general finite state machine design procedure is introduced with seven steps, from defining inputs and outputs to implementing FSM circuits. A simple "Digital Lock System - sequence detector" is examined as an FSM circuit example. Ultimately, this presentation provides a fundamental understanding of FSM abstraction methods in designing sequential logic circuits systems.

Bio: Dr Noori Kim is an assistant professor at Newcastle University in Singapore (NUIS) in the Electrical and Electronic Engineering department and a chair of IEEE Women in Engineering Singapore Affinity group. She worked at the Digipen Institute of Technology Singapore in the Electrical and Computer Engineering department prior to joining the NUIS. She has extensive experience in Electrical/Electronics/Computer engineering teachings from fundamental to practical topics.

Dr Kim graduated with a PhD from the University of Illinois at Urbana-Champaign (UIUC) in Electrical and Computer Engineering (thesis title: *Analysis and measurement of anti-reciprocal systems*). Then she served as a research fellow in the Mechanical and Aerospace engineering department at Nanyang Technological University (Singapore) for a year. Dr Kim received her BS and MS degrees in Computer Science from Ewha Woman's University in South Korea. During her two years of MS degree study (medical image processing lab, MS thesis title: *Microscopy image segmentation for cell viability analysis*), she was invited to the Fraunhofer Institute for Computer Graphics Research IGD in Darmstadt, Germany, as a short-term visiting scholar. Her other accomplishments include research at Stanford University's Department of Medicine in 2007 as a visiting scholar.

She has taught courses such as Computer Environments (computer architecture, ARM Assembly programming), Embedded Microcontroller Systems (ARM C programming), Electric Circuits, Analogue Electronics, Digital Electronics I (Digital logics and labs), Digital Electronics II (VHDL, FPGA), Project and Career Professional Development, Embedded Systems and Industrial Internet Of Things (IIoT), Work and Integrated Study Program (Internship), and Final Year Projects, Capstone projects.

Based on her multidisciplinary background, her general research interests are Hearing Mechanics, Future Healthcare, MEMS, Electromagnetics, Acoustics, and Embedded Systems (IoT), which spans computer, electrical, and mechanical engineering systems.

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