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ECE Research Seminar
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Security of Embedded Systems: Backscatter Side Channels Against Wired Interconnects and Input Devices

Lina Pu | lina.pu@ua.edu

Abstract: Physical-layer side channels have a long history: unintended electromagnetic emanations from cables, displays, and keyboards can betray data that cryptography was supposed to protect. However, passive EM attacks are limited by whatever leakage the victim happens to radiate. This talk introduces an active attack, in which the attacker supplies the energy: an external continuous-wave carrier illuminates the victim, and data-dependent impedance changes at CMOS I/O ports modulate the amplitude of the reflected wave. The same principle that makes passive backscatter communication (e.g., RFID) work also makes an unmodified device into an unwilling transmitter. This talk presents the necessary background (side-channel basics, EM eavesdropping, RF retroreflectors, and backscatter communication) and then walks through two results that mark this line of work. The first shows that unshielded serial cables carrying UART, I2C, and SPI leak their bitstreams at meter-scale range. The second shows that the same illumination principle leaks a qualitatively different signal: in a keyboard, a keypress is not a readable bit but a sub-inch change in conductive geometry that perturbs the matrix-scan backscatter frame, turning recovery into a label-free, multi-class inference problem solved with unsupervised clustering plus language-model substitution decoding.

Lina Pu is an Associate Professor in the Department of Computer Science at The University of Alabama. She received her Ph.D. and M.S. in Computer Science and Engineering from the University of Connecticut in 2015 was an Assistant Professor at the University of Southern Mississippi before joining UA in 2020. In 2026, she received the NSF CAREER award. Her research covers the Internet of Things, IoT security, wireless and underwater communication and networking, and edge computing. Recent work includes underwater acoustic reconfigurable intelligent surfaces, eavesdropping on serial communication through backscatter signals, RF energy harvesting and the nonlinear behavior of real harvesting hardware, and energy-aware scheduling for edge computing. Her group builds and measures real systems: field deployments, testbeds and hardware prototypes rather than simulation alone.

*** For further information contact: Dr. Jenny Du | du@ece.msstate.edu | 5-2035**

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