*Hong Kong Joint Chapter of Electron Devices and Solid-State Circuits and HKUST – ACE Online Seminar Series*

## Cross-Layer Design for Search-in-Memory using Ferroelectric Field-Effect Transistors

**Xunzhao YIN,
Zhejiang University**

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As Moore's law-based device scaling and accompanying performance scaling trends slow down, and the rapid growth of data-intensive applications in the era of "Internet of Things" and "Big Data", there are increasing interests in emerging technologies and computational paradigms that enable more efficient information processing. Meanwhile, in the context of traditional Boolean circuits and/or von Neumann architectures, it is challenging for beyond-CMOS devices to compete with the CMOS technology as simple replacements. Exploiting the unique characteristics of emerging devices – especially in the context of alternative circuits and architectural paradigms – indicates a promising approach to further improve the information processing capability of hardware. In this talk, I will show how our research work has leveraged the unique characteristics of emerging devices to build efficient circuits and architectures with significant improvements in area, energy and performance. Specifically, I will consider Ferroelectric FETs (FeFETs) which are nonvolatile and can function as both a transistor and a storage element. This unique property enables FeFETs to be used for building efficient computing-in-memory (CiM) circuits called content addressable memories (CAMs). CAMs perform the parallel search function across the memory blocks, thus are desirable in many applications including IP routers and advanced machine learning hardware. Using models calibrated by experimentally fabricated devices as well as cross-layer design approaches, we show that the FeFET-based CAM designs could enable orders of magnitude improvements in energy efficiency and performance when considering application-level computing tasks.

Biography: Xunzhao Yin is an assistant professor of the College of Information Science and Electronic Engineering at Zhejiang University. He received his Ph.D. degree in Computer Science and Engineering from University of Notre Dame in 2019 and B.S. degree in Electronic Engineering from Tsinghua University in 2013, respectively. His research interests include emerging circuit/architecture designs and novel computing paradigms with both CMOS and emerging technologies. He has published more than 30 top journals and conferences, including Nature Electronics, IEEE TCAD, IEEE TED, IEEE TVLSI, IEEE TCAS-II, IEEE Design & Test, ICCAD, DATE, IEDM, etc. He has received the best paper award nomination of ICCAD 2020, the Outstanding Research Assistant Award in the department of CSE at University of Notre Dame in 2017, and Bronze medal of Student Research Competition at ICCAD 2016, etc.