Department of Electrical Engineering
香港城市大學
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CityU Architecture Lab for Arithmetic and Security (CALAS) Seminar Series

Exploration of Logic Synthesis and Its Application in Superconducting Logic Design

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Abstract:

Logic synthesis plays a pivotal role in the circuit design process. This talk investigates advanced paradigms in logic synthesis to transcend traditional heuristic limitations. We propose a theoretical framework that integrates algebraic rewriting via equality saturation and learning-guided optimization to navigate complex Boolean spaces. Furthermore, we pioneer LLM-driven algorithmic evolution and technology-aware library extension, shifting from manual tuning to automated operator design. These methodologies collectively address fundamental challenges in optimization convergence and mapping efficiency. Extending these principles to post-Moore computing, we address the rigorous design challenges of superconducting logic (RSFQ/AQFP). Governed by flux-quantization dynamics, these technologies necessitate strict path balancing and topological constraints. We present a specialized EDA framework that adapts logic synthesis and physical design algorithms to these unique requirements. This work bridges abstract logic optimization with the realization of next-generation low-power computing systems.

Biography:

Rongliang Fu recently completed his Ph.D. in Computer Science and Engineering at The Chinese University of Hong Kong. He received his M.S. in Computer Science and Technology from the University of Chinese Academy of Sciences in 2021 and his B.S. in Software Engineering from Northwestern Polytechnical University in 2018. His research spans logic synthesis and EDA for superconducting electronics. He has authored 30 papers across major journals (IEEE TC and IEEE TCAD) and conferences(DAC, DATE, ICCAD, etc.), with Best Paper Award nominations at GLSVLSI 2021 and ISPD 2024.

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