Millimeter-Scale Neuromorphic Vision System

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Millimeter-scale sensing semiconductor devices offer a unique combination of features, including wireless communication, energy harvesting, and ultra-compact form factors. These capabilities enable non-invasive and secure deployment in next-generation Internet-of-Things (IoT) applications across biomedical, ecological, surveillance, and infrastructure domains. Significant progress in miniaturization has advanced the vision of "smart dust" at the millimeter scale [1]. Meanwhile, emerging artificial intelligence (AI) technologies are enhancing the intelligence, accuracy, and reliability of traditional sensing systems. Motivated by these advances, I am investigating how to integrate advanced machine learning (ML) techniques to further expand the capabilities of millimeter-scale sensing platforms.

In this talk, I will highlight the key challenges involved in developing ultra-small sensing systems and introduce a millimeter-scale platform recognized as the world's smallest computer. I will also present recent research advances in digital circuit design for implementing Dynamic Neural Fields (DNF) [2] and Convolutional Neural Networks (CNN), enabling bio-inspired dynamic vision sensing (DVS) for low-power object classification and motion tracking.

References

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2. Y. Li, V. S. Vivekanand, R. Kubendran and I. Lee, "Dynamic Neural Fields Accelerator Design for a Millimeter-Scale Tracking System," in IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 32, no. 10, pp. 1940-1944, Oct. 2024, doi: 10.1109/TVLSI.2024.3416725.