

Ultrahigh-throughput single-pixel complex-field microscopy with frequency-comb acousto-optic coherent encoding

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Single-pixel imaging (SPI) is a promising technology for optical imaging beyond the visible spectrum, where commercial cameras are expensive or unavailable. However, limitations such as slow pattern projection rates and time-consuming reconstruction algorithms hinder its throughput for real-time imaging. Consequently, conventional SPI is inadequate for high-speed, high-resolution tasks. To address these challenges, we developed an ultrahigh-throughput single-pixel complex-field microscopy (SPCM) system utilizing frequency-comb acousto-optic coherent encoding (FACE). This system enables real-time complex-field monitoring in the non-visible domain. Operating at 1030 nm, our system achieves a record-high space-bandwidth-time product (SBP-T) of 1.3×10^7 , surpassing previous SPCM ($\sim 10^4$), SPI ($\sim 10^5$), and even certain types of commercial near-infrared cameras ($\sim 10^6$). It supports real-time streaming at 1,000 Hz with a frame size of 80×81 pixels and a lateral resolution of $3.76 \mu\text{m}$ across an approximately $300 \mu\text{m}$ field of view.



Short Bio:

Shian Zhang is a professor and the executive dean of the State Key Laboratory of Precision Spectroscopy at East China Normal University (ECNU). He received his Ph.D. degree in Optics from ECNU in 2006. His current research interest focuses on ultrafast optical imaging, high-speed super-resolution microscopy, and light field manipulation.