

AI-Enabled Real Time Hyperspectral Ghost Imaging with Frequency Combs

Scientific Achievement

Researchers combined dual optical frequency combs with a transformer-based deep-learning model to achieve video-rate ghost imaging using an ultra-thin optical fiber and single-pixel detector.

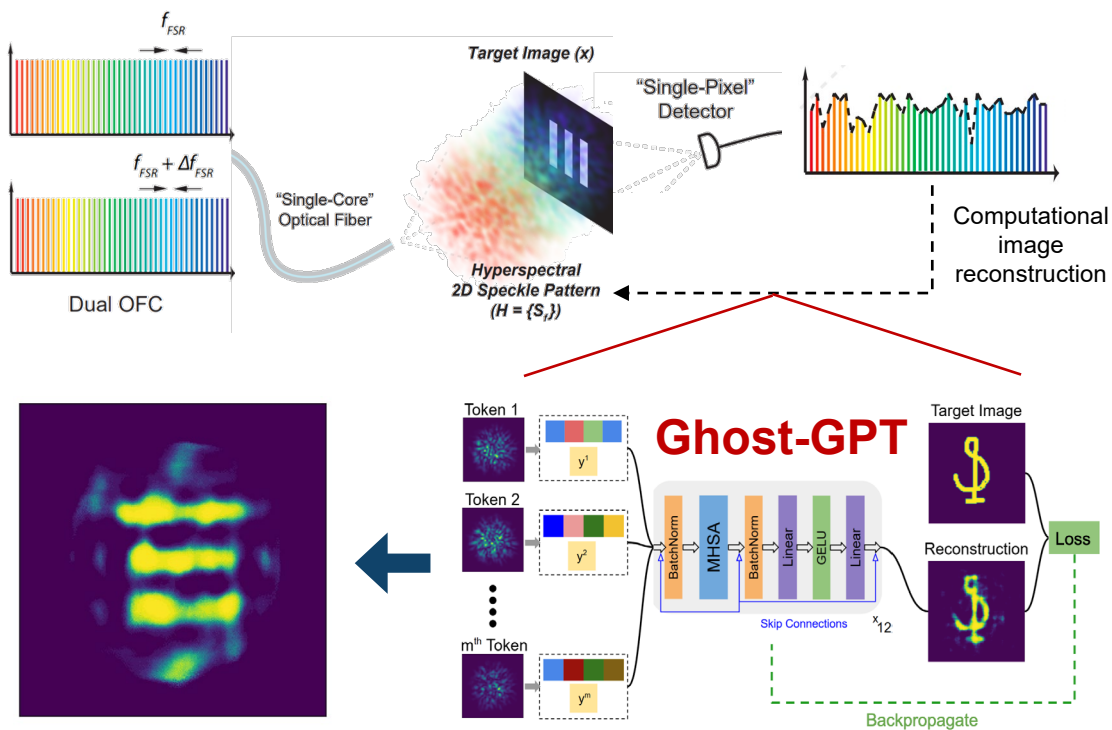


Figure: Schematic of hyperspectral dual-comb compressive ghost imaging. Each frequency-comb line generates a unique speckle pattern at the tip of a single-core fiber. The patterns illuminate the target simultaneously, and a single-pixel detector records the combined signal, and the reconstructed with the Ghost-GPT deep-learning model.

Work was performed, in part, at the Center for Integrated Nanotechnologies.

Significance and Impact

Ghost imaging reconstructs an image by using statistical correlations between the intensity of transmitted light and patterns of light. Previous methods were too slow for moving scenes or too bulky for any practical application. This approach removes the speed and size bottleneck.

Research Details

- Frequency combs generate ~200 colors (1532–1564 nm), each creating a distinct speckle pattern through a single optical fiber.
- Dual-comb interferometry measures the transmitted signal extremely quickly. Ghost-GPT then reconstructs images in 14 ms with 10× better quality than classical methods.
- Moving targets were imaged at 60 frames/s

Suh, M.-G.; Dang, D.; Gao, M.; Jin, Y.; Shin, D.-C.; Gupta, A.; Park, B. J.; Uzundal, C.; Hu, B.; Kort-Kamp, W. J. M.; Lee, H. W. H. Hyperspectral Dual-Comb Compressive Ghost Imaging with Deep Learning Reconstruction. *Light: Sci. Appl.* 2026, 15, 380.



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