Researchers develop hyper-sampling imaging to deliver ultra-high-resolution images

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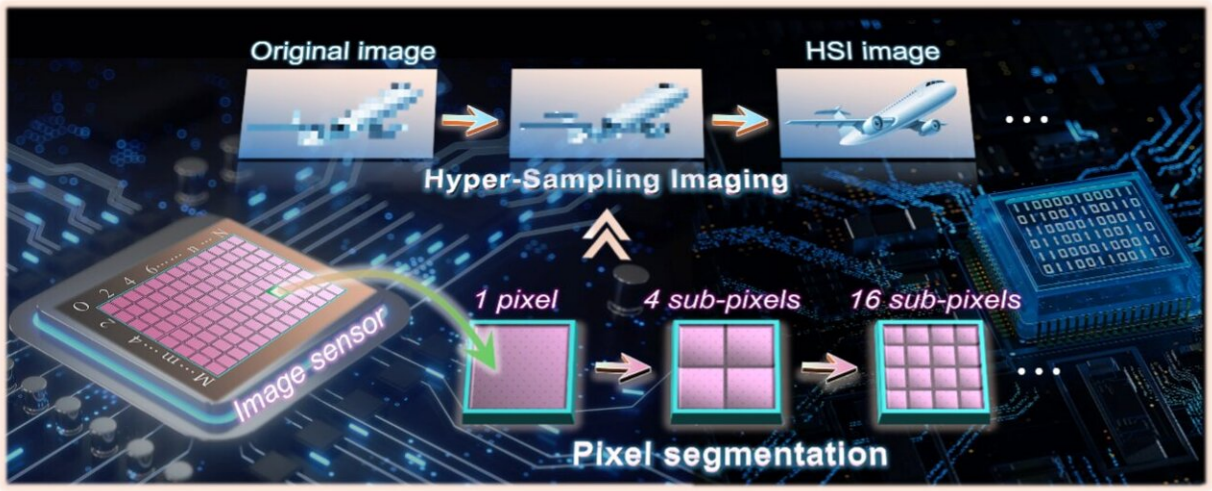

The mechanism of hyper-sampling imaging. Credit: *Laser & Photonics Reviews* (2024). DOI: 10.1002/lpor.202401306

A research team led by Prof. Zhang Ze from the Aerospace Information Research Institute (AIR) of the Chinese Academy of Sciences has developed a hyper-sampling imaging (HSI) technology that enhances the image quality and resolution of digital imaging systems. The study was published in *Laser & Photonics Reviews*.

Current digital image sensors, such as CCD and CMOS chips, have reached their technical limit in pixel resolution, a core factor in

capturing fine details for applications such as astronomy and remote sensing.

In this study, researchers introduced HSI technology to enable sensors with fewer pixels to deliver ultra-high-resolution images. HSI operates by leveraging an optical steady wave field, which scans digital imaging sensors and extracts fine details beyond the traditional pixel resolution limit.

Using this stable wave field—generated through the transverse-wave-vector-elimination method—the team determined the intra-pixel quantum efficiency of the sensor. This enabled the development of pixel subdivision algorithms that enhance digital cameras' imaging capabilities without relying on large datasets or creating artificial information.

Unlike traditional super-resolution image algorithms, HSI offers a stable and dataset-independent solution. Tests on various targets—including imaging unmanned aerial vehicles, buildings, high-speed trains, and the moon—proved this method's robustness.

HSI could be widely employed in satellite remote sensing, infrared night vision, and security surveillance, by delivering ultra-high-resolution images at a fraction of the cost required for upgrading current hardware. For example, using HSI, a 2k × 2k infrared imaging chip can achieve a pixel resolution of over 8k × 8k—levels that current commercial chips cannot achieve.

This study demonstrates the potential of HSI technology. However, additional computational power is required to implement HSI on a larger scale.

More information: Hemeng Xue et al, Hyper-Sampling Imaging by Measurement of Intra-Pixel Quantum Efficiency Using Steady Wave

Field, *Laser & Photonics Reviews* (2024). DOI: 10.1002/lpor.202401306