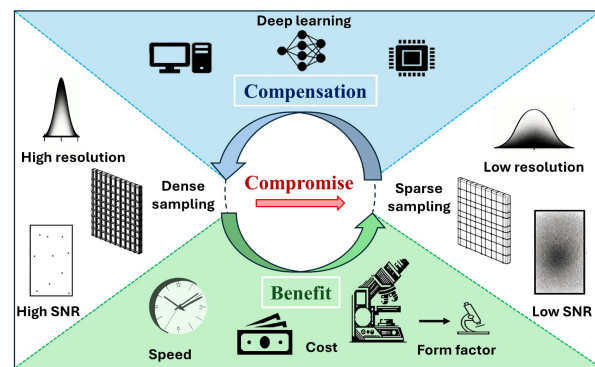


Deep Learning-based Processing and Reconstruction of Compromised Biophotonic Image Data

GA, UNITED STATES, September 10, 2024 /EINPresswire.com/ -- In recent years, the convergence of deep learning and [biophotonics](#) has ushered in a new era of bioimaging. This article reviews emerging approaches where certain measurement metrics are intentionally compromised to develop cost-effective, high-speed or more compact bioimaging tools. These compromises are subsequently compensated through the application of deep learning models trained on superior or alternative datasets. This strategic methodology improves various aspects of biophotonic imaging, such as temporal resolution, imaging speed, and hardware simplification.



Schematic illustrating the concept of neural network-based image processing and reconstruction of compromised photonic data in terms of resolution, sampling density, and SNR.

This article (doi: <https://doi.org/10.1038/s41377-024-01544-9>) delves into the intentional impairment of measurement aspects, including the point spread function (PSF), signal-to-noise ratio (SNR), sampling density, and pixel resolution in biophotonic image data. By leveraging deep learning networks, these compromised metrics are not only recovered but also enhanced, leading to improvements in the field of view (FOV), depth of field (DOF), and space-bandwidth product (SBP) of the resulting image data. The article showcases various biophotonic methods successfully employing this approach, underscoring the versatility and effectiveness of deep learning in handling compromised biophotonic data in various applications:

- Refocusing and Deblurring: The article highlights advanced neural network-based methods for image refocusing and deblurring, crucial for obtaining high-fidelity, all-in-focus images. Some of these techniques demonstrate significant enhancements in imaging speed and quality without requiring hardware modifications.
- Reconstruction with Less Data: The article also covers various methods for efficient image

reconstruction with reduced data acquisition. Innovations like single-shot Fourier ptychographic microscopy and the Recurrent-MZ volumetric imaging framework exemplify how deep learning can compensate for undersampled data, maintaining high imaging quality while minimizing photodamage.

- Improving Image Quality and Throughput: The article also summarizes various approaches to enhance image quality and throughput using modest, cost-effective equipment. Techniques such as mobile phone microscopy illustrate how neural networks can transform suboptimal imaging data into high-quality representations.

Future Perspectives and Impact

By strategically compromising measurement metrics and compensating through deep learning, researchers can achieve higher temporal resolution, increased imaging speed, and simplified hardware configurations, making advanced bioimaging techniques more accessible. These presented methods have profound implications for the future of bioimaging, particularly in applications requiring rapid and high-quality imaging, such as real-time observation of biological processes and clinical diagnostics. These innovative methodologies are poised to revolutionize the field of biophotonics, paving the way for more cost-effective and efficient bioimaging solutions.

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