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Deep Learning for In Vivo Near-Infrared Imaging

Near-infrared (NIR) imaging is a valuable research tool that produces quality images with high spatial and temporal resolution through millimeter tissue depths. Imaging at the NIR-IIb window (1500 – 1700 nm) is the most effective one-photon approach to suppressing light scattering and maximizing imaging penetration depth. Unfortunately, toxic nanoparticle probes must be used to capture images in the NIR-IIb window. Biocompatible fluorescent probes can be used at a lower wavelength at NIR-I (700 – 1000 nm) or NIR-IIa (1000-1300 nm); however, light scattering occurs at shorter wavelengths and results in suboptimal imaging. Inventors in the Dai lab at Stanford trained artificial neural networks to transform a fluorescence image in the shorter wavelength NIR window of 900-1300 nm to a high-resolution image resembling a NIR-IIb image. With deep-learning translation, in vivo lymph node imaging achieved unprecedented signal-to-background ratio, while enhancing tumor-to-normal tissue ratio to improve tumor margin localization. The deep learning software also improved image clarity and in vivo non-invasive NIR-II resolution. The invention is compatible with any fluorescence imaging system and a wide range of NIR fluorophores. NIR imaging equipped with deep learning could prove to be a valuable tool to facilitate basic biomedical research and empower clinical diagnostics and imaging-guided surgery in the clinic.

Applications

- -Tumor imaging
- -image-guided therapy
- -Fluorescence microscopy

Advantages

- -Compatible with any NIR fluorophores and targeting ligands
- -Generalizable to other fluorescence imaging systems
- -Does not require prior information input for imaging processing

Publications

- Ma, Z., Wang, F., Wang, W., Zhong, Y., & Dai, H. (2021). " Deep learning for in vivo near-infrared imaging". Proceedings of the National Academy of Sciences, 118(1).

Patents

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