Autumn 2023

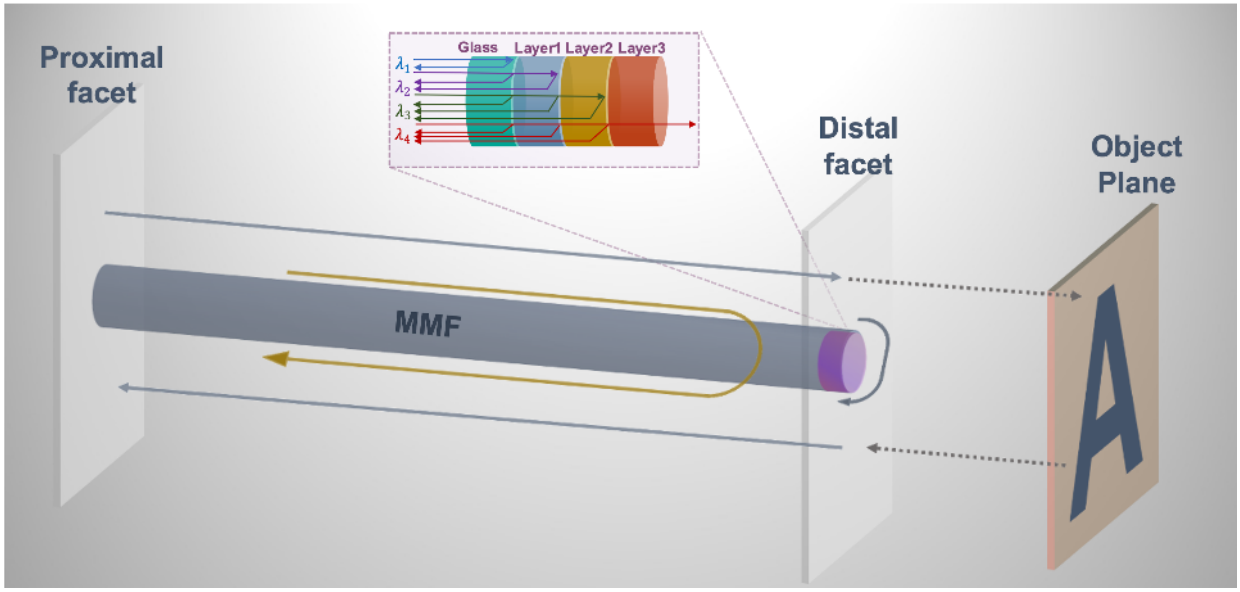
Optics & Photonics Group Lunchtime Seminar Series

University of Nottingham

Imaging through ultra-thin fibre: Single-ended recovery of optical fiber transmission matrices using neural networks

Yijie Zheng

University of Nottingham



13:30 Wednesday 22 November 2023

Coates Building - C24

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Yijie Zheng

Imaging through ultra-thin fibre: Single-ended recovery of optical fiber transmission matrices using neural networks

Ultra-thin multimode optical fibre imaging promises next-generation medical endoscopes reaching high image resolution for deep tissues. However, current technology suffers from severe optical distortion, as the fibre's calibration is sensitive to bending and temperature and thus requires in vivo re-measurement with access to a single end only. We present a neural network-based approach to reconstruct the fibre's transmission matrix (TM) based on multi-wavelength reflection-mode measurements. We train two different NN architectures via a custom loss function insensitive to global phase-degeneracy: a fully connected NN and convolutional U-Net. We reconstruct the 64×64 complex-valued fibre TMs through a simulated single-ended optical fibre with ≤ 4% error and cross-validate on experimentally measured TMs, demonstrating both wide-field and confocal scanning image reconstruction with small error. Our TM recovery approach shows advantages: 4500 times faster; robustness to 6% fibre perturbation during characterisation; operation with non-square TMs and relaxed requirements for reflector properties.

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All are welcome

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