Studienarbeit/Diplomarbeit/Masterarbeit, ET / MT / IST / NES / BMT / CS / POL

Quantitative accuracy comparison of multiple algorithms for optical tomography 3D reconstruction

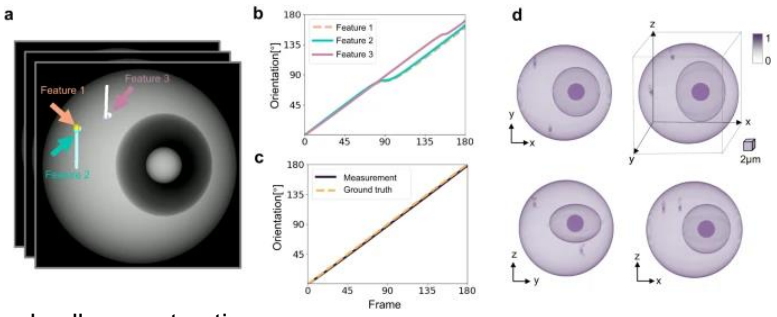
Motivation

Optical projection tomography (OPT) and optical diffraction tomography (ODT) are widely used for three-dimensional reconstruction of microscopic samples such as cells, hydrogel beads, and embryos. Classical reconstruction algorithms, including filtered backprojection (iradon), simultaneous algebraic reconstruction technique (SART), and model-based ODT methods, are still extensively applied in practical experiments. However, the reconstruction accuracy strongly depends on multiple factors, such as projection number, angular precision, noise level, and model mismatch. A systematic and quantitative comparison of these reconstruction algorithms under controlled conditions is still lacking. In this topic, a quantitative benchmark framework will be established to evaluate and compare the reconstruction accuracy of iradon, SART, and ODT methods using both simulated phantoms and experimental rotating sample data. Error metrics, resolution limits, and robustness against noise and angular deviations will be systematically analyzed.

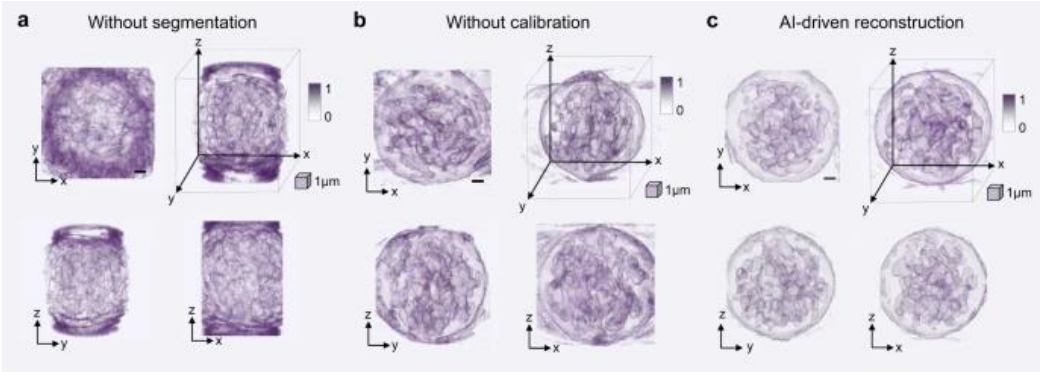
Keywords

Tomographic 3D reconstruction, image quality evaluation, Python

(a) Phantom cell reconstruction



(b) Real cell reconstruction



Sun, J., Yang, B., Koukourakis, N., Guck, J. and Czarske, J.W., 2024. AI-driven projection tomography with multicore fibre-optic cell rotation. Nature Communications, 15(1), p.147.

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Task

- Implementation and validation of different reconstruction algorithms
- Generation of numerical phantoms and simulated projection data
- Quantitative evaluation of reconstruction accuracy