

WUTScope-FPM – a Fourier ptychographic microscope system for ultra high-resolution, label-free widefield biomedical imaging

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1. Main Text

Fourier Ptychographic Microscopy (FPM) is an advanced computational imaging technique that extends the capabilities of conventional optical microscopy. By using a programmable LED array to illuminate the sample from multiple angles, FPM synthesizes a high numerical aperture (NA) in Fourier space. This effectively surpasses the resolution limits set by traditional objective lenses, allowing for high-resolution image reconstruction over a large field of view (FOV).

One of the key advantages of FPM is its hardware simplicity and cost-efficiency. It can be implemented on standard brightfield microscopes by replacing the condenser with an LED array, making it highly accessible and easy to adapt in existing lab environments.

FPM is especially well-suited for biological imaging. Its combination of high resolution, wide FOV, and long working distances makes it ideal for studying large and delicate samples, such as tissue sections, organoids, or neuronal networks (see Fig. 1). In neuroscience, FPM enables observation of fine cellular features over broad areas without the need for expensive, high-NA optics. Moreover, the phase data retrieved by FPM reveals subtle refractive index variations in transparent specimens. This enables label-free imaging of live cells and neural activity, providing a powerful tool for non-invasive, high-content biological research.

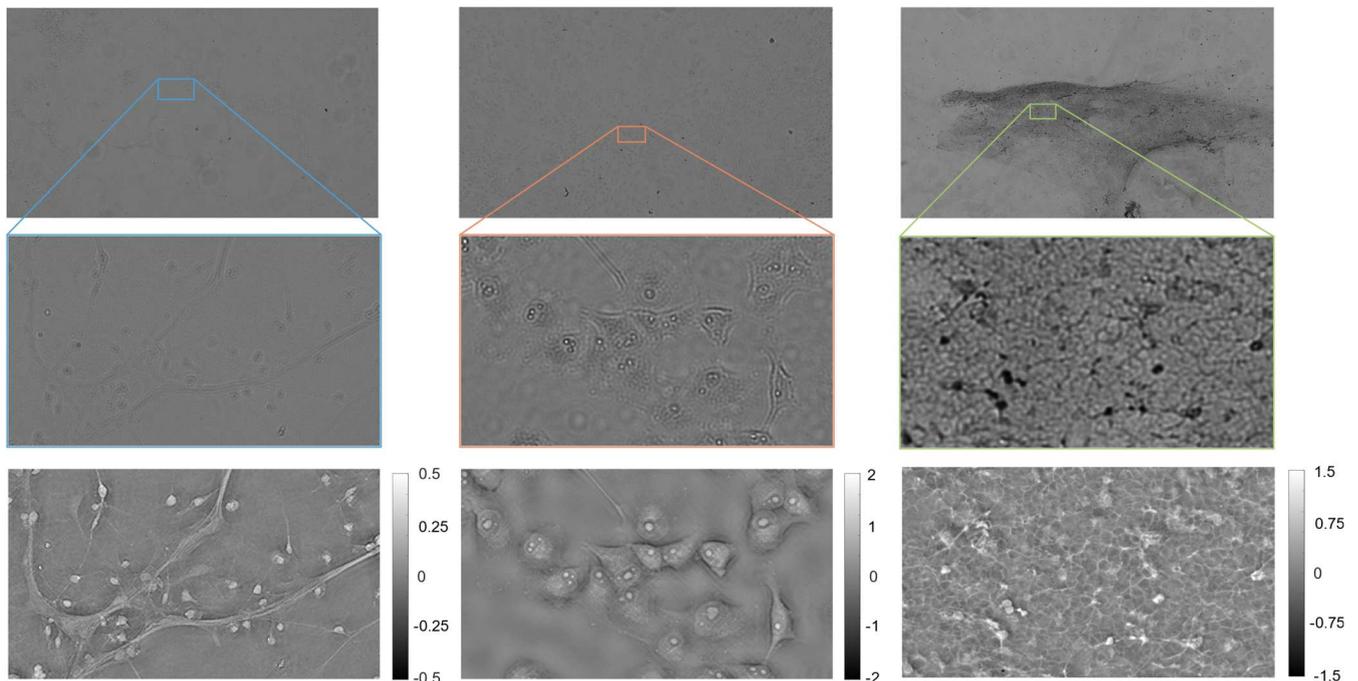


Fig. 1. In the first row, the full FOV images acquired with central LED illumination are presented. The second row shows a zoomed-in region of interest from each image, while the third row displays the corresponding FPM phase reconstructions of the same zoomed area.

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4. References

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