High-resolving-power long-working-distance holographic microscopy using a scattering layer

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As microscopy techniques develop, the demand for high resolving power and a long-working distance is increasing. However modern microscopy provides a limited performance, as the refraction based lens forces a compromise between resolving power and a working distance. Long working distance objective lenses can alleviate the issue, yet their performance is vulnerable to aberrations due to the enlarged aperture. In digital holographic microscopy, researchers suggested lensless imaging [1] and phase retrieval algorithms [2] to solve this issue. However, the performance of the methods is limited by the size of an imaging sensor or a heavy computation with a thin sample approximation.

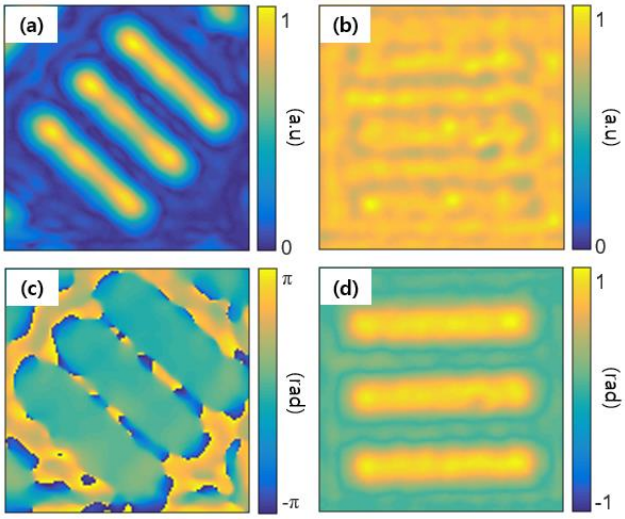

Figure 1: Microscopic samples imaged with the proposed method. Measured amplitude of amplitude mask and phase mask (a-b). Measured phase of the same sample (c-d).

Here we present a high-resolving-power long-working-distance holographic microscopy using a scattering layer. Exploiting the speckle-correlation scattering matrix [3], the proposed method breaks the conventional relationship between resolving power and a working distance in microscopy. As a demonstration, various microscopic samples are imaged with the proposed method, and the results are compared with the off-axis digital holographic microscopy [4].

Reference

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