Super-resolution linear optical imaging in the far field

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The resolution of optical imaging devices is ultimately limited by the diffraction of light. To circumvent this limit, modern super-resolution microscopy techniques employ active interaction with the object by exploiting its optical nonlinearities, nonclassical properties of the illumination beam, or near-field probing. Thus, they are not applicable whenever such interaction is impossible, for example, in astronomy or non-invasive biological imaging. Far-field, linear-optical super-resolution techniques based on passive analysis of light coming from the object would cover these gaps.

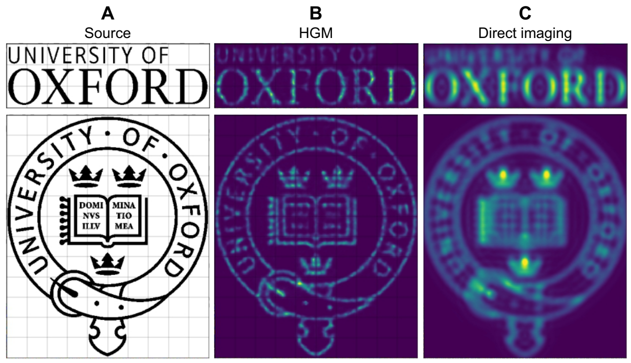

Figure 1: Original (A), reconstructed using our method (B) and direct camera (C) images of the University of Oxford coat of arms and logo test sets

We present the first proof-of-principle demonstration of such a technique. It works by accessing information about spatial correlations of the image optical field and, hence, about the object itself by measuring projections onto Hermite-Gaussian transverse spatial modes. With a basis of 21 spatial modes in both transverse dimensions, we perform two-dimensional imaging with twofold resolution enhancement beyond the diffraction limit [1].

References

[1] A A Pushkina, G Maltese, J I Costa-Filho, P Patel and A I Lvovsky, arXiv:2105.01743 (2021)