Shaping Bessel beams with arbitrary on-axis intensity profiles using a single phase-only spatial light modulator

Ismail Ouadghiri-Idrissi, Remo Giust, Luc Froehly, Luca Furfaro, Pierre-Ambroise Lacourt, John Michael Dudley, and Francois Courvoisier*

Institut FEMTO-ST, UMR 6174 CNRS, Université Bourgogne Franche-Comté, 15B Avenue des Montboucons, 25030 BESANCON, France

*ismail.ouadghiri@femto-st.fr

The conical structure of the light flow in Bessel beams brings energy to the central intense core all along propagation, in a propagation invariant way. Due to the spatial limitation of experimentally generated Bessel beams, their on-axis intensity varies significantly along propagation. In this context, arbitrary manipulation of their longitudinal propagation is necessary to control the core intensity at any point of the propagation.

Arbitrary manipulation of the axial propagation of Bessel beams requires the modulation of both the amplitude and phase of an incoming beam [1]. So far, this has solely been performed using an iterative technique to encode the desired beam's spatial spectrum on a phase only spatial light modulator (SLM) [1,2]. In our work, we use a non-iterative technique [3] to exactly encode the optical field in a single SLM, from direct space, thus preserving high energy throughput.

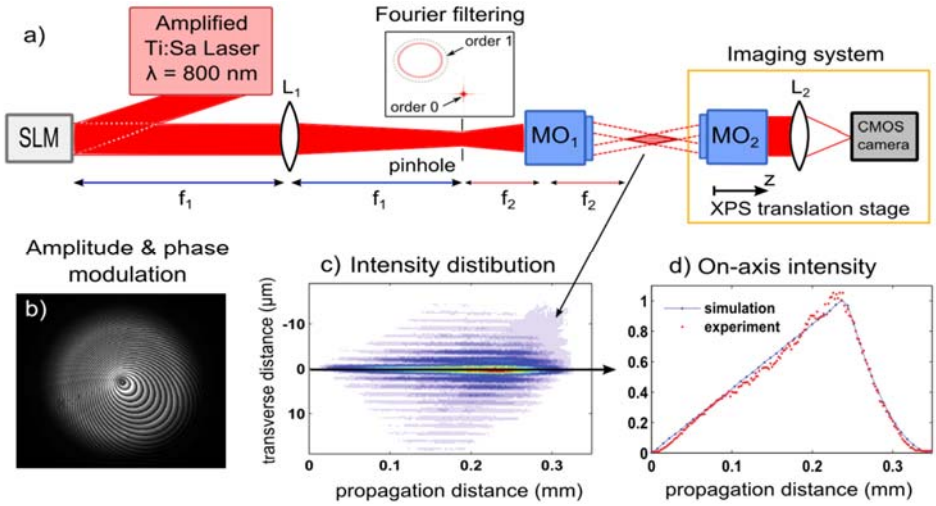

Fig. 1. a) Experimental setup, b) computer generated hologram allowing the modulation of the amplitude and phase of an incoming beam, c) intensity distribution of a modified Bessel beam and d) the corresponding on-axis intensity.

This technique is based on the modulation of the phase wrapping of a computer generated hologram, which allows to control the diffraction efficiency at each point of the phase mask (Fig. 1.b). The experimental setup is based on a 4f system and the desired optical field is retrieved at the first diffraction order (Fig. 1.a). Figure 1(c,d) shows the experimental results with are in excellent agreement with target profiles (solid line of Fig1.d). The limitations on the shaping capability will also be discussed.

We anticipate this will open very novel perspectives for nonlinear optics.

References

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