Laser beam characterization with digital holograms

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Abstract: We show how laser beam characterization may be done in real-time with digital holograms. We illustrate the power of the techniques by applying them to a variety of laser sources, from fibers to solid-state.

OCIS codes: (140.3300) Laser Beam Shaping, (140.3295) Laser beam characterization, (090.1995) Digital holography.

1. Introduction and Results

While the tools of laser beam characterization have been around now for roughly two decades, it is only recently that the power of digital holography has come to bare on the problem [1-6]. We applied digital holograms, written to a phase-only spatial light modulator, to execute real-time laser beam characterization. We show how using modal decomposition the intensity, phase, wavefront and orbital angular momentum may be determined from arbitrary sources. Also, we show how virtual propagation may be executed to observe the propagation of light over extended distances without any moving parts, resulting in accurate beam quality factor measurements. Some typical results are summarized in the figure below. The pertinent point is that while the results in Fig. 1 are inferred from measurements with a single digital hologram, several optical tools (CCD detectors, wavefront sensors, M^2 meters) were required to validate the data.

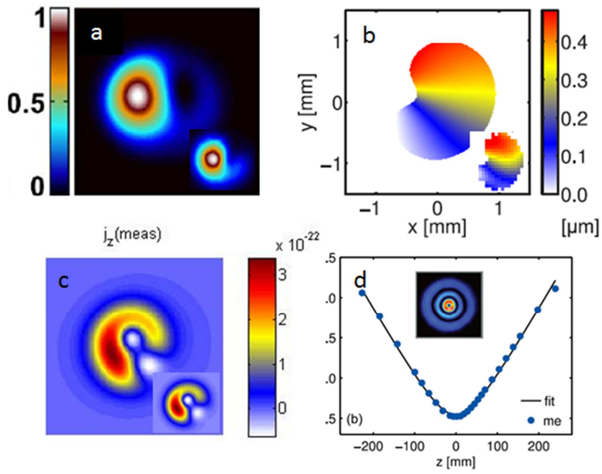

Fig. 1. Experimental images of digital holograms used to measure: (a) intensity, (b) phase, (c) orbital angular momentum, and (d) beam quality factor of an arbitrary laser beam. The results are all in excellent agreement with that measured with a variety of traditional tools (see insets).

Our results suggest the power of digital holography in emerging fields such as quantum information and quantum key distribution with spatial modes of light, and mode division multiplexing for increased fiber bandwidths.

2. References

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