PROPAGATION

Airy Beam Induced Optical Routing

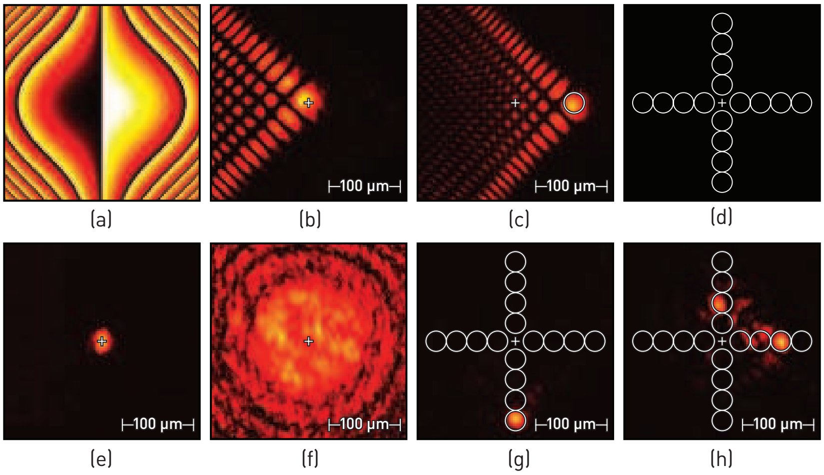
Optical information processing requires controlling light in all its parameters as well as considering nonlinear responses and adaptivity. Therefore, optical storage, optical interconnects and optical routers in nonlinear reconfigurable systems have been the subject of intensive research in recent years. Since waveguiding is typically associated with fixed refractive index structures, adaptivity is one of the most challenging issues in optical routing.

Previously, reversible discrete refractive index structures created in nonlinear optical materials were important for controling light and light propagation.[1] This year, we presented a new adaptive all-optical routing technique that combines the versatility of this approach with the unique propagation properties of Airy beams.

Airy beams are self-accelerating beams that propagate on a curved trajectory.[2] Their transverse shape is asymmetric showing a characteristic pattern with one pronounced bright lobe. Their most striking feature is that they do not diffract, thereby compensating for disturbances via self-healing. Airy beams have been used for many applications ranging from optical micromanipulation to electron acceleration.[3] Until now, they have not been combined with waveguiding concepts in order to realize accelerated self-healing adaptive waveguides.

Our approach allows for the creation of reversible curved paths of increased refractive index that guide light from the input position of the Airy beam maximum at the front face of a photorefractive crystal to the shifted output position at the back.[4] Since our setup is based on a computer-controlled spatial light modulator, we can easily rotate the writing beam or change its phase spectrum in order to modify the direction or magnitude of this shift. Moreover, when applying the concept of incremental multiplexing of optically induced structures, we can superimpose and activate several channels at the same time, thus creating a structure that simultaneously routes light to multiple outputs.[5]

The flexibility of this new all-optical waveguide concept facilitates complex routing schemes and could be pathbreaking for novel waveguiding applications. OPN



(a) Cubic phase spectrum used for the holographic generation of the 2-D Airy beam shown in (b). This beam propagates through the photorefractive material, and at the output we find a shifted pattern (c). (d) Schematic array of 16 spatially separated output channels. (e) Gaussian input beam. (f) Without an optically induced structure, the Gaussian beam diffracts. (g) With an Airy beam induced refractive index channel, the beam is precisely guided. (h) Demonstration of this unique feature for a two-channel splitter.

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References

1. J.W. Fleischer et al. Nature **422**, 147 (2003).
2. G.A. Siviloglou et al. Opt. Lett. **32**, 979 (2007).
3. Y. Hu et al. *Self-accelerating Airy Beams: Generation, Control, and Applications.* Z. Chen and R. Morandotti (eds.), Springer (2012).
4. P. Rose et al. Appl. Phys. Lett. **102**, 101101 (2013).
5. M. Boguslawski et al. Opt. Express **20**, 27331 (2012).