Supercontinuum light shaping with GPC

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Many important applications of the interaction of light with matter strongly depend on the illumination wavelength. Hence, supercontinuum light sources have been used in a plurality of applications that include optical characterization or sensing in optofluidic systems, optical coherence tomography, spectroscopy, imaging and microscopy, neuroscience and neurophotonics, and metrology among many others. A proper choice of wavelength from a supercontinuum source can alter the properties or behavior of materials or biological systems. Combining spectral control with spatial control further increases the versatility of supercontinuum sources, hence offering new possibilities for research. For example, selective excitation and characterization enabled by structured multi-wavelength light would be desirable for probing cells or tissues in neurophotonics or optogenetics research. However, to enable such possibilities, it is necessary to deal with the complications of efficiently shaping light across different wavelengths. Generalized Phase Contrast (GPC) is a versatile light shaping technique for efficiently rerouting and managing photon energy into speckle-free contiguous spatial light distributions. GPC exhibits robustness to shifts in wavelength and can maintain both projection length scale and high efficiency over a range of 0.75x to 1.5x of a characteristic design wavelength [1]. We verify this performance using a supercontinuum light source [2], interfaced with a compact GPC light shaper, optimized for standard Gaussian input beams [3,4]. Preliminary light shaping experiments show ~70% efficiency, ~3x intensity gain, and ~85% energy savings from 500nm to 675nm, in good agreement with theoretical and numerical predictions.

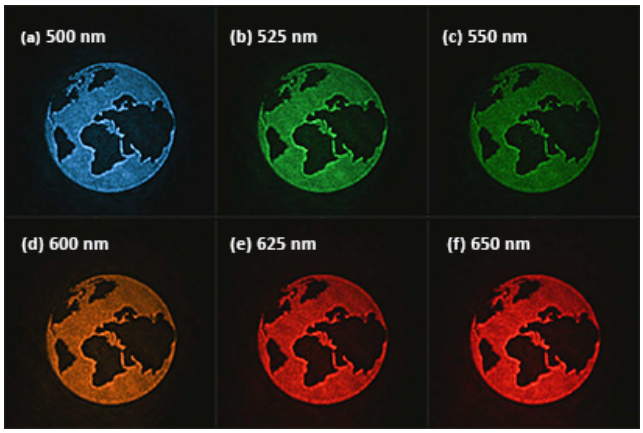

Figure. CCD images of GPC projections from the same setup, as the wavelength selector is varied from 500nm to 650nm.

References

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