made? What can be done with the optical nonlinearity? The next few years could be exciting yet challenging as graphene must ultimately prove its worth beyond the laboratory. I would again urge caution, but the findings of this work are undoubtedly a step towards the right direction. ❐

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POLARIZATION OPTICS

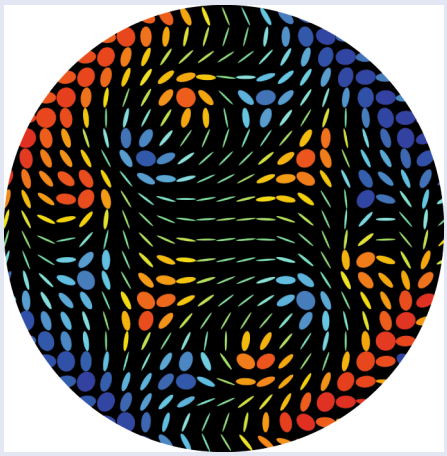
Graded lens surprise

While commonly overlooked or seen as a nuisance, the birefringent properties of graded index (GRIN) lenses can offer unexpected new opportunities for vortex beam generation, imaging and polarimetry. That's the finding of a Chinese–UK collaboration who have recently published a study on the topic (*Nat. Commun.* https://doi.org/10.1038/s41467-019-12286-3; 2019).

In contrast to conventional lenses that have a uniform refractive index, GRIN lenses are rod-shaped glass elements that possess a refractive index profile that varies across the rod's cross-section in the form of a gradient. Such lenses are typically used in imaging systems to reduce spherical aberrations or to improve coupling to optical fibres or waveguides.

When GRIN lenses are manufactured, the ion-exchange process that is used to create a graded refractive index also introduces a gradually changing birefringence that is rotationally symmetric and features a retardance that increases with the size of the radius from the rod's axis.

Chao He and co-workers have now shown, both theoretically and experimentally, that these properties mean that a cascade of one or more GRIN lenses can directly generate a variety of vector vortex beams (vector light fields that feature complex phase and polarization properties). While such beams can be made by other means, it often requires specialist equipment rather than off-the-shelf components.



Furthermore, when light with a suitable polarization state is input to a cascade it has been found that the GRIN cascade can focus the light to a point spread function that is squeezed in the longitudinal direction, offering the opportunity for imaging with enhanced axial resolution.

The authors also used a dual-lens cascade to build a single-shot Müller matrix polarimeter — an instrument that can comprehensively extract the polarization characteristics of an object. When applied to a sample of biological tissue this potentially offers a means to distinguish between healthy and diseased tissue based on an analysis and spatial map of the sample's optical retardance.

The authors told *Nature Photonics* that they believe that the use of GRIN lens cascades will open up many surprising applications, spanning from quantum optics to clinical diagnostics. They are now considering to combine the approach with deep learning and adaptive optics to further expand its potential. ❐

Oliver Graydon

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IMAGING

Video-rate gigapixel imaging of the brain

A wide-field system that can perform video-rate imaging of the entire area of the brain of an awake mouse is aiding the study of neurones, epilepsy and the immune system.

Gail McConnell

As neuroscientists and biologists around the globe strive to gain a better understanding as to how the mammalian brain functions, there is a need for fast, wide-field imaging tools to help. In particular, there is great demand for an optical microscope that can image the near-surface structure of a mouse brain at high resolution and at video rate.

Now, writing in *Nature Photonics*, Fan and co-workers[1] report a system that is able to perform exactly this task. This group at Tsinghua University in Beijing, China is to be congratulated in solving