Research duo develop a means for people to conceptualize polarized light

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(Phys.org) —Two researchers from Queensland University in Australia have developed a way to describe polarizing objects in a way that can be visualized by the human eye. In their paper published in *Proceedings of the Royal Society B: Biological Sciences*, Martin How and Justin Marshall describe a technique they have developed for using attributes of polarization to describe what they call "polarization distance."

It's a well-known fact that animals other than humans can see polarized light and that many use it as a means of navigation, terrain discrimination or even as a form of communication. Recent studies have even found that some organisms, such as shrimp, are able to communicate with one another using polarized light that is reflected off a part of their bodies, in this case, their tails. Many scientists believe that there likely exists a hidden world of communication going on in natural world, where only those who can see polarized light are able to join in. How and Marshall describe it as a secret language—one where prey are able to communicate silently, for example, unseen by a predator, without fear of being overheard.

Unfortunately, because it is invisible to the human eye, researchers have had a hard time studying the impact of polarization on animals and the ways they use it. To help in this area, How and Marshall have come up with a way to use several attributes of polarization to mimic what is known as "color distance," which in normal light is calculated by quantifying saturation, hue and intensity. In this case, they instead use attributes of polarized light—percentage, intensity and angle—to provide a means for estimating the discriminability of objects in polarized light.

Creating a characteristic of polarization based on actual attributes allows for calculating polarization distance, which in turn can be used to convert polarized reflections into false colors the human eye can see. That in turn, the researchers hope, will lead to the creation of devices that will allow scientists to study the hidden world of communications used by animals in a more natural way—by "listening in" on their secret signals and noting how those that can see them respond.

More information: Polarization distance: a framework for modelling object detection by polarization vision systems, Published 18 December 2013 DOI: 10.1098/rspb.2013.1632

Abstract
The discrimination of polarized light is widespread in the natural world. Its use for specific, large-field tasks, such as navigation and the detection of water bodies, has been well documented. Some species of cephalopod and crustacean have polarization receptors distributed across the whole visual field and are thought to use polarized light cues for object detection. Both object-based polarization vision systems and large field detectors rely, at least initially, on an orthogonal, two-channel receptor organization. This may increase to three-directional analysis at subsequent interneuronal levels. In object-based and some of the large-field tasks, the dominant e-vector detection axes are often aligned (through eye, head and body stabilization mechanisms) horizontally and vertically relative to the outside world. We develop Bernard and Wehner's 1977 model of polarization receptor dynamics to apply it to the detection and discrimination of polarized objects against differently polarized backgrounds. We propose a measure of 'polarization distance' (roughly analogous to 'colour distance') for estimating the discriminability of objects in polarized light, and conclude that horizontal/vertical arrays are optimally designed for detecting

differences in the degree, and not the e-vector axis, of polarized light under natural conditions.