SINGLE-PIXEL POLARIMETRIC IMAGING THROUGH SCATTERING MEDIA

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ABSTRACT: Imaging of an object that is hidden behind scattering media often results in images that bear little, if any, resemblance to the obscured object, due to the overwhelming presence of scattered light. Unfortunately, scattering media are naturally present in many applications, such as in biological imaging. In order to overcome scattering and reconstruct the hidden object, traditional methods – such as optical coherence tomography and confocal microscopy, aim to use only the ballistic or weakly scattered light for imaging. However, the exponential decay of ballistic light with scattering medium thickness quickly becomes a challenge for these techniques. It is thus unsurprising that in recent years, there has been a growing interest in seeking to utilise, instead of reject, scattered light [1,2]. In particular, single-pixel cameras have shown good imaging performance, even in the presence of multiply scattering media [3].

Despite recent progress in imaging with scattered light, many proposed methods have only considered imaging in intensity. In contrast to intensity images, the additional information provided by polarimetric images can give insight into an object's underlying structure. As a result, polarimetry has been found to be a promising approach for label-free biomedical imaging, such as for the purposes of cancer discrimination (see review in [4]). Unfortunately, scattering scrambles not only the direction of light, but also its polarisation, and this limits the applicability of current polarimetric imaging techniques.

In this work, we report on a single pixel imaging system capable of measuring the full Mueller matrix of a hidden object. Critically, our system does not require measurement of the vector transmission matrix, but instead only average scattering properties of the disordered medium are needed. Experimental imaging of a resolution target (see Figure 1) hidden behind scattering phantoms will be presented and supporting numerical simulations discussed.

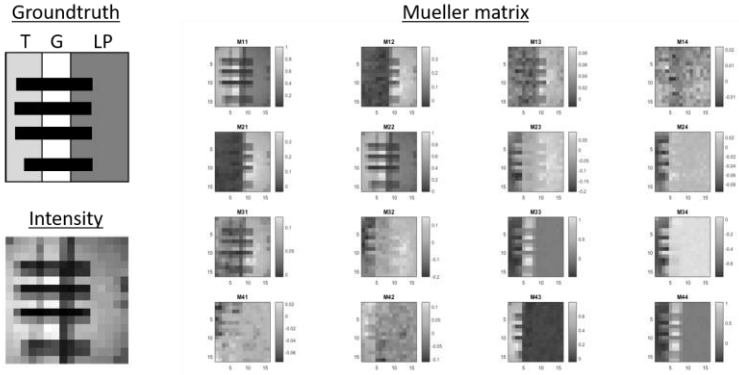

Figure 1: Polarimetric imaging of a test object without a scattering medium present.
The test object consists of clear tape (T) and a linear polariser (LP) on a glass (G) USAF resolution target

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