

## Reciprocity in vector radiative transport and the sensitivity of probing regions to various polarization imaging channels

Callum MACDONALD\*,<sup>1</sup> Ugo TRICOLI,<sup>1</sup> Anabela DA SILVA,<sup>1</sup> Vadim MARKEL,<sup>1</sup>

<sup>1</sup>Aix Marseille Université, CNRS, Centrale Marseille, Institut Fresnel UMR 7249, 130013 Marseille, France

Keywords: polarization, reciprocity, diffuse optical tomography, polarization gating

We have derived a reciprocity relation for the Vector Radiative Transport Equation (V-RTE), and have applied it in the calculation of the sensitivity kernel for polarized diffuse optical tomography measurements. This new formalism provides a unique ability to investigate the regions of a scattering medium that are most sensitive to various polarization imaging channels (having different combinations of filters for incident and detected light). In particular, we can explore the potential differences involved when probing with polarizations having angular momentum, i.e. circular or elliptical states.

The reciprocity relations we derive relate to the Green's functions of the V-RTE, and follow from the previously derived reciprocity relations for the single scattering phase matrix detailed by Hovenier [1]. These relations, along with additional symmetries inherent in certain experimental geometries, dramatically reduce the computational requirements for calculating the kernel of the sensitivity function for diffuse optical tomography with polarized light.

With the inclusion of polarization information in the tomographic problem, it is hoped that the ill-posedness of diffuse tomographic reconstruction is reduced. The derived formalism however also provides new insight into the sensitivity of different probing regions to polarization, which is of particular interest to the community involved with polarization gated imaging of highly scattering media (see example in Fig. 1).

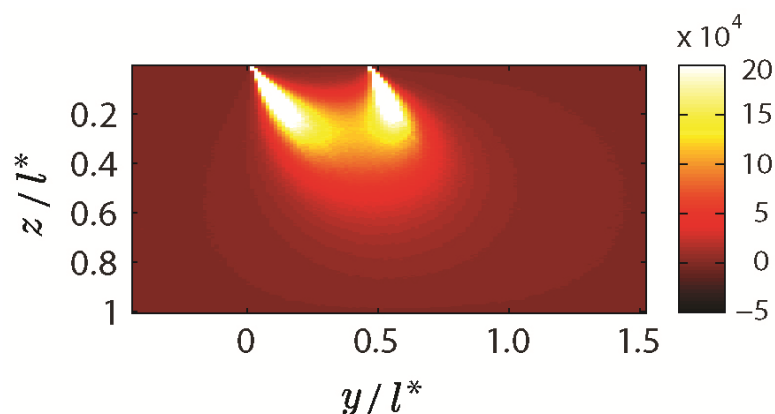


Fig. 1: Example of a kernel matrix element of the sensitivity function for polarized diffuse optical tomography (light source located on the left, detector on the right). Results calculated via polarized Monte Carlo program.