Probing Complex Media Using Structured Light with Orbital Angular Momentum

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This study investigates the propagation of structured light—Laguerre-Gaussian, Lloyd, Poggendorff, and Raman beams—through air, normal, and cancer-like scattering media. Using off-axis holography, we retrieved azimuthal phase maps to assess the impact of turbidity. Significant phase degradation was observed in LG and Poggendorff beams, while Lloyd and Raman beams showed greater resilience. These results align with recent findings on OAM phase preservation in scattering environments [1] and support the potential of structured light for robust, label-free biomedical diagnostics [2,3].

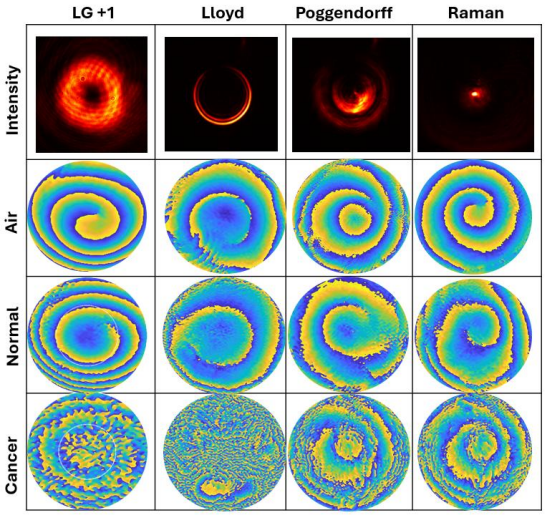

Fig. 1: Intensity (top row) and retrieved azimuthal phase (bottom rows) of a Laguerre-Gaussian beam with $\ell = +1$, along with Lloyd, Poggendorff, and Raman beams, after propagation through air, normal tissue, and cancer-like scattering media. Phase distortions increase with scattering, with the LG and Poggendorff beams showing the most degradation. In contrast, Lloyd and Raman beams demonstrate greater phase stability, highlighting their potential for robust optical diagnostics in turbid biological environments.

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