Recovering scattered data from twisted light via 'scattering-matrix-assisted retrieval technique (SMART)'

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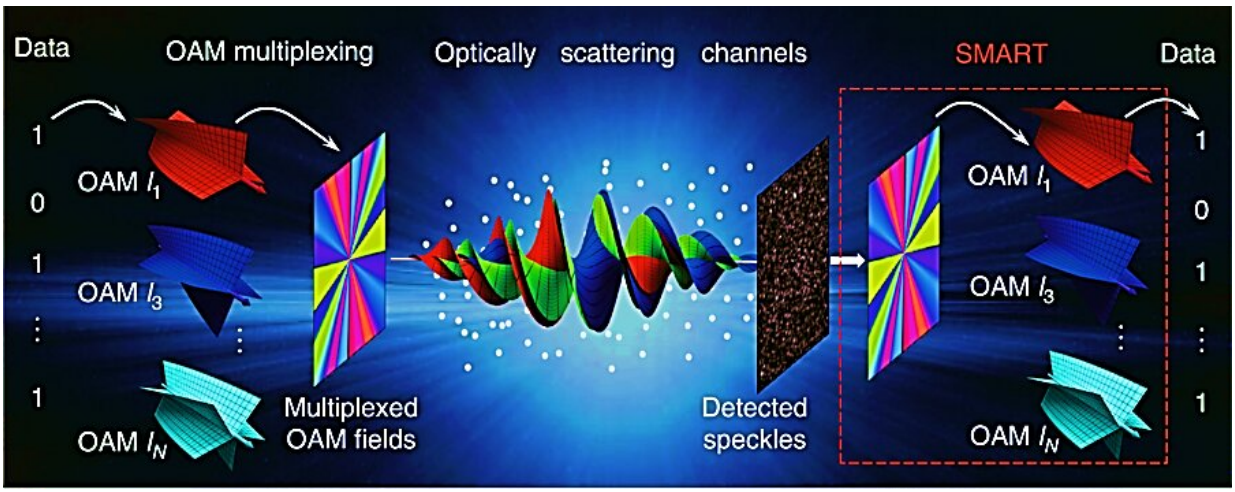

The concept of SMART-enabled OAM-multiplexed transmission across scattering channels. Information is encoded into an orbital angular momentum (OAM) superposition state of light. A data-carrying vortex beam propagates across scattering channels. At the receiver, the SMART method retrieves the original field from the scattered random speckles and completes OAM demultiplexing from the retrieved field. On this basis, the data carried by light can be extracted from the reconstructed OAM spectrum. Credit: Light: Science & Applications, doi: https://doi.org/10.1038/s41377-019-0140-3.

High-capacity optical communication can be accomplished by multiplexing multiple light-carrying orbital angular momentum (OAM)

channels. However, in turbulent environments, optical scattering and 'speckle patterns' occur due to ambient, atmospheric microparticles and significantly decrease the orthogonality between OAM channels, demultiplexing (extracting information) and increasing crosstalk during communication. In a recent study now published in *Light: Science & Applications*, Lei Gong and co-workers at the departments of optics and optical engineering, medical engineering, electrical engineering and physical sciences in China and the USA developed a 'scattering-matrix-assisted retrieval technique' (SMART) to efficiently recover scattered data from multiplexed OAM channels. In the study, they used 24 OAM channels in parallel, passing through a scattering medium to demultiplex the channels from the scattered optical fields and achieve minimal experimental crosstalk approximating -13.8 dB.

The scientists decoded the information of multiple twisting light beams that passed through scattered media containing atmospheric microparticles (causing reduced image quality) and retrieved high quality data from the multiplexed OAM channels instead. The SMART platform allowed high-fidelity transmission of images and reduced the error rate by 21 times compared with previous studies. Gong et al. envision the optimized technique will facilitate high quality optical data transfer in harsh atmospheric conditions or underwater for practical applications.

The scientists implemented the experimental setup in a self-built data transmission system, by employing a digital micromirror device (DMD) to encode OAM channels. They simultaneously provided high-tolerance to misalignment in the setup through reference-free calibration. They then successfully demonstrated the high-fidelity transmission of gray and color images under scattering conditions, at an error rate of