Imaging in Scattering or Turbid Media

Overview: Adaptive optics was first utilized to correct for aberrations that are introduced when imaging through atmospheric turbulence. In monochromatic imaging systems or laser communication systems wavefront correction is most easily accomplished by adding a liquid crystal spatial light modulator to the imaging system. By applying an equal and opposite phase to the SLM it is possible to restore diffraction limited images. In recent years, much of the research on atmospheric turbulence correction is translating to biology, where biological systems introduce scattering and turbidity. For example, SLMs can be used in STED microscopes for deep tissue imaging. In order to maintain the structure of the excitation and depletion sources, the aberrations that the sources will encounter when passing through the sample must be pre-corrected for. Similarly SLMs used in multi-photon imaging systems are used to pre-correct for scattering and aberrations the illumination will encounter when exciting deep tissue targets.

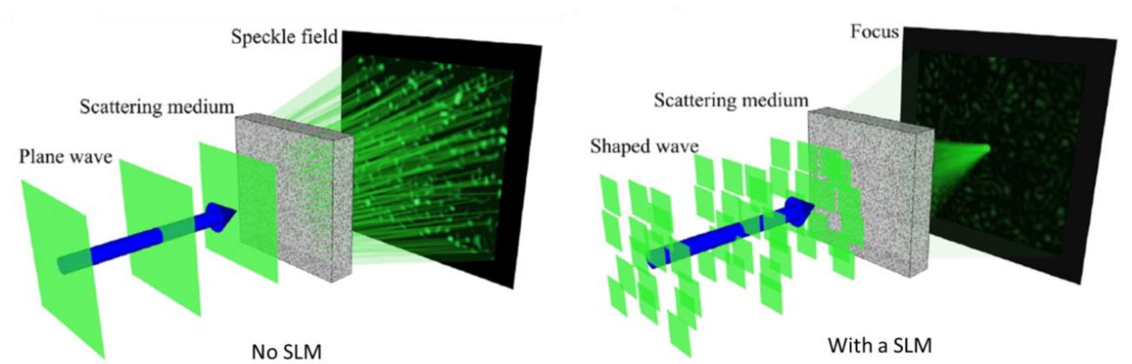

Figure 1 Hemphill, A. S., Tay, J. W., & Wang, L. V. (2016). Hybridized wavefront shaping for high-speed, high-efficiency focusing through dynamic diffusive media. Journal of biomedical optics, 21(12), 121502.

Critical requirements: For this market the SLM must offer high resolution, phase stability, and high speed switching. The SLM resolution determines the ability to correct for complex aberrations. High phase stability ensures temporally stable excitation which is important when imaging in scattering media with significant losses. High speed SLMs allow for real time adaptive optics.

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