Wavefront Shaping with varying degrees of freedom

Maël Hubert*[1], Bert Mulder[1], Timon Vreman[1], Tamara Tromp[1], Ad Lagendijk[1], and Willem Vos[1]

[1]University of Twente [Twente] – Netherlands

Abstract

Optical WaveFront Shaping (WFS) uses the physical feature that whereas light scattering is complex, it is a linear process, thus deterministic. The incident wavefront is controlled to focus light through a scattering sample, by spatially dividing an incoming wavefront and modulating the resulting segments with Spatial Light Modulators (SLMs) or Digital Micromirror Devices (DMDs) paired with a holography system.
The main criterion for such a process is the enhancement of the intensity at the target, defined as the ratio of the optimized intensity at the target, and the average intensity at the target for many realizations of the scattering sample.

We focus on the effect of restricting the degrees of freedom of the phase modulating devices on the optimization performance. By turning off certain segments, which contribute very little to the optimization, it is possible to greatly shorten optimizations without a significant loss in enhancement. By shrinking the active area of segments, issues with holography systems occur, as small segments and phase transitions negatively affect performance.
Our results lead to better choices regarding the areas of interest and limits of such optimizations to improve speed and efficiency, which are relevant for WFS applications.

*Speaker