Aligning a wavelength selective switch with swept-wavelength digital holography

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Wavelength selective switches (WSS) have been developed in optical communications for wavelength division multiplexing, where the spectral components of an incoming beam are dispersed through a grating and can be independently manipulated and routed to different spatial ports [1]. In the quest of controlling both the spatial and the spectral degrees of freedom of light, a WSS was recently combined with a multi plane light conversion (MPLC) device [2] to achieve an optical "time-reverser" [3].

In this paper, we illustrate to align a WSS by means of swept-wavelength digital holography. The optical field is recovered by interfering the output beam from the WSS with an off-axis reference beam, and recording the interferogram on a large field of view InGaAs camera (Figure 1a). This method provides spatial resolution to unravel valuable misalignment features of the WSS across the spectral bandwidth (90 nm centered at 1555 nm), which are hardly accessible by conventionally coupling the beams back into a 1D fiber array.

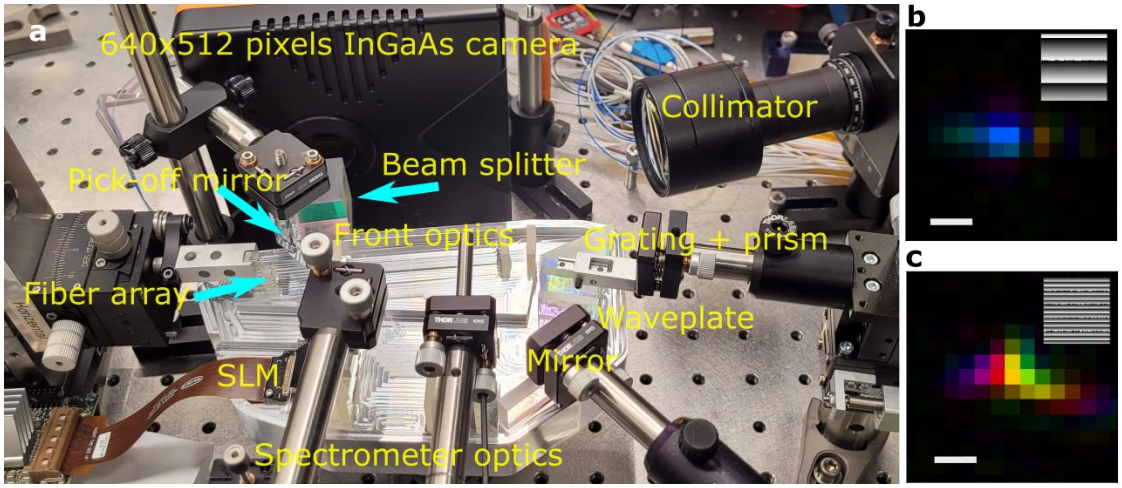

Figure 1: (a) 90-port WSS prototype. (b,c) Optical fields at 1550 nm when steering to a (b) low or a (c) high spatial frequency port. Inset: corresponding spatial light modulator (SLM) hologram.

Figure 1b,c depicts the optical field when a hologram is displayed in the spatial light modulator within the WSS to steer light to a certain spatial port. From these fields we can calculate the overlap integral with an ideal fiber detector to extract insertion loss and crosstalk. We can also extract the optical aberrations of the optical fields, an insight feedback for further optimizing the complex alignment of the WSS.

[1] G. Baxter et al. "*Highly programmable Wavelength Selective Switch based on Liquid Crystal on Silicon switching elements*". OFC Conference 2006

[2] J.F. Morizur et al. "*Programmable unitary spatial mode manipulation*", JOSA A **27**, 2524 (2010)

[3] M. Mounaix et al. "*Time reversed optical waves by arbitrary vector spatiotemporal field generation*", Nat. Comm. **11**, 5813 (2020)