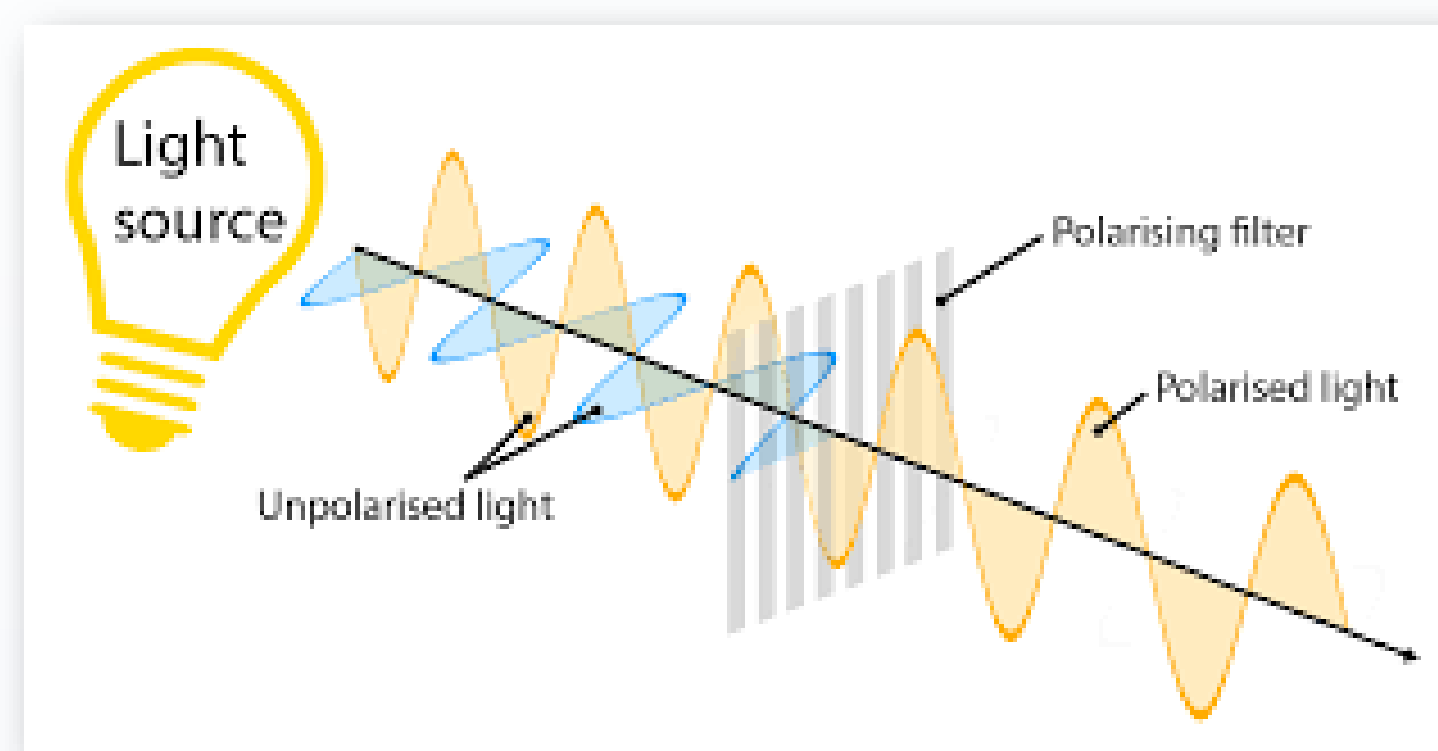
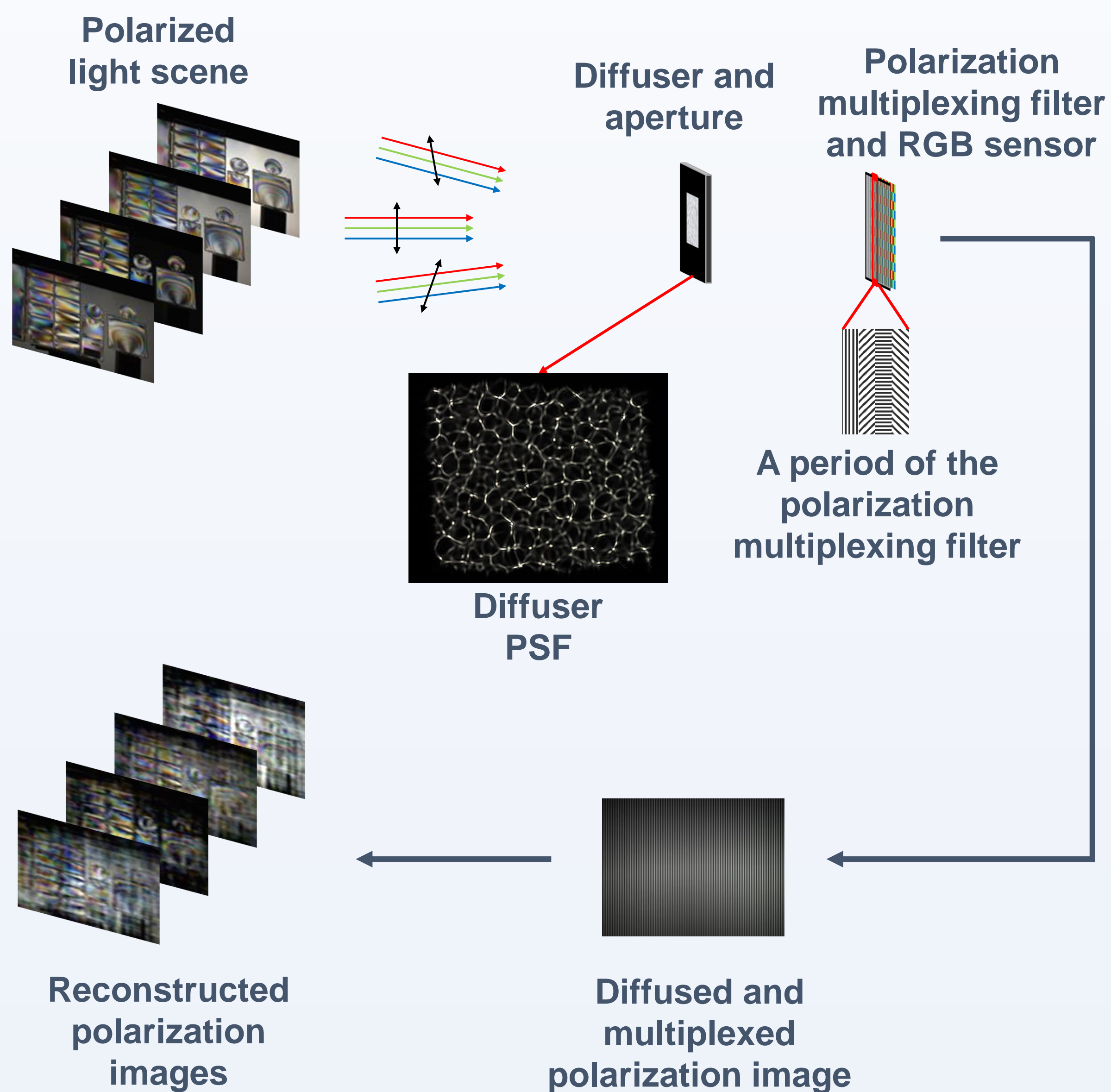


Introduction

- Polarization is a property of light which the human eye cannot see, however, Polarization imaging is very useful for various applications
- most polarization cameras are based either on a focal plane division or sequential polarization filtering.
- Recently, a diffuser-based lensless camera was presented. The diffuser generates a caustic-like PSF, which spreads a unique pseudo-random pattern on the sensor.
- Such a PSF enables compression and reconstruction of an additional modality, like depth, time or spectrum, along with 2D images.
- We take a similar route to design a snapshot lensless polarization camera.



Lensless Polarization Camera Design

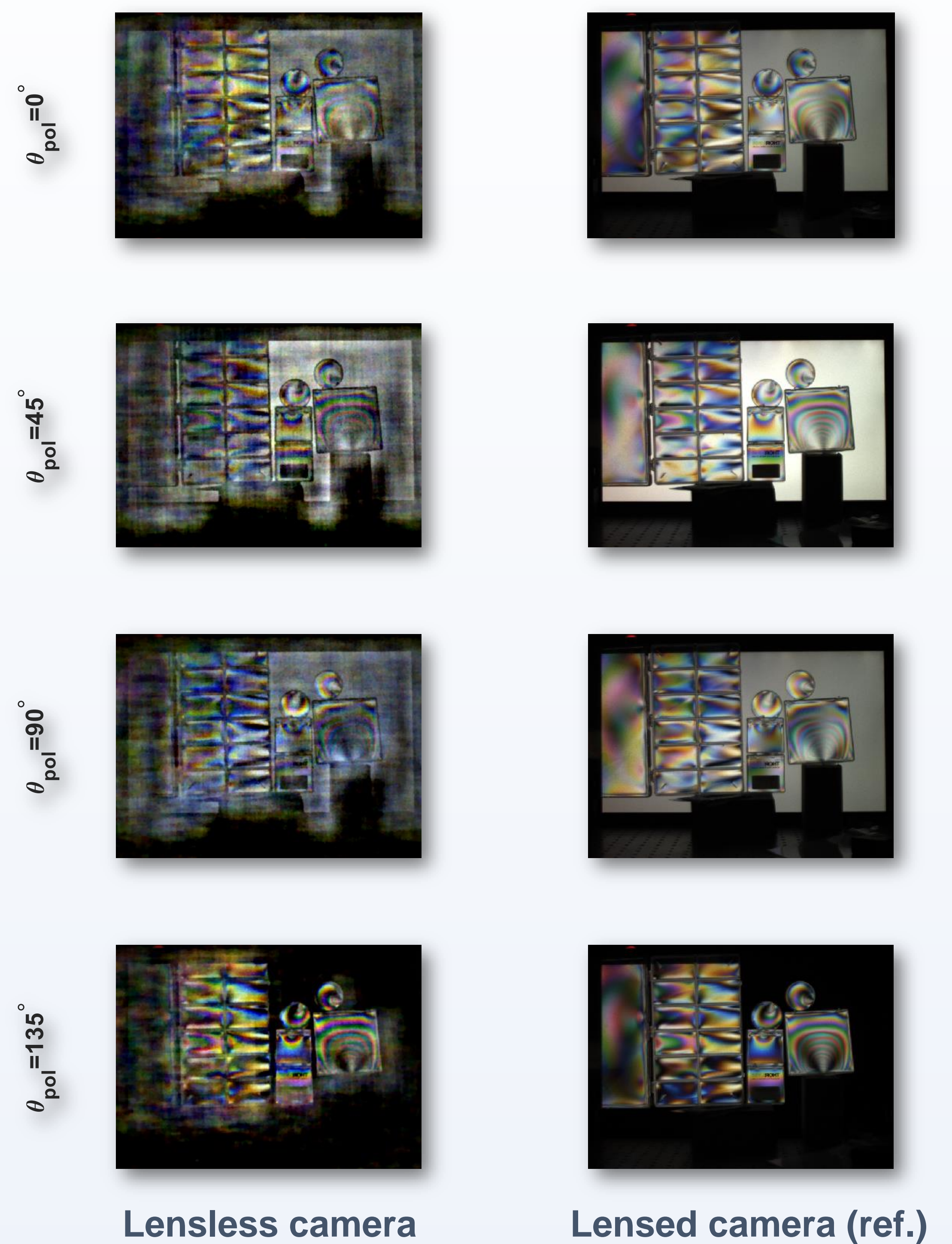


- A polarized light scene is acquired using a diffuser located a few millimetres before a sensor.
- The caustic-like pattern of the diffuser PSF is widely spread on the sensor, with large number of local sharp features.
- The unique PSF enables reconstruction of a scene even from a partially sampled image.
- By incorporating a simple add-on spatial multiplexing polarizer filter before the sensor, reconstruction of four polarization sub-images is achieved.
- The sub-images are easily transformed to a linear polarization mapping of the scene.

Polarization Image Prior for P&P Reconstruction

- As the reconstruction problem is ill-posed, a prior-based reconstruction should be used.
- Polarization images have unique properties, which are not easily derived from natural image priors.
- Several works presented image reconstruction methods based on plug and play denoiser prior. In this approach, the denoising step can be considered as a projection operator to the manifold of natural images.
- We use this scheme with a CNN trained for polarization image denoising, which implicitly learns the polarization image unique features.

Initial experimental results



Summary and Conclusion

- Initial results indicate that a lensless polarization camera can be designed using a diffuser and a simple polarization filter.
- A dedicated polarization image prior enables reconstruction of the compressed polarization information.
- Various improvements and extension are under consideration.

Contact Details

The work is under active research. Feel free to contact us for additional information and updates:
shay.elmalem@gmail.com

