

## H-PDLC Tunable Filter DOE Phase I STTR

The purpose of this Phase I program is to determine the feasibility of obtaining a high-speed hyperspectral imager (HSI). The HSI is comprised of a holographic-polymer dispersed liquid crystal (H-PDLC) tunable filter and a compressive imaging sensor (CIS).

The H-PDLC element is a periodic structure comprised of alternating polymer and LC droplet layers that comprise a Bragg grating. The period determines the Bragg wavelength of the structure and leads to reflection of light at that wavelength. Voltage biasing an element causes the LC droplets to rotate state, changing the refractive index to match the polymer layers and result in full transparency at all wavelengths. The small size of the LC droplets results in extremely fast switching time. A filter is realized with a stack of H-PDLC elements tuned to different Bragg wavelengths, each separated by the passband of the H-PDLC element. A byproduct of the fast response time is the ability to modulate each layer at a different frequency. This provides the ability to encode each wavelength orthogonally in frequency, which can be used to obtain a spectral multiplex and increase system throughput. Drexel University is developing the H-PDLC technology.

The CIS measures information about an image based on linear orthogonal projections. The image is reconstructed post-measurement from the measured projection values (weights). The projections are generated by directing portions of the image via a digital micromirror device (DMD) to a single element photodiode detector, which obtains the projection weight. Spectrally independent signals are obtained by simultaneously modulating the H-PDLC filter elements at different frequencies and synchronously detecting these signals to obtain spectrally encoded weights.

The advantages of this system are high switching speed (tens of microseconds) as shown in the adjacent figure, increased throughput (via the spectral multiplex) and smaller size, weight, and power (SWaP) than conventional HSI (no need for two-dimensional detector arrays).

