

Theory and applications of twisted nematic liquid crystal devices as spatial light phase modulators

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Light is used to transmit information by its nature of being fast and having parallel processing capability. Laser light is used when the phase information is of importance in an application, such as holography and interferometry. Three dimensional images are reconstructed from the phase information in the case of holography and very accurate measurements are performed by analyzing interference fringes that contain the phase information, in the case of interferometry. Various techniques were developed to realize spatial phase modulations in real time, incorporating twisted nematic (TN) liquid crystal devices. A TN liquid crystal device was modeled by Jones matrix formalism and the parameters of the model were determined from transmission measurements. Though, not mathematically unique, these parameters were determined with the help of physical insight of such devices. An optical system was setup and optimized to have ideal phase modulation characteristics based on the results of computer simulations using the Jones matrix model. The characteristics were experimentally verified in an interferometric configuration and were analyzed with polarization eigenstates as well. Finally, applications of these devices in real-time holography and straightness measurement experiments were discussed. TN liquid crystal devices were thus widely studied theoretically and experimentally. A wider use of such devices is anticipated in a variety of applications in the future.