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Localized Dynamic Lensing with Extended Depth of Field via Enhanced Light Sound Interaction

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Abstract : In recent years, acousto-optic (AO) lenses with tunable foci have emerged as a powerful tool for optical beam shaping, imaging, and particle manipulation. In most current AO lenses, the incident light that propagates orthogonally to a standing ultrasonic wave converts to a Bessel-like beam pattern due to the Raman-Nath effect, thus forming annular fringes that result in compromised focus response. Here, we report a new class of AO dynamic lensing based on generating a 3D-variable refractive index profile via a z-axis-scan ultrasound transducer. By utilizing the co- /counter propagation of light and acoustic waves that interact over a longer distance, the laser beam can be strongly focused in a fully controllable manner. Using this approach, we demonstrate AO lenses with instantaneous extended depth of field (DoF) and laterally localized dynamic focusing. This new light-sound interaction scheme may pave the way towards applications that require remote focusing, 3D micromanipulation, and deep tissue therapy/imaging.

Keywords : acousto-optic, optical beam shaping, dynamic lensing, ultrasound
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