Dynamic IR Beam Steering and Switching with Active Metasurfaces

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The growing demand for ultra-fast telecommunications, autonomous driving, and futuristic technologies highlights the crucial role of active beam steering at the nanoscale. In most studies, such devices rely on gate arrays composed of a large number of independently-controllable local gate electrodes that address local scattering response of individual metaatoms. While this approach in principle enables arbitrary wavefront control, the complicated driving mechanism and low optical efficiency have been hindering its practical applications.

In this presentation, we experimentally demonstrate an active beam switching device that provides high directivity, consistent efficiency across diffraction orders, and a wide field of view while operating with only a single-gate bias. We then theoretically expand the idea of single-gate beam switching from two-level to multi-level configurations by utilizing a low-loss dielectric metasurface platform with freeform inverse-design approaches. Finally, we present that active metasurfaces can steer not only the input beam with high spatial coherence, but also incoherent thermal emissions by employing a laterally delocalized optical mode.