INVERSE DESIGN OF LARGE-AREA METASURFACES

RAPHAEL PESTOURIE

ABSTRACT. We present a computational framework for efficient optimization-based "inverse design" of large-area "metasurfaces" (subwavelength-patterned surfaces) for applications such as multi-wavelength/multi-angle optimizations, and demultiplexers. To optimize surfaces that can be thousands of wavelengths in diameter, with thousands (or millions) of parameters, the key is a fast approximate solver for the scattered field. We employ a "locally periodic" approximation in which the scattering problem is approximated by a composition of periodic scattering problems from each unit cell of the surface, and validate it against brute-force Maxwell solutions. This is an extension of ideas in previous metasurface designs, but with greatly increased flexibility, e.g. to automatically balance tradeoffs between multiple frequencies or to optimize a photonic device given only partial information about the desired field. Our approach even extends beyond the metasurface regime to non-subwavelength structures where additional diffracted orders must be included (but the period is not large enough to apply scalar diffraction theory).

This work has been accepted in the journal Optics Express, and is yet to be published.

Keywords: inverse design, metasurfaces, hybrid solver

HARVARD J. PAULSON SCHOOL OF ENGINEERING AND APPLIED SCIENCES/MIT MATHEMATICS
E-mail address: pestourie@g.harvard.edu