New Optimization Strategies in Inverse Electromagnetic Design

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In this talk, I will discuss new advances in the inverse design of nanophotonic devices. As a model system, I will focus on the application of these design modalities to high efficiency metasurfaces, though the concepts are general and broadly apply to passive electromagnetic systems. First, I will show how freeform geometric design can be achieved using the adjoint variables method. The resulting devices utilize qualitatively new types of light-matter interactions based on strong near-field interactions between nanostructures, enabling new diffractive optics phenomena. I will then discuss two ways generative neural networks can augment and generalize the freeform inverse design process. The first is with generative adversarial networks, which can learn from images of topology-optimized devices. The second is from global topology optimization networks, termed GLONets, in which the global optimization process is reframed as the training of a generative neural network. These ideas help set the stage for data-driven approaches to be used in defining the next generation of high performance electromagnetic technologies.

Jonathan Fan is an Assistant Professor in the Department of Electrical Engineering at Stanford University, where he is researching new design methodologies and materials approaches to nanophotonic systems. He received his bachelor's degree with highest honors from Princeton University and his doctorate from Harvard University. He is the recipient of the Air Force Young Investigator Award, Sloan Foundation Fellowship in Physics, Packard Foundation Fellowship, and the Presidential Early Career Award for Scientists and Engineers, which is the highest honor bestowed by the United States government on outstanding young scientists and engineers.