Docket #: S20-204

Photonic Device Metasurface Optimization with Guaranteed Device Fabricability

Stanford researchers in the Fan Lab have developed a photonic device optimizer that generates designs with hard geometric constraints to guarantee device fabricability. This global optimizer combines the training of a generative neural network with adjoint-based topology optimization. Instead of evaluating and modifying devices in the physical device space, candidate device layouts are defined in a constraint-free latent space and mathematically transformed to the physical device space with geometric constraints. (Figure 1.) Unlike other existing local optimizers or strategies that apply filters or penalty functions to restrict minimum feature size, the Fan Lab optimizer avoids the existence of tiny features so that the fabrication requirement will not go beyond the ability of lithography and etching. The Fan Lab optimizer not only generates high performance, fabricable designs, but it does so much faster and computationally efficiently than conventional methods.

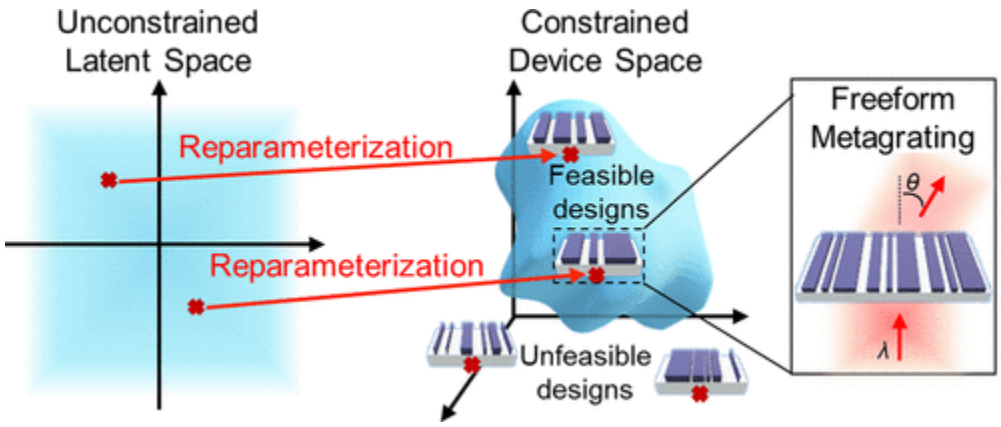

Figure 1 Overview of reparameterization for metagrating design. Figure courtesy Fan Lab.

Applications

- Optical and **photonic device design** (lens, gratings, filters) for:
  - Cameras and computer vision systems
  - Computational imaging and augmented reality
  - Microscopes and wavelength sorters for hyperspectral imaging

Advantages

- Optimizes device performance AND **guarantees device fabricability**
- Computationally efficient optimizer **saves time** – generates the global optimized device **27000x faster** compared to a guaranteed global optimization algorithm.

Publications

- Chen, M., Jiang, J. and Fan, J.A., "Reparameterization to Enforce Constraints in the Inverse Design of Metasurfaces." In *2020 Conference on Lasers and Electro-Optics (CLEO)* (pp. 1-2). IEEE. https://doi.org/10.1364/CLEO_QELS.2020.FW4B.4
- Chen, M., Jiang, J. and Fan, J.A., "Design space reparameterization enforces hard geometric constraints in inverse-designed nanophotonic devices." *ACS Photonics*, 7(11), pp.3141-3151. https://doi.org/10.1021/acsphotonics.0c01202

Patents

- Published Application: 20210356738
- Issued: 11,796,794 (USA)

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