Docket #: S18-019

Fully-automated design of grating couplers (software)

Stanford researchers at the Vuckovic Lab have created a computational nanophotonic design library for gradient-based optimization called the Stanford Photonic INverse design Software (**Spins**). This extremely flexible and adaptable photonics design software can be used to design any linear, passive photonic element. To use **Spins**, the designer simply specifies a design region and desired functionality for a device. The software will then automatically design an optimized device that meets these specifications.

Spins is now being licensed to any interested parties through Stanford's Office of Technology Licensing (OTL).
Spins-B is an open source version available on Github.

Stage of Research:
Prototypes - The team designed and experimentally demonstrated a spatial-mode demultiplexer, wavelength demultiplexer, compact broadband power splitter and directional coupler.
This invention is an application of **Spins** (Stanford reference **S18-012 "Inverse design software for nanophotonic structures - Spins"**)

Applications

- **Designing innovative structures for efficient optical devices**
- **Examples include silicon photonics components** such as power splitters, wavelength demultiplexers, fiber-to-chip grating coupler design, mode converters, metasurface design, quantum circuits (photonic and microwave) LEDs, solar cells, lasers designs

Advantages

- **Fully automated and efficient** - no human guidance required
- **Allows user to 'design by specification'**
- **Uses gradient-based optimization methods** not derivative-free optimization methods which are computationally inefficient and only work well for small numbers of degrees of freedom
- Resulting designs are significantly **more compact, have higher performance, and can potentially realize novel functionalities**
- Devices can be **easily fabricated** by standard lithography techniques

Publications

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- Logan Su, Dries Vercruysse, Jinhie Skarda, Neil V. Sapra, Jan A. Petykiewicz, and Jelena Vu?kovi? Nanophotonic inverse design with SPINS: Software architecture and practical considerations *Appl. Phys. Rev.* 7, 011407 (2020) Featured in *ScienceDaily, PhysOrg, EurekAlert,* and more.
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- Neil V. Sapra, Dries Vercruysse, Logan Su, Ki Youl Yang, Jinhie Skarda, Alexander Y. Piggott, Jelena Vu?kovi? Inverse design and demonstration of broadband grating couplers *Applied Physics* (2018).
- Fully-automated optimization of grating couplers Logan Su, Rahul Trivedi, Neil V. Sapra, Alexander Y. Piggott, Dries Vercruysse, Jelena Vu?kovi?. (2017)

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- Alexander Y. Piggott, Jesse Lu, Thomas M. Babinec, Konstantinos G. Lagoudakis, Jan Petykiewicz, Jelena Vuckovic Inverse design and implementation of a wavelength demultiplexing grating coupler *Scientific Reports* 4, 7210, (2014).
- Jesse Lu and Jelena Vuckovic Nanophotonic computational design *Optics Express* Vol. 21, 11, pp. 13351-13367 (2013).

Innovators

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