Docket #: S15-472

Phase Shifting by Mechanical Movement in Integrated Photonics Circuits

Stanford researchers developed a method to make large phase shifts with little or no power dissipation in integrated optics. The approach uses a directional coupler moved by a MEMS actuator to achieve a path delay, i.e. an effective change in refractive index. The method is easily applied to silicon photonics, where micromechanical techniques can bend waveguides making the necessary mechanical displacements within the integrated circuit resulting in large refractive index changes without heating or optical absorption. These phase shifts or time delays in interferometric structures allow light beam intensity modulation and path switching, and spectral filtering control. It is especially useful in optical telecommunications circuits and applications requiring controlled phase shifts and interferometers.

Stage of Research
Proof of concept testing completed in the Miller Lab.

Miller Lab silicon photonics technology available for licensing includes:
“Ge-Si quantum well structures” U.S. Patent No. 7,599,593.
“Integration of optoelectronics with waveguides using interposer layer” U.S. Patent 8,824,837.
“Selective area growth of germanium and silicon-germanium in silicon waveguides for on-chip optical interconnect applications." U.S. Patent No. 9,368,579.
"Self-aligned semiconductor ridges in metallic slits as a platform for planar tunable nanoscale resonant photodetectors." U.S. Patent No. 8,829,633.
"Universal Linear Components." U.S. Patent Application No. 14/092,565.
"Field-Programmable Optical Component." U.S. Patent Application No. 15/080,170.
“Phase shifting by mechanical movement “ U.S. Patent Application No. 15/380,062 (Stanford docket 15-472)

Applications

- **Optical telecommunications** circuits, such as:
  - Integrated photonics interferometers or directional couplers
  - Receivers and transmitters, mode converters, beam couplers and power combiners
- Adaptive front ends for **optical sensing systems**, optical beam tracking and steering
- **RF photonics** for high performance radar and electronic sensing
- **Interferometric microscopy**
- **Quantum information processing** and encryption

Advantages

- **Versatile** and **efficient** – large, controllable phase shift with little or no power dissipation
- **Conveniently integrated** in optical circuits

Publications

- Miller, David AB. “Phase shifting by mechanical movement.” U.S. Patent Application No. 15/380,062.

Patents

- Published Application: 20170235056
- Issued: 10,338,319 (USA)

Innovators

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