Docket #: S14-430

Field-Programmable Optical Component

Stanford researchers have developed a method to make non-ideal beam-splitters operate as perfect beam-splitters, using a double Mach-Zehnder interferometer. Complex optical telecommunications circuits will only function properly if optical interferometer beams can be split equally among different legs of the device, but fabricating interferometers with ideal internal split ratios is extremely difficult. This invention structures the circuits so they can be corrected in the field using simple progressive algorithms. Devices with initial split ratios in the range 15:85 to 85:15 will to operate as ideal (50:50), without any physical changes to the circuit. In addition, optical circuits can be programmed after fabrication to perform a wide range of complex, precise, linear optical functions. Mass-fabrication of these universal field-programmable linear array (FPLA) optical elements may also produce higher yields with lower cost.

Stage of Research
Researchers have successfully built and tested prototypes in the 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:
  - Devices for separating different spatial modes
  - Polarization tracking
  - Optical hybrid circuits
  - Automatic alignment and tracking of optical beams into fibers
  - Linear optical sensor preprocessing
- Quantum optical networks for communications and computing

Advantages

- **Simple adjustment in the field** yields more **precise** optical circuits post fabrication - split ratios anywhere from 85:15 to 15:85 will operate as if the ratio was exactly 50:50.
- Potentially **higher yield and lower cost** due to more relaxed fabrication tolerances.

Publications

- Wilkes, Callum M., Xiaogang Qiang, Jianwei Wang, Raffaele Santagati, Stefano Paesani, Xiaoqi Zhou, David AB Miller, Graham D. Marshall, Mark G. Thompson, and Jeremy L. O'Brien. "60 dB high-extinction auto-configured Mach–Zehnder interferometer." *Optics letters* 41, no. 22 (2016): 5318-5321.
- Miller, David AB. "Perfect optics with imperfect components." Optica 2, no. 8 (2015): 747-750.

Patents

- Published Application: 20170031101
- Issued: 9,753,224 (USA)

Innovators

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