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On-chip quaternary/octal/hexadecimal optical computing using silicon nanophotonic devices

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Optical signal processing is considered to be an attractive technique to overcome the speed bottleneck of electronics and accelerate future high-speed optical communication networks. Optical nonlinearities are potentially well suited to perform various optical signal processing functions, among which optical computing is a basic building block. With recent advances in signal modulation schemes from binary modulation formats to m-ary modulation formats, it is expected to promote the traditional binary logic operations to high-base (quaternary/octal/hexadecimal) optical computing functions. Previously, binary logic operations and high-base optical computing functions were demonstrated on different platforms of semiconductor optical amplifiers (SOAs), highly nonlinear fiber (HNLFs) and periodically poled lithium niobate (PPLN) waveguides. Despite impressive operation performance, ultra-compact platform is still highly desired to offer integrated optical signal processing solutions. Silicon photonics isa promising low cost integration platform enabling on-chip optical signal processing owing to its distinct advantages of high index contrast, large optical nonlinearity, relaxed latencies, lower power consumption, and compatibility with complementary metal-oxide-semiconductor (CMOS) technology. In this scenario, it would be valuable to exploit optical nonlinearities in silicon nanophotonic devices to facilitate on-chip high-base optical computing.

In this talk, we review recent research progress in on-chip high-base optical computing using silicon nanophotonic devices. By exploiting degenerate and non-degenerate four-wave mixing (FWM) processes in ultra-compact silicon waveguides and employing quadrature phase-shift keying (QPSK)/8-ary phase-shift keying (8PSK)/16-ary phase-shift keying (16PSK) signals, we demonstrate grooming on-chip quaternary/octal/hexadecimal optical computing functions (addition, subtraction, doubling, hybrid).

Biography:

Jian Wang received the Ph.D. degree in physical electronics from the Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, Wuhan, China, in 2008. He worked as a Postdoctoral Research Associate in the optical communications laboratory in the Ming Hsieh Department of Electrical Engineering of the Viterbi School of Engineering, University of Southern California, Los Angeles, California, USA, from 2009 to 2011.He is currently a professor at the Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology,Wuhan, China.

Jian Wang has devoted his research efforts to innovations in photonic integrated devices and frontiersof high-speed optical communications and optical signal processing. He has more than 250 publications, including 3 book chapters, 2 special issues, 2 review articles, 5 invited papers, 42 tutorial/keynote/invited talks, 8 postdeadline papers, and more than 100 journal papers published on Science, Nature Photonics, Scientific Reports, Optics Express, Optics Letters, etc.