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Focus issue: Coherent optical communication

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It is an exciting time for the field of optical communication, in large part, due to the rebirth of coherent optical communication. Pre-amplified optical communication systems enabled by the invention of EDFA have been the mainstay for research and commercialization since the demise of coherent optical communication in the early 1990s. Advances in integrated circuits and digital signal processing technologies fortunately have brought coherent optical communication to the forefront again.

In fact, recent developments in DSP-enabled coherent optical communication mirror advances in the field of RF/wireless communication. However, DSP-enabled coherent optical communication is advancing at a much faster pace; techniques that were developed in RF/wireless communication over the last few decades have been applied to coherent optical communication in the last few years. We are excited to bring this Focus Issue on Coherent Optical Communication, consisting of 11 invited papers, to the readers.

This Focus Issue features work by first generation of veterans who worked in the field in the 1980s as well as second generation researchers who entered the field recently. The demise of coherent optical communication can be attributed to the impracticality of phase and polarization management, implemented in the optical domain using optical phase-locked loops and optical polarization controllers in the 1980s, that are required in a coherent receiver. In their contribution, Ferrero and Camatal described the latest developments in optical phase locking technologies. Advances in DSP allow these functionalities to be performed in the digital domain, which is exactly what happened in RF/wireless communication. Ip and Kahn provide an overview of recent research work in DSP-based coherent optical communication. Early work in digital phase and polarization management were performed offline. This is because the requirement for DSP in terms of both speed and precision for coherent optical communication at Gbaud was beyond the capability of the state of the art. It is noteworthy that Nortel and University of Paderborn have independently succeeded in implementing real-time coherent receivers performing both digital phase estimation and polarization demultiplexing for QPSK signals at Gbaud rates.

One of the advantages of coherent optical communication is the potential to compensate fiber chromatic dispersion and polarization-mode dispersion in the digital domain. Savory presents advanced filter design for efficient dispersion compensation using DSP at the receiver. Liu *et al*. explore self-coherent receivers based on DSP in a effort to further simplify coherent receivers. An alternative modulation format for combating dispersion and PMD is orthogonal frequency-division multiplexing (OFDM). Shieh summarizes research in coherent OFDM while Lowery presents a comparison between coherent and incoherent OFDM. There are also many efforts in demonstrating advanced modulation formats containing richer constellations. This area is highlight by the work on 64- and 128-QAM transmission from Nakazawa *et al.*

Optical fiber is a quite different transmission channel compared to free space for RF/wireless communication because of fiber nonlinearity. DSP-enabled coherent optical communication offers new possibilities in nonlinearity compensation, which can be accomplished using lumped nonlinearity compensation described in the work by Kikuchi or using distributed nonlinearity compensation presented in the paper by Li *et al.*

Coherent optical communication is indeed a very vibrant and rapidly progressing field. It is almost impossible to include important progresses that have been made after the initiation of this focus Issue 6 months ago. I apologize for any omission of other works that deserve to be included in this Focus Issue. We encourage the readers to submit their work in this field to *Optics Express*.

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