Making A Many-Colored Processing Engine: Signal Processing with Optical Filters

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The ultimate information capacity of optical fibers is far beyond currently deployed systems even with the exponential growth in system capacity over the past 20 years. Even now, the performance of high-capacity, long-distance wavelength-division-multiplexed (WDM) networks depends significantly on reconfigurable optical filters for bandwidth management and adaptive filters for compensating analog impairments. Optical filters are also key elements in optical code generation and detection with applications in optical packet header processing. Whether the end goal is for communications or high-speed signal processing, optical filters that can operate on amplitude, phase and polarization are critical to unleashing the full potential of optical systems. To be practical, a cost-effective implementation that can scale in optical circuit integration density and functionality is required. This talk addresses optical filters in the context of their analog and digital relatives. I will show how well-known filter types are related to the underlying interference mechanisms and how digital filter theory concepts are beneficially translated to the optical domain. Then, the present capabilities of integrated optics for implementing adaptive optical filters and an overview of some challenges ahead will be discussed. Adaptive filters implemented using high-index-contrast silica-on-silicon planar waveguides with applications to tunable chromatic dispersion compensation and polarization monitoring, control and polarization mode dispersion compensation will be used as examples. With state-of-the-art integrated optical filters, we have the ability to realize a many-colored, high-speed and cost-effective processing engine that truly harnesses the power of photonics.

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