Multi-Gbps Optical Receivers with CMOS Integrated Photodetectors

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The integration of high-speed optoelectronics alongside CMOS garners much research attention. Consider how the emergence of CMOS image sensors in the 90's revolutionized and proliferated digital cameras. Likewise, a multi-Gb/s CMOS photodetector enables highly-integrated, compact, and low cost optical receivers opening up new applications for optical links in data centers, consumer electronics, and automobiles.

As photodiodes, the pn-junctions and depletion regions available in a standard CMOS process have an intrinsic bandwidth of, at most, 10's of MHz, so considerable innovation has been required to make them useful for multi-Gb/s communication. “CMOS photonics” researchers seek modifications to standard CMOS processing that will permit the integration of high-performance photodetectors and optical waveguides, for example made of germanium. By contrast, this presentation illustrates that the slowly diffusing photocarriers that usually limit the bandwidth of photodetectors made in standard CMOS may be considered simply a form of ISI. Hence, the bandwidth limitations of such CMOS photodetectors can be dealt with using the same signal processing tools being applied with success in other wireline communication applications. A combination of spatially-modulated light detection, analog equalization, and modest decision feedback equalization appears to offer a path towards data rates in excess of 10-Gbps using standard CMOS photodetectors. Nanoscale CMOS is particularly well suited to the implementation of such signal processing functions, and prototype results ranging from 0.18um CMOS to 65nm CMOS will be presented.

Biography: Tony Chan Carusone completed the B.A.Sc. and Ph.D. degrees at the University of Toronto in 1997 and 2002 respectively. Since 2001, he has been with the Department of Electrical and Computer Engineering at the University of Toronto where he is currently an Associate Professor. He is a Senior Member of the IEEE, has co-authored the best paper at the 2005 Compound Semiconductor Integrated Circuits Symposium, and the best student papers at both the 2007 and 2008 Custom Integrated Circuits Conferences, and the best invited paper award at 2010 Custom Integrated Circuits Conference where he presented his work on CMOS photodetectors. He was the Editor-in-Chief of the IEEE Transactions on Circuits and Systems II: Express Briefs and currently serves on the editorial board of the IEEE Journal of Solid-State Circuits and on the Technical Program Committees for both the VLSI Circuits Symposium and the International Solid-State Circuits Conference. He is an author, along with David Johns and Ken Martin, of the 2nd edition of the classic textbook "Analog Integrated Circuit Design".

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