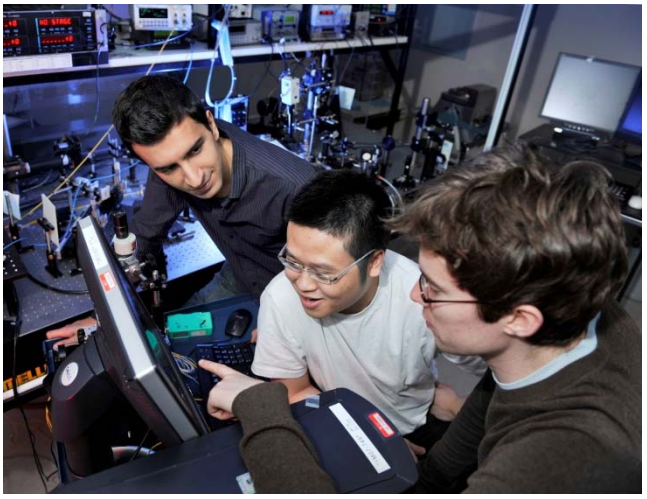
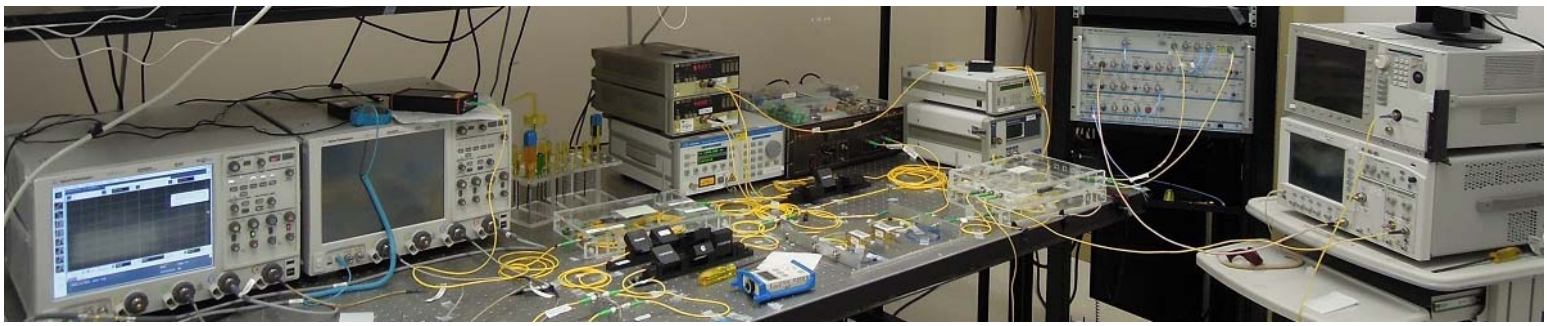
Canada Research Chair APTEC

Advanced Photonic Technologies for Communications



Increased connectivity has transformed our daily lives: private and public organizations now rely on the Internet as the preferred means to distribute information, emailing has changed the workplace, accessing web-based information is now part of children's education and new applications such as video sharing and social networks are spreading rapidly among enthusiast user communities. To enable these applications, telecommunication networks must efficiently transport and distribute enormous amounts of data. At the core of today's high speed networks is an optical fiber backbone deployed across continents and oceans. For a long time, the capacity of optical fiber communication systems seemed deceptively impossible to saturate. However, optical network scalability is now being questioned. The objective of the CRC-APTEC is to increase the capacity and connectivity of optical networks through innovations taking place at the physical layer.

The CRC-APTEC is part of the Center for Optics, Photonics and Lasers (COPL) a multi-disciplinary research center located at Université Laval, Québec, Canada. Building on its long tradition of research in classical optics, lasers, optoelectronics and microwave frequency standards, Université Laval established the COPL in 1989. The center now regroups 21 faculty members and more than 200 researchers (students, post-doctoral fellows, and research scientists). The excellence of the COPL-Laval research program provides an exceptional training environment for future scientists and directly contributes to the development of a strong local photonics industry. Université Laval is located in Québec City, Canada, a UNESCO World heritage site. Québec City offers a wide variety of cultural activities and easy access to outdoor activities.



The Optical communication laboratory (OCL) is equipped with state-of-the-art characterization equipment including a high resolution optical spectrum analyzer (5 MHz), wavelength swept interferometers for full spectral characterization, photonic network analyzers, polarization analyzers, mode-locked sources, an optical sampling oscilloscope, etc... Central to our research are several very high speed transmission testbeds with advanced modulation format capability, including six high-speed real-time oscilloscopes and arbitrary waveform generators. Spatial division multiplexing research is performed with a free space coupling setup that includes several spatial light modulators (SLM) and integrated multiplexers/demultiplexers. The laboratory further comprises three test setups for full electrical and optical characterization of passive and active silicon photonic integrated circuits. A state-of-the art fiber Bragg grating writing facility is also available for fabrication of custom spectral filters. COPL researchers have access to a common equipment pool that includes near-IR refractometers, scanning electron and atomic force microscopes, thin film deposition systems, and fs-lasers. COPL also hosts an optical fiber fabrication laboratory equipped with MCVD and drawing towers. Researchers have the opportunity to design fibers that will be fabricated on site by an experienced team of technicians.

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Research program

The program of the Canada Research Chair (Tier 1) for Advanced Photonic Technologies for Communications explores new strategies aimed at increasing the amount of information transmitted over optical fiber links with innovative photonic systems and sub-systems. The research addresses current challenges in optical communication networks such as improving spectral efficiency and flexibility with the goal of increasing user bandwidth.

- Novel optical fibers and sub-systems (amplifiers and lasers)

  We examine the design of new optical fibers for spatial multiplexing, i.e. channel transmission at the same carrier frequency over the fiber orthogonal modes. Our objective is to demonstrate fibers with weak coupling modes therefore eliminating the need to use MIMO signal processing at the receiving end.

  We are also studying novel optical fiber amplifiers to increase capacity and bandwidth by proposing novel erbium-doped fiber designs. We further extend this research to high power fiber lasers in collaboration with an industrial partner.

- Digital and analog communications over optical fiber

  At the moment, this research activity consists in exploring modulation formats, specifically intensity modulation – direct detection (IM-DD), which can increase spectral efficiency in short haul links where the transmitter is either a wideband directly modulated laser or an integrated silicon photonic modulator.

- Optical signal processing

  Photonics allows ultrafast signal processing to perform operations such as optical sampling, pulse shaping or signal switching. We are currently studying frequency conversion of optical signals with advanced modulation formats, i.e. coded in amplitude and phase.

- Integrated photonic circuits for communications

  We design, characterize and demonstrate integrated silicon photonic devices at the system level. The research targets the development of modulators and filters in integrated circuits fabricated using CMOS technology in silicon on isolator. We strive to increase modulator performance (speed, extinction ratio) while decreasing their footprint and energy consumption. As for filters, we are developing solutions for reconfigurable spectral responses that are polarization insensitive in order, for example, to perform channel multiplexing/demultiplexing.

- Integrated photonic for sensing

  We are investigating how to integrate an infrared spectrometer on a silicon chip for monitoring applications in remote environments.

For more information, contact:

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