Projects: Photonic Signal Processors for Advanced Signal Processing and Communications

Microwave signal processors with high resolution, broadband signal processing capability and wide tunability are important for the implementation of advanced communication and radar defence systems. However it becomes increasingly difficult for digital signal processing and conventional analog signal processing techniques to perform widely tunable and high-fidelity functions at high signal frequencies.

Photonic signal processing of microwave signal refers to the use of photonic techniques and structures to optically extract, modify and manipulate microwave signals, particularly high-bandwidth signals. In contrast to the inherent bottlenecks caused by limited sampling speeds in conventional electronic signal processors, photonic signal processors, based on optical delay lines, are capable of transcending the frequency limitations, as they are generally insensitive to the modulation frequency. This is due to the optical carrier of extremely high frequency. They can perform equivalent functions to those of conventional electronic processors within RF and microwave systems. In addition, they also bring the advantages inherent in photonics, such as low loss, reduced size, large time-bandwidth product, and immunity to electromagnetic interference (EMI). Furthermore, they can carry out tasks that are very complex and even impossible to realize directly in the RF domain and offer the opportunity of direct integration with the optic-fiber communication systems.

In recent years, the vast capability offered by photonic technologies for the transmission and processing of broadband signals has been widely recognized. Photonic signal processor applications can be found in broadband wireless access network, sensor networks, satellite communications, scientific instrumentation and radio-astronomy.

If you are interesting in working with us on some challenging topics of this exciting research area, please drop me an email to xiaoke.yi@sydney.edu.au with your academic transcripts (University of Sydney) and your technical strength/background. We will discuss with you a project that will be in particular tailored to you.

Number of students required: 3–4

Desirable knowledge: Signals and Systems, Digital Signal System, Communication Electronics and Photonics (or Optical Communication Systems)

Main supervisor: A/Prof. Xiaoke Yi
Laboratory supervisor: Dr Liwei Li

Projects: Smart Photonic Sensor for New Medical Devices.

There is an increasing demand for real-time non-invasive monitoring and detection diseases. The photonic based sensing technology offers sensors with relative immunity to electromagnetic interference, weight savings and safety improvement as the detector does not need to directly
interact with the sensed material. The sensors are completely passive and only the sample cell and related components are directly exposed to the material.

In this project we develop photonic sensor for medical applications with a focus of extract significant biomarkers for disease identification. This multi-disciplinary field provides new opportunities to advance medical devices and instruments. The project involves several key experimental aspects including sampling cell design, optical source design, circuit design, sensor implementation and system integration.

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Assumed knowledge: ELEC3404 Electronic circuit design or ELEC3405 Communication Electronics and Photonics

**Number of students required:** 2–3

**Main supervisor:** A/Prof. Xiaoke Yi
Laboratory supervisor: Dr Thomas Huang, Ms Liwei Li