Fiber Bragg based optical filters for photonic signal processing

In photonic signal processing, high time-bandwidth computations, such as convolution, correlation, matrix operations, and frequency filtering, are carried out directly in the optical domain, in order to overcome limited sampling speed imposed by conventional electrical signal processors. This limitation stems from the fact that the sampling speed required to process high frequency electrical signals increases in proportion to the bandwidth of the electrical signal to be processed. The low-loss (fractional decibels/kilometer) and large bandwidth-length product (bandwidths exceeding 100 GHz over a 1-km distance for single mode fiber) of optical fibers, together with the advances in fiber-optic component technology provide an attractive technology for processing broadband signals. Moreover, since in such fibre optic systems the signal is already in the optical domain, it is desirable to incorporate photonic signal processing into the optical fibre network, as this can provide in-built signal conditioning that can be integrated with the fibre optic system.

Implementing signal processing functions in an all-optical domain requires versatile, reliable and high performance optical devices, particularly optical filters. Fiber Bragg gratings are attractive as optical filters, because they offer flexibility for photonic signal processing via controlling grating reflectivity and wavelengths. In this project, we investigate narrow bandwidth optical filters based on sampled fiber Bragg grating techniques. Specifically, we will develop software modules to optimize the new optical filter design for wide bandwidth signal processing functions. This involves theoretical analysis of the transfer function of photonic signal processors, modelling of sampled grating and Matlab programming.

Students required: 2
Assumed knowledge: ELEC3405 Communication Electronics and Photonics or ELEC5511 Optical Communication Systems
Skills required: Matlab programming.