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The use of fibre Bragg gratings for advanced optical signal processing

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The development of ultrafast laser technology and high-speed fibre-optic communications, has resulted in the need to develop all-optical techniques for implementing many network operations.

Superstructured fibre Bragg grating (FBG) technology has advanced to the point that the design and fabrication of passive filters of highly complicated optical responses is feasible. Thus, FBG's can be used for applications involving coherent control of short or ultrashort pulses, such as pattern generation and pulse shaping at high speeds. Key benefits offered by this filtering approach are full integration with fiberised systems, and precise control of the amplitude and phase of the filter responses. Due to their coherence properties, superstructured FBG's are monolithic devices, and consequently their operation does not require any external configurations (e.g. adjustable delay lines, etc.).

We have demonstrated this powerful signal processing technique in a series of different experiments, including the generation of a 40GHz pulsed signal by repetition rate multiplication of 10GHz pulses, and shaping of solitons into square pulses. In this talk I will focus mainly on our more recent results, concerning pulse encoding and decoding schemes suitable for optical code-division multiple access (OCDMA) systems. Bipolar codes of a chip rate of 160Gchip/s are written in single superstructured FBG's. An incoming 10Gbit/s signal is encoded, transmitted and then decoded using a second, matched-filter FBG.