UNIVERSITY OF SOUTHAMPTON

ADVANCED FIBRE BRAGG GRATING STRUCTURES: DESIGN AND APPLICATION

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FACULTY OF ENGINEERING AND APPLIED SCIENCE

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ABSTRACT

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This thesis presents experimental and computational work on a variety of advanced fibre Bragg grating structures covering long dispersion compensating chirped Bragg gratings, superstructured Bragg gratings for identical multiple channel operation, Bragg gratings for pulse-shaping applications and Bragg gratings for add-drop applications in high bit-rate systems.

Development of the fabrication-technique developed and analysed as a part of this work has led to a number of experimental 'firsts', including the meter-long Bragg gratings with dispersion-characteristics designed to compensate simultaneous linear and higher order dispersion. Upon transfer of this technology to our industrial partners, a number of field-trial experiments utilising gratings written using this fabrication technique have been successfully performed. Some of the requirements identified from customers led to the discovery of the importance and understanding of high-quality reflection and time-delay profiles. Another product of the high flexibility provided by the developed fabrication technique have led to demonstrations of superstructured Bragg gratings for a number of exciting applications such as multiple-channel filters obtained through a periodic sinc modulation of the refractive index-profile in fibre Bragg gratings and pulse-reshaping from a soliton to square-pulse with applications in high-speed demultiplexing. Additionally, it is discussed how uniform apodised Bragg gratings filters for application in dense WDM networks, despite their near ideal spectral performance, suffer from non-linear phase attributes in the stop-band, that could limit their use in high bit-rate systems (10Gbit/s and above). Linear phase-filters for dispersion-free filtering are proposed and demonstrated as a solution to this problem for bit-rates up to 40Gbit/s and channel spacings as narrow as 25GHz.

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