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STUDY OF LINEARLY-CHIRPED FIBRE GRATINGS

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Fibre gratings are proving to be one of the most important devices in a number of optoelectronic applications. They basically constitute generalised Bragg reflectors with well designed, adjustable reflection and dispersion characteristics. They can be used effectively for dispersion compensation in high-bit-rate, long-haul fibre-optic communication links, as well as, for the implementation of a variety of high quality fibre-optic laser cavities of various geometries. In this paper, we investigate thoroughly the reflective and dispersive properties of linearly chirped fibre gratings for use, particularly, in dispersion-management applications, such as dispersion compensation in communication links [1] and short-pulse manipulation [2].

We have calculated systematically the variation of the maximum reflectivity, full-width-half-maximum (FWHM) reflection bandwidth, as well as, the mean dispersion and time delay variation across the FWHM bandwidth as a function of the chirp parameter C (in m^{-1}) for gratings of different length. The chirp parameter gives the rate of the fractional change of the local grating period along its length. It is shown that, for a given grating, the peak reflectivity decreases quasi-exponentially, while the FWHM bandwidth increases linearly, with the chirp parameter. For $C > \sim 0.005$, the grating peak reflectivity is independent of the grating length. The total time delay difference across the FWHM bandwidth is almost constant and about equal to the time delay along twice the grating length. This results in a 1/x decrease of the mean grating dispersion (in ps/nm) with the chirp parameter and the FWHM bandwidth, for all grating lengths. For all grating lengths and FWHM bandwidths greater that 1.5nm, the mean dispersion converges asymptotically to the same value. The theoretical predictions are in very good agreement with recently obtained experimental results [3].

The effect of the FWHM grating bandwidth on short pulse compression and reshaping has also been considered in detail. Finally, the grating-length requirements in order to achieve a certain dispersion over a given bandwidth has been calculated and the results are summarised in Figure 1.

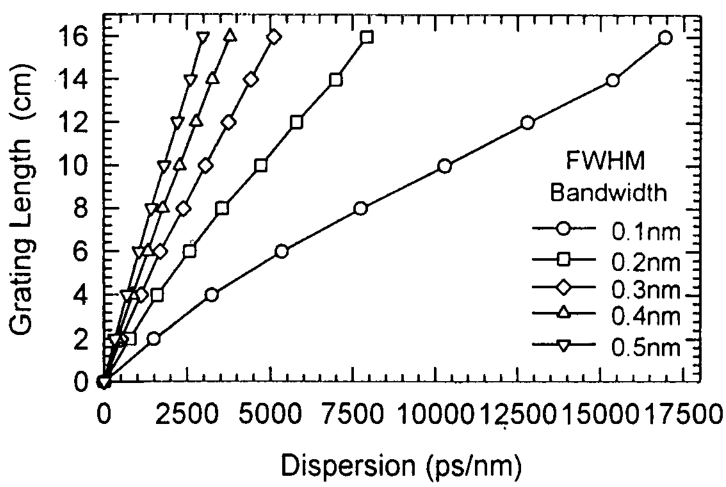

Figure 1: Grating length versus mean grating dispersion for FWHM bandwidths of 0.1-0.5nm

References

[1] R. I. Laming, et al., submitted to ECOC'95.
[2] D. Taverner et al., submitted to ECOC'95.
[3] S. Barcelos, et al., Submitted to ECOC' 95.