Low Cost All Optical Swept Source for Optical Communication Applications

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Abstract

By introducing a periodic modulation in a waveguide, it is possible to create an interaction between forward-traveling and backward-traveling modes of an optical waveguide. Bragg grating may be a one dimensional diffraction grating which diffracts light from the forward-traveling mode into the backward traveling mode. The condition for diffraction into the reverse traveling modes is called the Bragg condition.

The Bragg period Λ must be related to free space wavelength λo by
$\Lambda = \lambda o /2n(eff)$
This is condition for a first order Bragg grating. It is possible to utilize higher order diffraction to couple the forward and backward modes. The condition for constructive interference is that the phase accumulation between subsequent reflection must be an integral number of wavelengths. The Bragg gratind condition for an mth order Bragg grating is
$\Lambda = m\lambda o /2n(eff)$.

Bragg grating is a perfectly periodic structure which has a sharply defined beginning and end point. Either by design or because of fabrication technique used, the Bragg grating will deviate some what from its perfect periodic structure.
Wavelength sweep generation is providing light where a wavelength of the light is changed according to a sweep function: interrogating one or more reflective optical elements with the wavelength swept light to produce reflected optical signals, filtering the reflected optical signals where in a bandpass wavelength range is changed based on the sweep function to follow the change in the light's wavelength and receiving the filtered reflected optical signals for processing.

Since the Bragg grating reflects at the wavelength for which it is designed, we would like to find the number grating element required the reflection of the signal. To simulate Chirped Bragg grating, we optimizes that how many minimum number of grating elements are used for reflection of particular wavelength.

The normalized component electric field reflected from the Bragg elements are shown in figure 1. The results obtained for different numbers of grating elements are exhibited in the figure. From the graph as we decrease number of grating element reflected electric

field reduces. The 1/e value of reflection electric field is obtained for number of grating elements 6 or more. Accordingly, we simulate Chirped Bragg grating using at least 6 grating elements in each case for reflection of each wavelength from 1μm to 1.55μm. Simulated design of Chirped Bragg grating is shown in Figure 2. Figure 3 shows simulation results for reflection of different wavelength by the chirped
Bragg grating. The reflected components execute oscillations due to the interference between the forward and reverse propagating em waves. In each design we used in Chirped Bragg grating first six grating elements each for every wavelength from 1μm, to
1.55μm with step size of 5nm. The chirping arising due to this can also be understand from the Graph 4. In Graph 4 we can see that 1μm wavelength have negligible intensity after some sort of distance. As wavelength is increased distance also increased to decrease intensity.

Figures used in the abstract

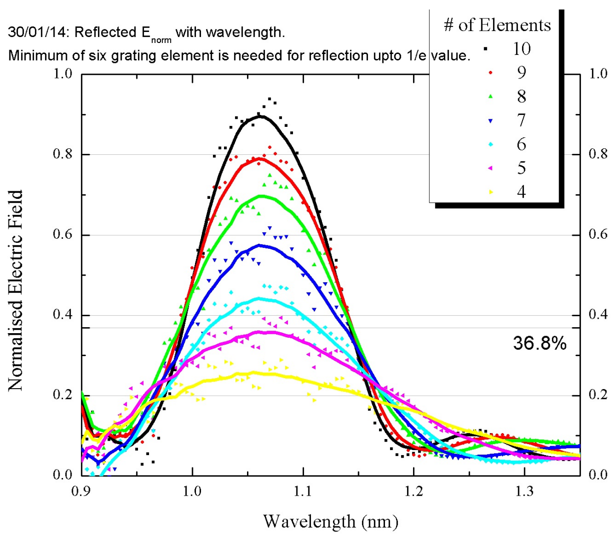

Figure 1: Normalised reflected electric field component with wavelength. The curves are obtained for various Bragg elemenst from 4 to 10. The 1/e value of 36.8% is obtained for 6 or more elements.

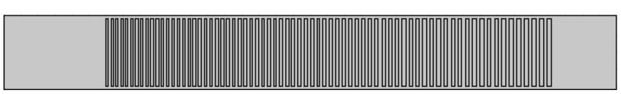

Figure 2: The design of Chirped Waveguide used with COMSOL for Swept source generation.

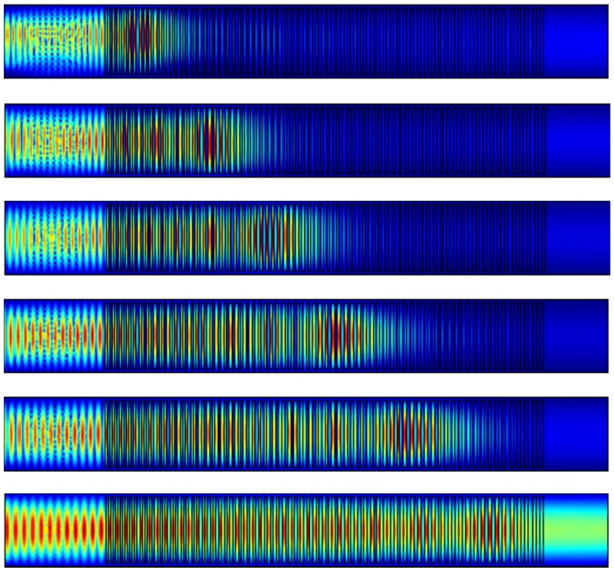

Figure 3: Simulated results of wavelength chirping at various wavelengths.

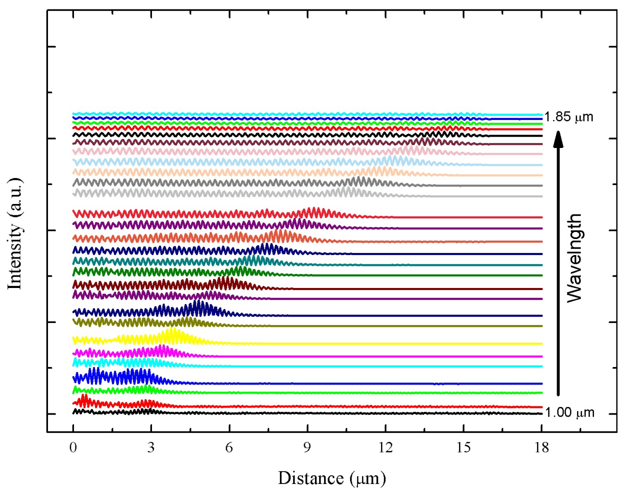

Figure 4: Intensity of chirped wave with wavelength is plotted.