

Evaluation of FBG parameters for applications in WDM systems

Optical wavelength division multiplexing (WDM) communication systems are forging ahead towards higher data transmission rate and lower channel spacing to utilize available bandwidth more effectively.

Low channel spacing and high data transmission rate sets strict requirements for WDM filter characteristics. One realization of optical filtering is based on fiber Bragg grating (FBG) filters. A FBG is periodic variation of the refractive index along the propagation direction in the core of optical fiber that reflects particular wavelengths of light and transmits all others.

In this paper we demonstrate performance of two different apodization profiles: rectangular and Gaussian, and their influence on high speed dense WDM system. We foresee that lower channel spacing and higher data transmission rate WDM systems will need FBG optical filters with inscribed more complex apodization profiles.

At both data transmission speeds and all channel spacing values, the worst performance showed the FBG optical filters with rectangular apodization profile. This is mainly because of great undesirable side lobes in optical filter amplitude response. These imperfections in filter amplitude response reduced channel isolation. Adjacent channel had high optical power (see Fig.1.) after optical filter and this factor consequently resulted in system degradation (BER level was higher than $1.0E-9$). Fig. 2 depicts output that, FBG with Gaussian apodization profile imparts high adjacent channel isolation and result in appropriate BER values for high speed dense WDM system.

As we could see from simulation results the influence of FBG filters with different apodization profiles on high speed dense WDM communication systems is enormous. To ensure high channel isolation and thus realize systems high performance we need to use FBG filter with Gaussian apodization function (narrow bandwidth at -20 dB level).

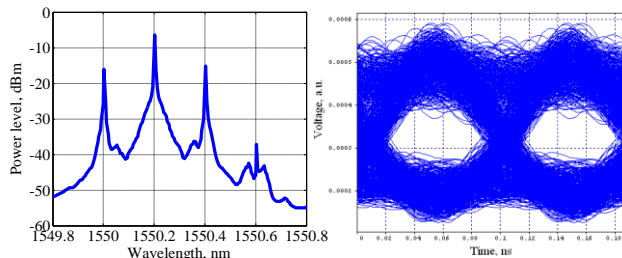


Fig.1. 10.52 Gbit/s 25 GHz 4 channel WDM system spectrum after 25 GHz FBG filter with rectangular apodization profile and the second channel eye diagram (BER = $4.95E-5$).

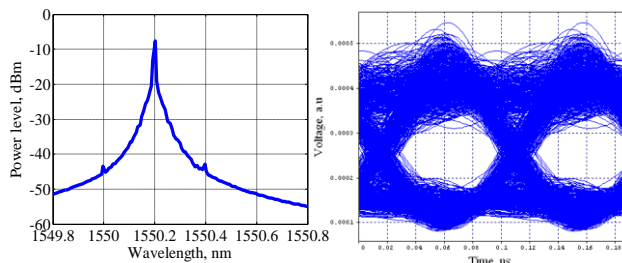


Fig.2. 10.52 Gbit/s 25 GHz 4 channel WDM system spectrum after 25 GHz FBG filter with Gaussian apodization profile and the second channel eye diagram (BER = $5.6E-10$).

FBG with rectangular apodization profile showed the worst performance which resulted in whole system degradation because of imperfections (great side lobes) in amplitude response.

Realization of low insertion loss optical filter is a core problem for realization of high speed dense WDM systems. As we could see from the numerical results, filter with Gaussian apodization profile had best stability to insertion loss. We have numerically realized 10.52

Gbit/s data transmission speed 25 GHz channel spacing WDM communication system with 25 GHz FBG optical filters with rectangular and Gaussian apodization profiles utilizing two different simulation programs.