Abstract

This thesis focuses in non-linear phenomena as cross gain modulation (XGM) and cross phase modulation (XPM) in semiconductor optical amplifiers (SOA). Both phenomenas allow taking advantage of no linearity of the gain in saturated SOA's in order to carry a wavelength conversion process.

This process consists in the translation of the information conveyed by a signal modulating the optical carrier (pump signal) to a continuous signal with a different wavelength (the probe signal) when both traverse the amplifier.

Through this study we will compare XGM with XPM conversion method to establish the advantages and drawbacks for each one. In one hand XGM allows a simple setup and low costs. In the other hand XPM provides more efficient conversions, lower chirp and bigger bandwidth.

The translation of information from the modulated pump signal to the probe has several applications in small and large signal processing.

In small signal regime, the signal inversion of the probe respecting to the input pump signal is used for the implementation of microwaves filters with negative coefficients. This kind of filter has the advantage of eliminating the continuous component of the signal. The filter transfer function is designed by tuning and profile modification. The filter tuning is done by means of delay elements whereas the profile modification is carried out by varying the optical power of each signal representing a coefficient using optical attenuators. All these characteristics are supported by a theoretical study, simulations and experimental results carried out on the GCOC laboratory.

In large signal regime, we have designed a conversion module formed by two cascaded stages: XGM followed by a XPM phase. This configuration allows taking advantage of each one of the methods. The conversion module is integrated in the optical node of the LABELS (Ligthwave Architectures for the processing of Broadband Electronic Signals) demonstrator. In this optical node the routing is carried out by the wavelength value. For that reason being able to convert the input signal to another one without any intermediate electro-optical conversion gives these systems the property of being transparent to the modulation format and transmission rates (as long as the transmission is inside the bandwidth of the optical devices). That is the reason why this module is so important within the optical node. Several experiments have been carried out to establish the working conditions and qualities of the conversion module which results are shown in this work.