Modelling of Actively Mode Locked Laser Based on a Fiber Gires-Tournois Interferometer

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Abstract. We present an actively mode locked fiber laser. Introducing a Gires-Tournois interferometer, as a filter and dispersion compensation. The results show, is possible to obtain pulse in order ~5ps, useful for OTDR and ultrafast communications.

OCIS. Codes. 140.3500. Lasers, erbium, 140.3510. Lasers, fiber

1. Introduction.

The actively pulse mode locked fiber laser are implement in diverse areas such as, communications systems and OTDR systems because it offers a very low insertion loss [1-3]. There are two techniques to implement an actively mode locked fiber laser for ultrafast pulse, one is a harmonic mode locked (HML) and the other is using an active mode locked by amplitude modulation [4-5]. In this work we report the result obtained by using a mathematical models for an actively model locked fiber ring laser. The laser was introduced a new device as filter (GTI), which it is conform by a two fiber Braga gratings (FBG) as a reflectivity mirror (one < 100% and the other one 100%). By manipulating the characteristics of the FBG's we can up the number of the channel to compensate the dispersion for a WDM systems, furthermore to abstain a bandwidths wider than >2 nm. For a 2 nm bandwidth of the filter (GTI), the simulations results show that we can get a temporal pulse of ~5 ps, with a FRS of 169 GHz, a separation per channel of ~0.1 nm (8.5 GHz). The simulation also shows a detuning because of the AOM frequency have been reported.

2. Setup configuration.

In Figure 1 is show the setup configuration used in computational model, we use an Er/Yb fiber dope double-clad as medium gain, an optical isolator to get a unidirectional of signal in the cavity, and an optic circulator to introduce the filter (GTI), a wavelength divisions multiplexing (WDM) was used to introduce the pump in the medium gain, and finally an acoustic-optics modulator as medium to disturb the gain and generated the pulses in the laser starting for *CW*. The RF generation is 10 GHz. The computational model was implemented by the pulse propagating in a fiber using the Schrödinger equations and it was implemented by the Split Step of Fourier method (SSF). The DGTI was implemented by the coupled mode equations are solved by the Transfer Matrix Method (a fundamental matrix method).

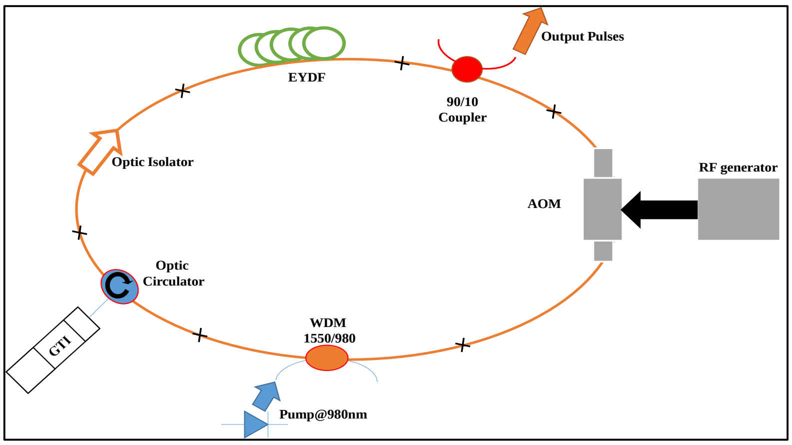

Fig. 1. Setup configuration.

3. Results and discussions.

Figure 2 shows the results obtained of the mathematical models, for application of a linear pressing by the micrometric screw from -200 to +200 micro-strain and linear temperature from 20 to 60^{o} C, for both weak and strong gratings and a wider bandwidth from ~1.5 nm to ~2 nm were obtained.

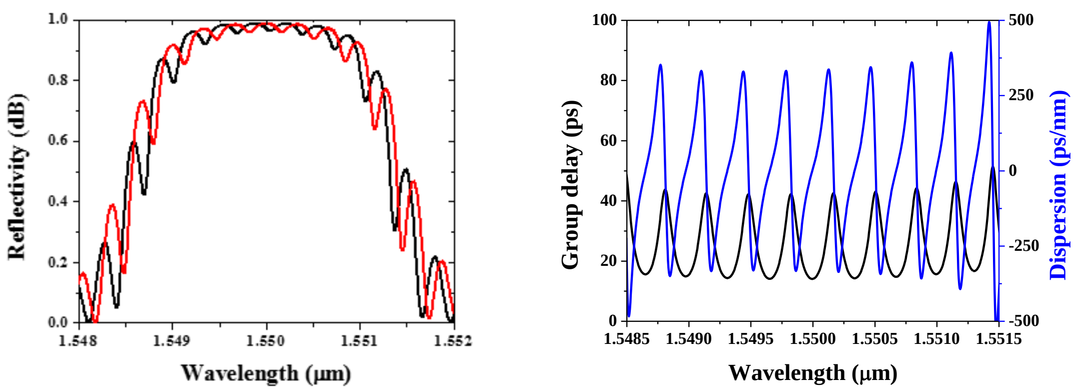

Fig. 2. Left figure. Reflectivity spectrum of the GTI, (back) without strain ~1.5nm, and (red) applying micro strain from -200 to +200 using a micrometric-screw. Right figure. Spectrum of the GTI, Group delay (black) vs. wavelength, and blue line dispersion vs. wavelength.

In right figure 2 is shown the spectrum for the group delay as a function of the wavelength, and the dispersion as a function of the wavelength. It was observed that the peak dispersion was located around of 1550 nm, for nine channel if we pretend to implement the laser in a WDM systems. The variation of the peak pulse position is shown in Figure 4. In which we can observe that at this position, the retiming effect of the modulation completely compensates for the delay due to detuning and hence the pulse position is fixed for every round trip afterward. This phenomena has been extensively studied in G. Zhu et al [6].

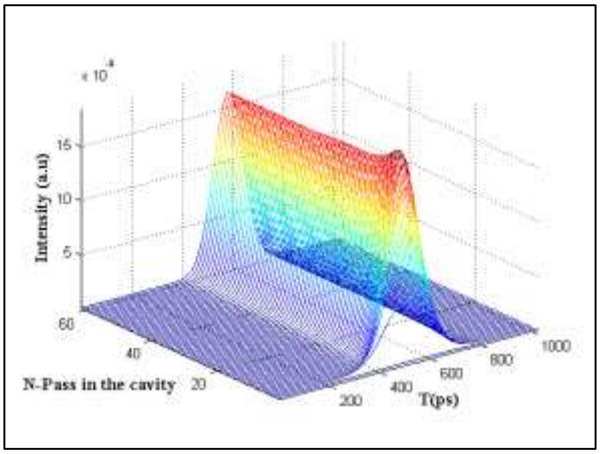

Fig. 4.Peak average output power and peak pulse position

The pulse width was independent of the detuning and has the same value as that due to exact tuning.

4. Conclusions.

We present a laser mode locked fiber laser which incorporated a new filter to optimized the dispersion in the cavity and also reduce the pulse which are propagating in the cavity. The filter is simulated in a mathematical model for a fiber GTI. Within this design can be obtained pulse in the order of 5 ps, with a bandwidth of 2 nm or more by manipulating the properties of the weak and strong gratings that conform the GTI.

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