Multiwavelength C+L band laser source using Linear Optical Amplifier

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Abstract

A scheme for generating multiwavelength laser source based on a linear optical amplifier (LOA) is demonstrated for potential applications in dense-wavelength division multiplexing (DWDM) communication systems. The laser output shows up to 80 laser lines (SNR at least 20 dB) with 0.4 nm channel spacing covering C and L band. Simultaneous tuning of muti-wavelengths is also demonstrated.

Index Terms: Linear Optical amplifier (LOA), multiwavelength laser, comb filter.
I. INTRODUCTION

Multiwavelength laser sources have potential applications in instrument testing, sensing and wavelength division multiplexing (WDM) systems. This type of source is always desired as it is an efficient and economical way to increase the transmission capability of the WDM systems. There are different methods to get simultaneous multiwavelength outputs such as multiwavelength Raman lasers [1,2], multiwavelength generation using Semiconductor Optical Amplifiers [3], multiwavelength outputs from spectrum-sliced supercontinuum [4,5] and multiwavelength Erbium doped fiber lasers [6,7]. The multiwavelength Er-doped fiber lasers are useful but the outputs are not stable at room temperature due to homogeneous broadening of lasing modes. In this paper, we propose and demonstrate a simple configuration of multiwavelength laser source in the C+L band, constructed with a Linear Optical Amplifier (LOA) acting as an inhomogeneous gain medium in the cavity. Our experimental results show that a stable continuous wave (CW) multiwavelength laser can be constructed at room temperature. The lasing lines can be tuned by changing the loss inside the cavity.

II. EXPERIMENTAL SETUP

Fig. 1 shows a schematic diagram of the proposed configuration of the laser. It consists of a 8:2 coupler, a polarization controller (PC), a polarization independent isolator, a fiber fabry perot (FFP) filter and a C band Linear Optical Amplifier (LOA) from Finisar. The optical isolator in the cavity ensures unidirectional operation of the ring cavity and avoids unwanted reflections. The free spectral range (FSR) of the FFP filter is 0.4 nm. The LOA has a typical bandwidth gain flatness of 1.4 dB. The laser output is taken from an 8:2 fiber coupler placed in the ring, which provides 20% for the output and 80% for the feedback function. The output is observed using an Ando AQ6317 optical spectrum analyzer. By carefully adjusting the polarization controller in the cavity, more than 80 laser lines are achieved with 0.4nm channel spacing. The total length of the cavity was approximately 3 meters and the round trip loss of the cavity was estimated to be less than 4 dB.

Fig.1. Experimental setup
III. RESULTS AND DISCUSSIONS

The output spectrum of the multiwavelength laser is shown in the Figure 2, which indicates a total of more than 80 wavelengths between C and L band (with at-least 20 dB SNR) with a channel spacing of 0.4 nm which coincides with the ITU-T grid. The lasing wavelength spacing was controlled by the cavity comb filter which has a FSR of 0.4 nm. The signal to noise ratio (SNR) of around 50 laser lines in L band was more than 40 dB.

The lasing wavelengths can also be tuned by varying the loss inside the cavity. In the experiment, a variable optical attenuator is inserted inside the multiwavelength laser setup. The attenuator is controlled using an electrical voltage with a dynamic range of 20 dB in the 1550 nm region. The multiple lasing wavelengths are tuned simultaneously as the attenuation level is adjusted. As the attenuation level is increased the multiwavelength comb blue shift (shorter wavelength region). Figure 3, shows the output spectra of the multiwavelength laser when the attenuation level is 1 dB (left), 5 dB (middle) and 7 dB (right), respectively. Other parameters such as the biasing current applied to the LOA, and the output coupling ratio are kept constant during the tuning process. The experimental results indicates that the maximum tuning range is about 14nm (1560 ~1574 nm), which corresponds to the shift of the longest lasing wavelength as the attenuation is increased from 1 to 7 dB. Since the carrier density of the LOA decreases due to strong optical feedback (80%) which in turn shifts the gain profile towards the red side of the spectrum.

Fig 2. Output spectrum of multiwavelength laser.
IV. CONCLUSION

In summary, we have demonstrated a multiwavelength operation of an LOA based laser anchored on the ITU grid at room temperature. A total of more than 80 lasing wavelengths were obtained with the channel spacing of 0.4 nm. By using a variable attenuator in the cavity, simultaneous tuning of multiwavelengths was achieved with a tuning range of around 14 nm. With an increase in the attenuation level the lasing wavelengths shifted towards the shorter wavelength region.

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