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干渉計測へ向けたサブテラヘルツ間隔の離散周波数掃引レーザー

Development of discrete frequency scanning laser for interferometry

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Fast frequency scanning laser with discrete frequency step of several hundred GHz is proposed. The laser simply consists of laser medium and frequency tuning part in a ring configuration. The lasing frequency, allowed by a Fabry-Perot etalon, is discretely oscillated in the laser cavity with scanning resonant-frequency. In this paper, the resonant-frequency was swept by a combination of polygon scanner and diffraction grating as a demonstration. The discrete frequency step of a 435 GHz was confirmed with 14 kHz scanning rate and 1.8μs of frequency switching time

1. Introductions

An optical frequency comb based interferometer was investigated[1]. In order to apply in industry, two methods have been reported: one was by putting an optical resonator after a broad light source[2-3], another was the resonator after a continuously tunable laser[4]. However, it was difficult to employ the ordinary frequency combs for highly scattered or absorbed samples, since the high-losses optical resonator.

In this report, we propose a technique to overcome the low-power optical frequency combs by using an in - cavity etalon. The etalon is placed inside the ring cavity, which includes laser medium and frequency tuning part. Every frequencies of light source, which satisfies the resonant condition of the etalon, are picked up and lasing. By this technique the discrete frequency scanning laser is generated.

2. System setup

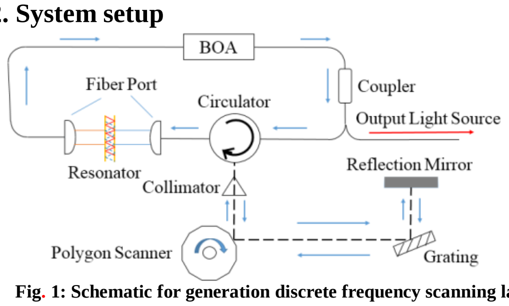

Fig. 1: Schematic for generation discrete frequency scanning laser

Figure 1 shows the configuration of proposed system. The spontaneous light source from booster optical amplifier (BOA) will be picked up by polygon mirror, grating and mirror. It is then passed the etalon, which is located inside the ring cavity. The optical wavelengths that satisfy the resonant effect of the etalon can pass through and comeback to the BOA to make a completed loop. These wavelengths travels many rounds along the loop and lasing. Consequently, all resonated frequencies are lasing and create a discrete frequency scanning laser.

3. Experimental results

As shown in Fig. 2, over 10 comb peaks were observed. The power of each discrete frequency peaks was amplified 10dB compare with spontaneous light from BOA at maximum when a spectral resolution of the spectrum analyzer was set to be 0.01 nm. Figure 3 shows output waveform measured by an oscilloscope. The scanning rate and frequency switching time of output light source were obtained as approximate 14 kHz and 550 kHz, respectively.

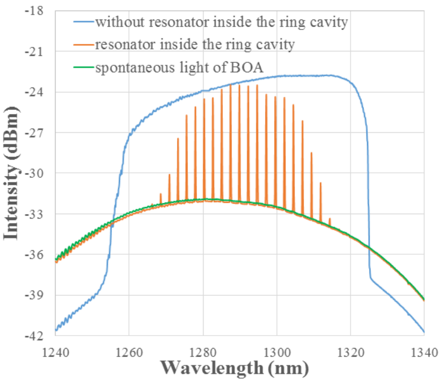

Fig. 2: Spectrum of light source

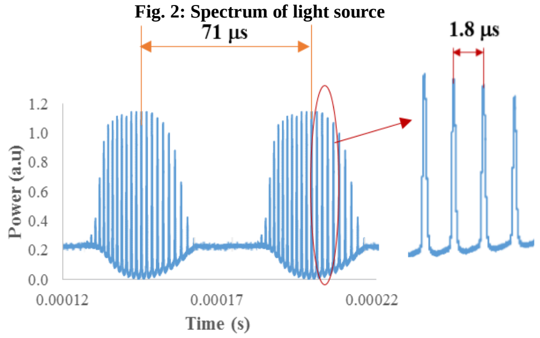

Fig. 3 Scanning rate and repetition rate of discrete frequency scanning laser

4. Conclusions

Fast frequency scanning laser with discrete frequency step of several hundred GHz is developed. The discrete frequency step of a 435 GHz was confirmed with 14 kHz scanning rate and 1.8 μs of frequency switching time. The power of each discrete frequency peaks was amplified 10dB compare with spontaneous light from BOA. This study was partially supported by JSPS KAKENHI Grant Numbers JP16H03879, JP15K13372.

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