Long-Term Stabilization of an Actively Mode-Locked Optoelectronic Oscillator Using Phase-Locked Loop

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Optoelectronic oscillator (OEO) is a microwave photonic system with a closed amplified positive feedback loop that can produce high-quality microwave signals[1]. Besides continuous single frequency microwave signal generated by conventional OEO, microwave frequency comb (MFC) signals and microwave pulses with fixed carrier play important role in radar[2], fiber optic sensing[3], arbitrary waveform generation[4] and so on. The conventional way to generate MFCs is electrical methods which suffer from the well-known electronic bottleneck[5]. Recent years, the active mode-locking optoelectronic oscillator (AML-OEO) has drawn considerable attention and is recognized as an attractive method to generate MFCs with an ultra-low phase noise over a broad frequency range[1,5,6]. However, most researches about the AML-OEO focused on different mode-locking structures, increasing the tunability and reducing the physical package[5,6]. The AML-OEO's long-term phase fluctuation and frequency drift, which is of great importance for high-precision applications such as optical sampling[7], have not been fully investigated. In this paper, we proposed and demonstrated a new long-term stabilization scheme using phase-locked loop (PLL) in actively mode-locked optoelectronic oscillator. By locking the AML-OEO to a highly stable microwave reference through a PLL, we can obtain a MFC signal with long-term stability and low phase noise.

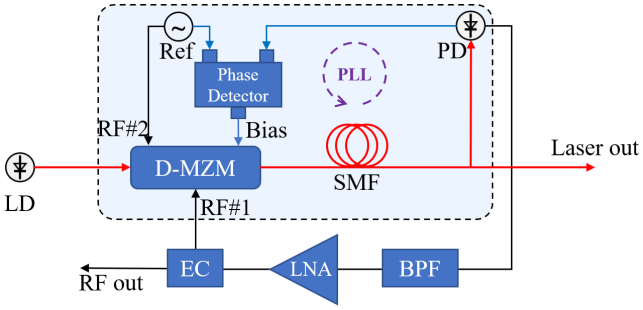

Fig. 1: Experimental setup of the long-term stabilized AML-OEO. LD: 1550nm continuous wave laser diode; D-MZM: dual-drive Mach-Zehnder modulator; SMF: single-mode fiber; PD: photodetector; BPF: bandpass filter; LNA: low-noise amplifier; EC: electrical coupler; Ref: microwave reference.

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