Data Processing Optimization and System Characterization of Frequency Comb-Based Time and Frequency Transfer

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Optical clock is playing an increasingly important role in many applications, such as precision navigation and timing, phased sensor arrays and future redefinition of the second. Ultra-precision time and frequency transfer technology underpins the applications of optical clock. We established a frequency comb-based two-way time and frequency transfer system, which is adequate for the comparison of state-of-the-art optical clocks. However, the surrounding environment (such as temperature and vibration) and data processing methods will affect the measurement precision of the system for clock offset.

In the setup, we used homemade fiber-couple housing most of optical fibers in our system to suppress the impact of temperature fluctuations. For data processing, we filtered the interference signals generated by linear optical sampling by digital bandpass filter. Hilbert transform was applied to extract the envelopes, then used parabolic fitting to figure out the peak of the envelopes (one-way time delays). The optical two-way time transfer test through a short fiber link shows that the noise floor-equivalent fractional timing stability is 0.07 fs at a gate time of 0.4 s.

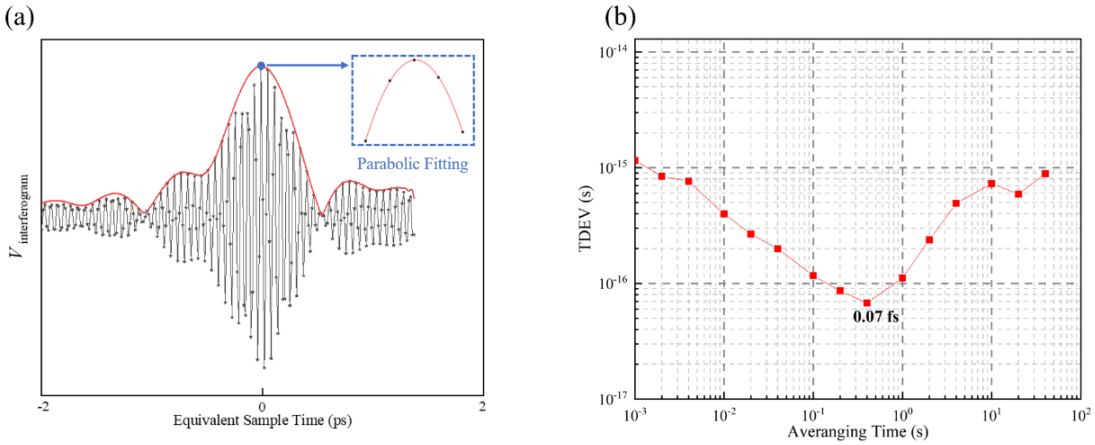

Fig. 1: (a) Example of measured interferogram filtered by digital bandpass filter (black symbol) and smooth envelope (red line). Peak search is conducted by parabolic fitting (blue dashed box). (b) TDEV of optical two-way time-frequency transfer through a short fiber link.

References

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