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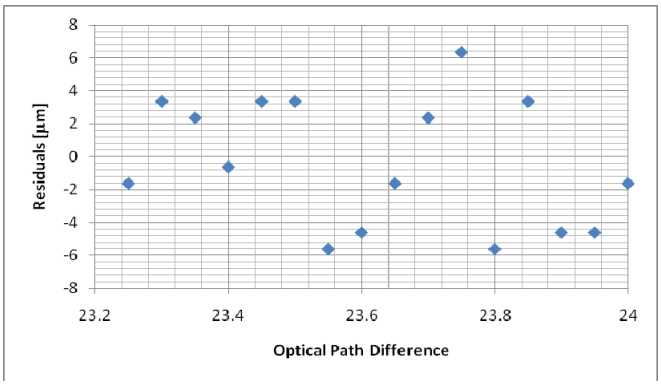

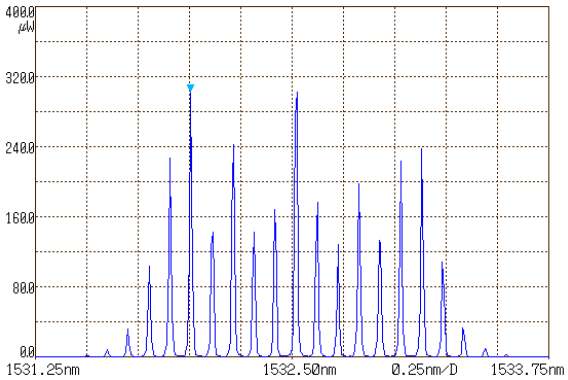

LA2SPI : OPTICAL FREQUENCY COMB

Application to absolute distance measurement by interferometry

Project Summary

Optical frequency combs are widely used for applications such as high-accuracy distance measurements. However, these laser sources are usually mode-locked, and it is almost impossible to change the repetition rate, so that in an interferometric set-up, one needs a tunable mechanical arm in order to get the absolute distance. In this work, we propose a simple technique to generate an optical frequency comb, based on a conventional dual-drive Mach-Zehnder intensity modulator that allows absolute distance measurements with a high accuracy. The modulator is driven by a direct-digital synthesizer (DDS) that is able to deliver a pure ramp in frequency between 13 GHz and 14 GHz. Under some conditions on radio-frequency powers and phase, it is possible to generate a flat optical frequency comb. We obtained about 15 modes, corresponding to a span of 200 GHz. This optical signal is launched in a Michelson interferometric set-up, and the absolute distance measurement is realized by sweeping the radio-frequency of the DDS. The duration of the sweep is 0.1 second, and could be even faster with a dedicated direct digital synthesizer. The measurements are then compared to a standard, which is a mode-locked femtosecond laser with a repetition rate of 100 MHz along with a counting interferometer. This standard has an accuracy of about 1 micron. Absolute distance measurements over a range of 1 to 25 meters give an accuracy of about ± 10 microns, corresponding to a sub ppm absolute distance measurement.

Valorisation

Publication : S. Le Floch, M. Llera & Y. Salvadé, "Sub ppm absolute distance measurements using an optical frequency comb generated by a conventional dual-drive Mach-Zehnder modulator" Optical Metrology (SPIE), Paper n° 8082-153, Münich may 2011.

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