DIRECT CONVERSION OF ABSOLUTE DISTANCE TO FREQUENCY VIA OPTICAL FREQUENCY COMB, PASSIVE OPTICAL CAVITY AND MICROWAVE TIME STANDARD

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The aim of the work is a presentation of our unique control algorithm for measuring the length of unknown distance with direct traceability to a time standard. The external resonator cavity represents an interferometer, where the laser beam propagates the cavity many times so that each pass interferes with others in the output of the cavity. By keeping the cavity mirrors in the exact distance to be measured and the time spacing of short femtosecond pulses generated by femtosecond laser is optically phase locked to the cavity free spectral range, a value of the repetition frequency of the laser determines the measured distance.

We report on a designed and experimentally implemented algorithm for femtosecond laser repetition frequency control by the optical cavity. The frequency spectrum of the femtosecond laser not affected by the optical cavity covers many spectral components because the femtosecond length of pulses generated by the laser is imagined as the comb of spectral components with spacing of the repetition frequency of the femtosecond laser. The length of the optical cavity length is transferred by the algorithm to the repetition frequency value monitored by the frequency counter. The frequency spectrum of the femtosecond laser with the repetition frequency locked to the optical cavity length only one spectral component at the frequency of FSR occurs. This principle of the FSR conversion representing the surveyed length by the optical cavity on PZT transducer displacement is demonstrated. Our control algorithm gives the unique possibility to measure mesoscale lengths with the absolute scale and nanometre resolution at the same time.