High-precision intermode-beating EDM for mitigation of atmospheric delays

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ABSTRACT

High-precision electro-optical distance measurement (EDM) is essential for deformation monitoring. Although sub-ppm instrumental accuracy is already feasible with state-of-the-art commercial technology, the practically attainable accuracy on distances over more than a few hundred meters is limited by uncertainties in estimating the integral refractive index along the propagation path, which often results in measurement errors of several ppm. This paper presents a new instrumental basis for high-accuracy multispectral EDM using an optical supercontinuum to enable dispersion-based inline refractivity compensation. Initial experiments performed on two spectrally filtered bands of 590 and 890 nm from the supercontinuum show measurement precision better than 0.05 mm over 50 m for an acquisition time of around 3 ms on the individual bands. This represents a comparable performance to our previously reported results on 5 cm by over a range of 3 orders of magnitude longer, which can still be improved by increasing the acquisition time. The preliminary results indicate a relative accuracy of about 0.1 mm at 50 m on each wavelength. Improvement is possible by calibration and by implementing a self-reference scheme that mitigates slow drifts caused by power-to-phase coupling. The results reported herein thus indicate that the presented approach can be further developed for achieving sub-ppm accuracy of refractivity compensated distance measurements on practically useful ranges and under outdoor conditions.

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