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Electro optic MWLI distance sensor for faster distance measurement

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Unclarity in phase measurement i.e. '2π phase ambiguity' is one of the most well-known problems of single wavelength interferometers which perform distance measurement with comparatively shorter unambiguity range. The idea of Multi Wavelength Interferometry (MWLI) helps to extend this range of unambiguousness by generating suitable synthetic wavelengths. The four-wavelength interferometric setup on which our work is based, can offer more than 1000 times larger unambiguity range compared to a simple single wavelength interferometer. For obtaining phase modulation with the present MWLI system, Piezoelectric Transducer (PZT) driven mechanical phase modulation process is being used. However, because of some unavoidable limitations of the PZT sensor i.e. comparatively higher driving voltage requirement and restricted value for the modulating frequency, a different approach based on linear Electro-Optic (EO) effect has been presented in this work in order to achieve the goal of faster distance measurement. At first, the efficiency of the EO-MWLI phase shifting distance sensor has been checked using a Lithium Niobate ($LiNbO_3$) crystal which showed phase modulation at a significantly lower voltage (Fig.1(a) and (b)) compared to the PZT sensor. Then, the distance measurement efficiency has been monitored for the sensor at higher modulating frequency under static and moving target conditions [1]. Finally, the influence of external perturbing factors has been studied to find out the reason behind the observed slow but continuous distance drift for the experimental setup with the EO sensor [2]. The results of the experiment demonstrated a strong influence of environmental temperature variation on interferometric stability under long term measurement.

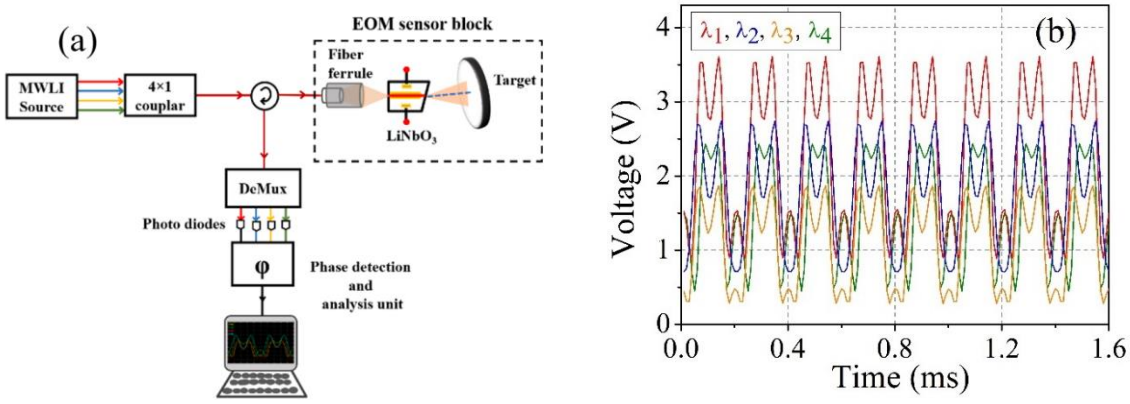

Fig. 1. EO-MWLI distance sensor (a) Experimental setup with EO crystal $LiNbO_3$; (b) Phase modulated signal using the EO sensor.

References

[1] S. Sharma, P. Eiswirt and J. Petter, *Opt. Express* **26**, 3443-3451 (2018).
[2] S. Sharma, P. Eiswirt and J. Petter, *Sensors & Transducers* **225**, 1-7 (2018).