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DELAY CALIBRATIONS OF CONNECTED ELEMENT INTERFEROMETRY (CEI) WITH SMALL ANTENNAS USING TWO SATELLITES

Abstract

The first optical-fiber based connected element interferometry (CEI) of China has been built completely in August 2012 in the northwest of Beijing region. The CEI is on a 5.5-km baseline between two 3m-diameter antennas, which is linked by a 15-km optical fiber applied to transmit the frequency standard signal to the remote station and the data to the near station for interfering. Regarding a new interferometry system, delay calibrations are fundamental to the accuracy of coming applications. In this paper, delay calibrations on the CEI using two satellites are introduced, where two points are focused on mainly: a) the calibrator observed should be artificial spacecraft (e.g., satellites), other than quasar because of the low gain of antennas; b) the frequency standard signals of the two stations should be coherent by the optical-fiber transmission. The ChinaSat-5A and ChinaSat-10 with ephemerides are chosen as calibrators

and 2-hour wideband downlink signals are picked up for interfering. Results show that the instrumental delay difference (including initial asynchronization) is 33.95 ns with an accuracy 0.25 ns defined as the residual delay between ChinaSat-5A and ChinaSat-10. However, there is an increasing trend. The reason is found that the timing error is increasing due to the frequency shift brought from the length change of the optical fiber against the environmental temperature change. Experiments show that the timing error can achieve even 0.2 ns during 2 hours. A compensation scheme is proposed to suppress the frequency shift. Compared with reported methods, less electronic components (especially mixers) are employed and hence the electronic noise is lower in the proposed scheme.