

Development of a digital zenith telescope for advanced astrometry

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Abstract

Like other optical astrometric techniques, the Photographic Zenith Tube (PZT) has played a key role in the past observations of the Earth rotation, and it also has a potential to be applied to several other observations by taking advantage of automatic observations with self compensation of tilt of the tube. We here propose In-situ Lunar Orientation Measurement (ILOM) to study lunar rotational dynamics by direct observations of the lunar rotation from the lunar surface by using a small telescope like PZT with an accuracy of 1 milli-seconds of arc (1 mas) in the post-SELENE mission. Our second application is to obtain local gravity field on the Earth by combining deflection of the vertical measured by PZT and the position measured by Global Positioning System (GPS) or Global Navigation Satellite System (GNSS). The accuracy required for this purpose is not as strict as ILOM. We have already developed a Bread Board Model (BBM) of the telescope for ILOM and made some experiments in order to know the performance of the driving mechanism under a similar condition to the lunar environment showing high vacuum, large temperature change and dusty condition. We have also shown that it is possible to correct the effects of uniform temperature change upon the optical system by using a simple model with an accuracy of better than 1 mas. This model has the potential to attain the accuracy of 1 mas, based on the results of the experiments and the simulations. © 2012 Science China Press and Springer-Verlag Berlin Heidelberg.

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Keywords

High accuracy, LRS, Orbit determination, SAR, SELENE