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SLR technical issues and challege confronting GGOS goal

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SLR(Satellite Laser Ranging), one of the space geodetic technology of GGOS, measures TOF (Time of Flight) of photons. It has a principle to measure an absolute value of the distance directly from the earth station to the satellite using the electromagnetic wave of the visible wavelength domain. These are unique aspect of SLR.

Since high accuracy demand of GGOS goal statement in that station position to be accurate equal or better than 1mm and its rate to be ˜0.1mm/yr, and SLR raw data measurement always corrected with bias by station procedure, we must investigate all the error factors those affect such precision and make sure accuracy by calibration method. The error of precision and accuracy of 1mm and 0.1 mm/y holding every bias and sum total of the factors means that variation of error factor each should be checked out

with submillimeters order. International Laser Ranging Service(ILRS) has held conference and working group meeting for solving such problems regularly and shared a common problems, lesson learned by each organization solution.

The error source is not only come from ground station, but others namely, space segment design and the propagation. As a whole system the problem of the network play a key role. The one example of network quality control method using the data obtained by global SLR network produces orbit analysis and fitting orbit to each observation every day or sub-daily.

According to the resuluted O-C of each orbit determination, outlier station will be warned and/or trend analysis can be done in cm level. These do big contribution for everyday use of SLR to find the bias source of station such as a clock, a laser, signal strength dependence of the detector and stability. The precision of the state of the world station has achievee a submillimeter by a progess of laser technology, development of the electronics and software, however bias and its stability has rarely reach 1mm and the average network performance have to be more precise. In the space segment, a satellite equipped with large number of retroreflector cube designed in the 1970 years level was aim of a cm order, but not for sub-millimeter. A pulse width deterioration by the target effect has an

order of a few mm to few cm some cases significantly affect an argument for CoM (Center of Mass) correction. A sub-millimeter order to overcome this will be challenge to design a new satellite. It is under discussion of the pulse reply pulse from the single cube as well as a single photon receiver v.s multi-photon one should be used.

As for monitoring the bias between SLR and other technique such as VLBI, and GPS for the colocation of each technique in GGOS, the demand to measure the three dimensional position among each technique reference point with accuracy of by a submillimeter meter continuously will be another challenge to elliminate a systematic error. The challenge of new technology and procedure for managing accuracy of 1mm level, Japan and the world present conditions toward GGOS will be reviewed.

Keywords: SLR, bias error, calibration