THE MOBLAS-6 SATELLITE LASER RANGING STATION AT HARTEBEESTHOEK, SOUTH AFRICA; TECHNOLOGY AND DATA APPLICATIONS.

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1. INTRODUCTION

The MOBLAS-6 Satellite Laser Ranging (SLR) station located at HartRAO has been operational since 2000. Data from this station are stored at a global data centre and are used with data from the global SLR network to determine Earth Orientation Parameters (EOPs), provide tracking data for precise satellite orbit determination and to provide highly accurate station coordinates in the International Terrestrial Reference Frame (ITRF). SLR data can also be used for a multitude of other applications such as evaluation of parameterized post-Newtonian parameters in order to test General Relativity. The positional information is used in a collocation sense to constrain the global ITRF solutions. Projects such as the African Geodetic Reference Frame (AFREF) which has as objective a unified reference frame for Africa, are supported. This support results from collocated space geodetic techniques at HartRAO, that provide a fundamental station for Africa and also due to the fact that MOBLAS-6 participates in the tracking of the new Galileo satellites which will aid the densification of the ITRF throughout Africa as densification is done via the establishment of core GNSS stations.

2. MOBLAS-6 TECHNOLOGY

MOBLAS-6 utilises a 0.76 m Cassegrain telescope on an azimuth-elevation mount equipped with a 100 mJ Nd:YAG LASER operating at a wavelength of 532 nm. This LASER light is green and the pulse length of each shot is 200 picoseconds. The timing, control and power supply circuits exhibit a trip in electronic history as it has captured the historic timeline of the system's development through stages of development, refurbishing and upgrades. The system configuration and specifications will be discussed.

3. GLOBAL SLR NETWORK

Space Geodesy is a global effort and similar to the global networks of the other space geodetic techniques such as Very Long Baseline Interferometry (VLBI), Global Navigation Satellite Systems (GNSS) and Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS), the SLR network [1] is a well organized, structured system participating in and contributing to several science and data application products which benefit a multitude of other projects and users. The network is operated under the auspices of the International Laser Ranging Service (ILRS).

4. DATA APPLICATIONS

SLR data basically consist of time-of-flight information in picoseconds required for the LASER pulse to reach the retro-reflector equipped satellite and return to the SLR system. Other data such as barometric pressure are also stored as it is required to model the atmospheric delay experienced by the LASER signal, which increases the apparent range to the satellite. This delay can be several metres at low elevations. Several data applications will be discussed, including the evaluation of PPN parameters Gamma and Beta (which have a value of one in PPN formalism), which have been tested using locally developed software and found to have a standard deviation of approximately 0.0005, reflecting the level of accuracy in evaluating General Relativity when using the LAGEOS satellites.

General Relativity is currently accepted as being compatible with observations, although possible violations of, or further validation of GR continue to be an active area of research utilising a multiple of approaches. Nordtvedt, [2] pioneered parameterized post-Newtonian formalism or PPN formalism which uniquely details the parameters in which a general theory of gravity (e.g.GR) can differ from Newtonian gravity. PPN formalism [3] is valid for metric theories of gravitation in which

all bodies satisfy the Einstein Equivalence Principle (EEP) and is particularly useful for its linearised weak-field and slow-motion approximation e.g in the proximity of the Earth.

In this work, the *radial component* of the SLR measurements is the strength of the technique and the relativistic acceleration on LAGEOS is *mainly* a radial component. Therefore the strategy employed in this study is to solve for PPN parameters γ and β in the least squares sense utilising SLR data in a strategy where the observed minus computed (O-C) residuals indicate better observation/modelling fits, through different levels of O-C residual rejection levels.

4. CONCLUSIONS

This presentation discusses the Satellite Laser Ranger MOBLAS-6 in general, reviewing its technical parameters, configuration and applications of MOBLAS-6 data as part of the ILRS global SLR network. Specifically, a technique developed to evaluate PPN parameters γ and β are presented indicating that SLR data can be used to test General Relativity by including PPN parameters as solve-for parameters.

6. REFERENCES

[1] Pearlman, M.R., Degnan, J.J., and J.M. Bosworth, "The International Laser Ranging Service", *Advances in Space Research*, Vol. 30, No. 2, pp. 135-143, July 2002, DOI:10.1016/S0273-1177(02)00277-6.

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