FIRST RESULTS FROM THE SATELLITE OBSERVING SYSTEM WETTZELL. S.Riepl, A.Böer, R.Dassing, J.Eckl, A.Leidig, S.Mähler, C.Schade, M.Schönberger, Bundesamt für Kartographie und Geodäsie, Geodätisches Observatorium Wettzell, D-93444 Bad Kötzting, Germany, email: stefan.riepl@bkg.bund.de.

Abstract: The Satellite Observing System Wettzell (SOS-W) is the newly envisaged SLR System at the Wettzell site which is expected to reach operational status within 2014. The innovative bistatic design permits routine two colour operation at kilohertz repetition rates. Due to the relative low pulse energy of kilohertz lasers, transmit pointing and defocus errors are a major obstacle limiting the performance of such SLR systems. In contrast to other pointing correction approaches, which rely on the analysis of laser radiation backscattered within the tropospheric transmission path, the optical design of the SOS-W enables for a system internal - and thus easy to automate - diagnose and compensation mechanism to align the transmit and receive optical axes with respect to each other. This improved alignment allows for the minimization of the receiver field of view below 20 arc seconds reducing both, the achievable daylight noise level as well as the atmospheric backscatter detections at transmit receive time overlaps. Moreover the SLR system features an integrated aircraft safety LIDAR, further easing the requirements for autonomous observation. Besides the continuous monitoring of mount parameters ongoing activities include link budget measurements in conjunction with characterization of the transmit telescope optics. First range measurement results are presented introducing a new type of single photon avalanche diode detector operated at a wavelength of 850nm. The overall system performance enables for observation up to GNSS orbits at elevation angles down to 20 degrees, which is unique for existing kilohertz laser ranging systems.

System Design

The initial design of the SOS-W dates back to 2004, where it was presented at the ILRS Workshop [1]. Being committed to support simultaneous two colour laser ranging the transmit telescope counts with an achromatic design for the laser wavelengths of 850nm and 425nm respectively. We effectively achieve collimation of the laser beam with a residual divergence of 4 arc seconds FWHM at 425nm and 3 arc seconds FWHM at 850nm. In addition to a separate transmit telescope, the telescope optical design also incorporates a calibration beam path permitting Coude-adjustment of the laser and compensation of diffdernetial pointing errors between the transmit and receive optics by piezo actuators. This ensures a total pointing accuracy at the few arc second level. The SLR System is equipped with a Titanium Sapphire Laser emitting 40ps pulses at an energy of up to 1.5mJ. The conversion to 425nm can be parametrically adjusted up to 40%. The detection scheme comprises a dichroic beamsplitter to separate the laser beams for each time of flight detector, as well as a 3 arc minutes field of view electron multiplying camera for guiding purposes. The detectors themselves are based on an avalanche diode (SAP 500) procured from Lasercomponents GmbH, which is operated at a single shot rms of 40ps at 2 sigma editing level. To ensure the air craft safety during observations an integrated LIDAR system has been implemented at the telescope providing a ring projected laser beam at an eye safe wavelength enclosing the actual pulse laser used for the measurement in a conical shape (cone angle 120 arc seconds) while propagating through the atmosphere.

First Observations

After initial test observations verifying the beam collimation capability of better than 5 arc seconds FWHM, quarantined observations have been carried out since May 2014. Observations to Ajisai have been found capable to reveal the satellite's spin rate [2]. Operating the laser at a pulse energy of 0.8mJ at 850nm has been found adequate to achieve ranging to GNSS orbits down to elevations as low as 20 degree, which is remarkable for known kilohertz ranging systems.

After an assessment field test regarding the air craft safety LIDAR in spring 2015, the system is expeceted to reach full operational status.

[1] S.Riepl, W.Schlüter, R.Dassing, K.H.Haufe, N.Brandl, R.Stöger, P.Lauber, A.Neidhardt: The SOS-W – a two colour kilohertz SLR System, Proceedings of the International Laser Ranging Workshop, San Fernando 2004

[2] D. Kucharski: private communication