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New telescope and observatory building to Metsähovi, Finland

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Abstract. *The satellite laser ranging (SLR) operations in Metsähovi have been offline since 2005 when the system was shut down for renovation. A High Q picoREGEN laser was purchased in 2007 to replace the old dye laser. In 2012 the refurbishment of the old system was put on hiatus when Finnish Government granted Finnish Geodetic Institute (FGI) a total of 8 M€ for upgrading the instrumentation of Metsähovi and the national GNSS network FinnRef. During 2013 an international call for tenders was arranged to procure a new SLR-telescope to Metsähovi. During 2014 a new observatory building will be constructed to house the new SLR-system. Also auxiliary instrumentation will be upgraded during 2013-2015. The aim is to resume SLR operations in Metsähovi in 2016. We present the current status of the upgrade process and the future plans of the new Metsähovi SLR-station.*

Introduction

Metsähovi Fundamental Geodetic Station of the Finnish Geodetic Institute is one of the GGOS's (Global Geodetic Observing System) Core Stations. Besides SLR, other geodetic instruments located in Metsähovi are, e.g., absolute and superconducting gravimeters, GEO-VLBI (in co-operation with the Aalto University), DORIS beacon (CNES/IGN), GNSS receivers (FGI, CNES/IGN, JPL) and as the latest addition, a TerraSar-X reflector (DLR/UMunich). There are also several instruments for monitoring the environment, i.e., the groundwater, soil moisture and weather. Since 2012, when FGI was granted 8 M€ for updating the Finnish geodetic research infrastructure, FGI has already upgraded the permanent GNSS network of Finland, a new superconducting gravimeter was installed to Metsähovi during January 2014, and the absolute gravimeter FG-5 has been upgraded to FG-5X. In fall 2013 a contract for manufacturing and installing a new SLR-telescope to Metsähovi was awarded to Cybioms Corporation. A tender for a new VLBI2010 compatible radio telescope is also under preparation, aiming for a new VLBI system installed in Metsähovi in 2016.

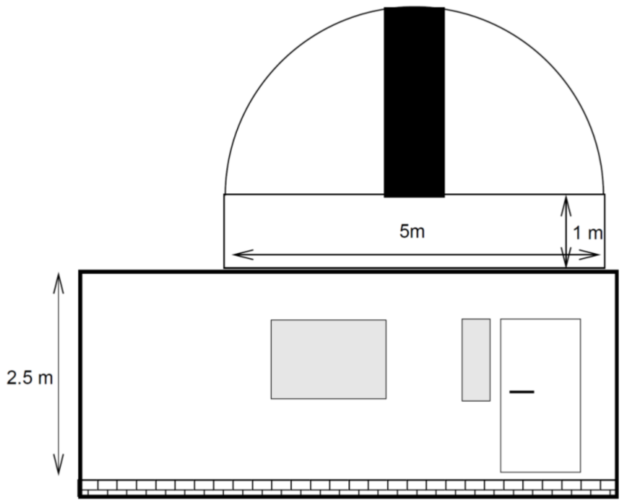
New telescope

After receiving the extra funding from the government, the then on-going refurbishment of the former Riga-built SLR telescope was put on hold as priority was set to procure a new telescope that will match the speed and reliability demands of a modern kHz system, and that also will be able to track even the lowest orbits precisely, accurately, and routinely in daylight. FGI published an international invitation to tender on March 2013 for procuring an SLR telescope system to Metsähovi. In total six tenders were received with main mirror diameters varying between 0.5 and 1.0 meters. Both monostatic and bistatic optical designs were proposed. In September 2013 the contract was awarded to Cybioms Corp. who will supply FGI with a bistatic 0.5 m telescope system.

First operational tests of the new Metsähovi SLR station are expected during winter 2015-2016. The telescope will constitute together with the existing hardware (High Q 2kHz laser, a Riga ET-33, and a C-SPAD) a cutting-edge SLR system.

New observatory building

To provide a proper shelter for the new telescope and other SLR equipment FGI will build a new observatory building in Metsähovi (Fig. 1. & 2.). The first SLR building in Metsähovi, erected 1975, has major moisture damage and will be demolished and replaced with a modern observatory building. The new building will have two levels: all the electronics as well as the operator room are in the ground floor; the telescope will stand on a ~3.5 meter high concrete pier on the second floor and the laser will be guided through the hollow pier up through the telescope's Coudé path. The pier will be attached straight to bedrock, which is readily available in Metsähovi. The telescope's azimuth axis will be approximately at a height of 4.5 meters above the ground level enabling a better field-of-view to the horizon as well as enhancing the seeing conditions. The instrument room's two optical tables and the pier's two optical exits make it possible to utilize another laser in the future for, e.g., space debris observations. Instrument room will be air conditioned in order to keep the temperature stable, dehumidified, and pollen/dust free. Positive air pressure will be maintained for the same reason. Also the dome will have dehumidified air blown in for minimizing condensation and dust building up on the telescope when not in use. The new building will be built during summer 2014 and a new slit-type dome will be installed during summer/fall 2014. In addition, a new high-end meteorological station fulfilling the standards of the World Meteorological Organization is planned to be installed in Metsähovi during 2014 in collaboration with the Finnish Meteorological Institute. The meteorological station will also include multiple rain sensors, which together with Boltwood Cloud Sensor II, already installed in Metsähovi, will allow automatic dome closure in the case of sudden rain.



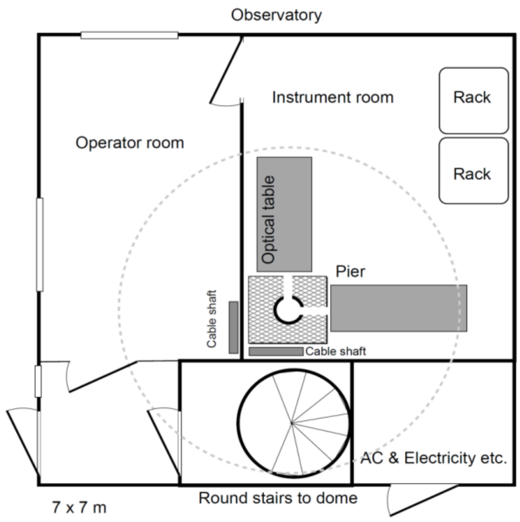


Figure 1. & 2. Drafts showing preliminary plans for the new observatory building.

Airplane safety

Due to the astronomical radio telescope at Metsähovi, all RF-emitters are forbidden in the area. As radar is not an option as the air safety solution for Metsähovi SLR, we are investigating a solution that would utilize multiple passive methods for detecting airplanes in Metsähovi airspace.

During spring 2013 we installed an Alcor OMEA all-sky CCD color camera with an auto-iris feature that allows both day and night image acquisition. For commercial airplane detection we installed a passive ADS-B receiver, AirNav RadarBox. We have done preliminary work to combine these two devices with Python. The operator can observe the positions of nearby planes and the cloudiness with a quick glance. The screenshot below (Fig. 3.) illustrates how the positions of nearby airplanes are constantly drawn to the latest all-sky image. Here satellite information is overlaid on top of the all-sky image. Orbits of the satellites and the pointing of the telescope can be easily added to the same image within the Python code. Next step is to further study and map the aircraft paths above Metsähovi and construct an alarm mechanism for notifying when aircrafts are close to the pointing direction of the telescope.

This system will give only a partial solution for the air-safety issue. The remaining challenge is to detect small airplanes and helicopters as those are not required to send ADS-B info, and hence are not seen by the AirNav RadarBox. During spring 2014 FGI will start negotiations to renew the laser firing permit with the local aviation administration and for the possibility to obtain the flight data from the nearby Helsinki airport.

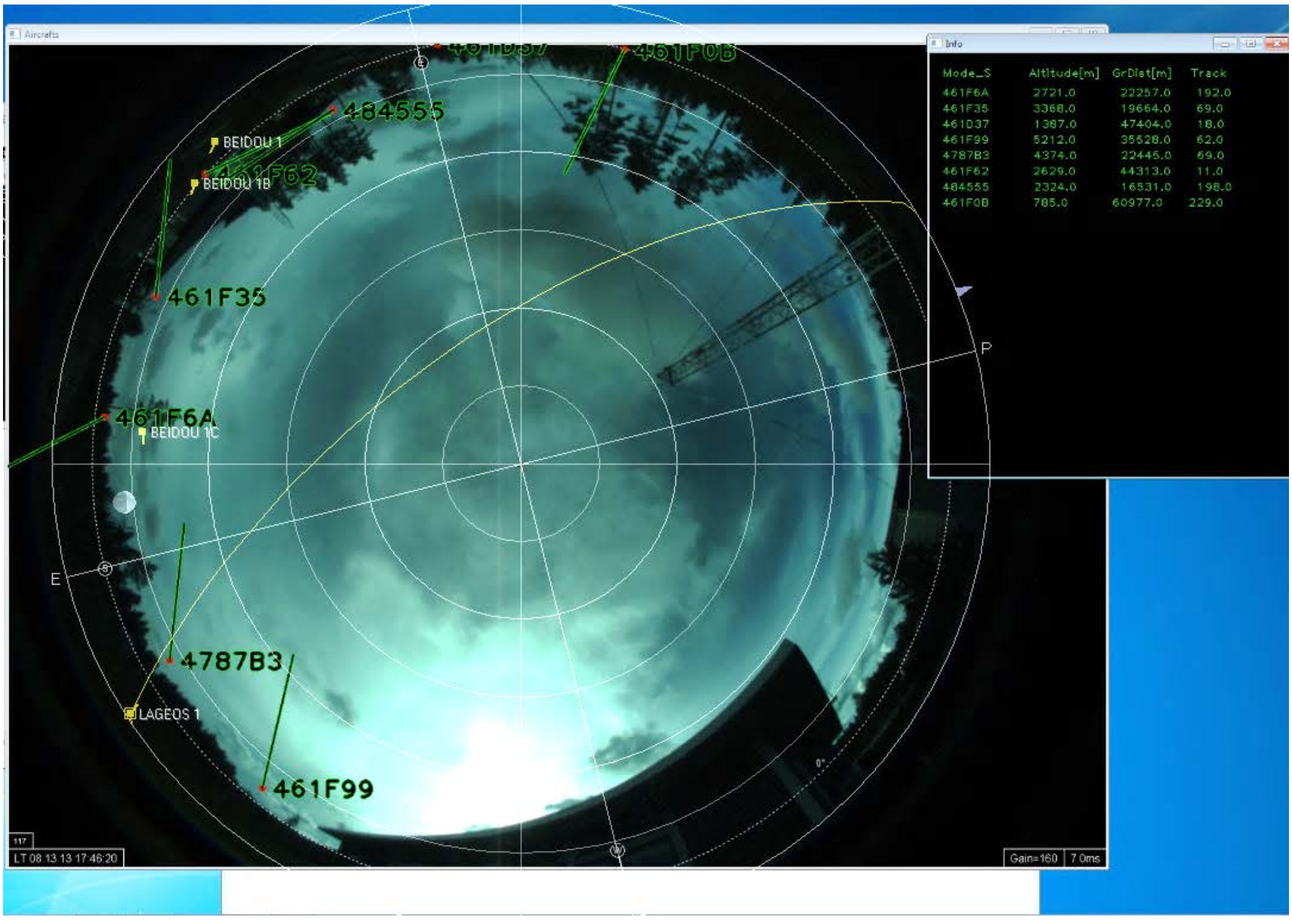


Figure 4. A screenshot showing the latest all-sky image with the airplane information (red dots and green lines), overlaid on top is the satellite visibility.