Development of a Full SLR Software Stack based on Real-Time Linux and a new Version of the Potsdam Range Gate

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Abstract

In 2011 André Kloth and Jens Steinborn (now DiGOS Potsdam GmbH, former SpaceTech GmbH) worked on a contract by the GFZ German Research Centre for Geosciences in Potsdam to redesign and re-engineer their SLR operation software to a modern kHz SLR system with the aims to enhance performance and maintainability, and to ensure SLR operation for the next decade(s) by using commercial off-the-shelf hardware and a state-of-the-art operating system with continuous long-term support. The former existing mix of MS-DOS/Windows software on distributed hardware systems was superseded by a real-time Linux operation software system on a single hardware platform with a simplified workflow and a central user interface for observations and complete station control. The newly developed, Linux based SLR operation software, called "SCOPE", is now actively running in Potsdam for two years and has provided a more efficient operation and increased number of observed satellites through an easier timeline optimization. [1]

SLR Software Stack

Now, in 2014 the same engineering group (today DiGOS Potsdam GmbH) was awarded by the Finnish Geospatial Research Institute (FGI, former Finnish Geodetic Institute) to adapt, extend and commission the SCOPE software for the new kHz SLR system of the Metsähovi Geodetic Research Station which is currently being established. The first engineering activities which include identifying and specifying necessary hardware interface adaptations and software extensions have been completed. In the next phase these adaptations will be implemented into the SCOPE software stack.
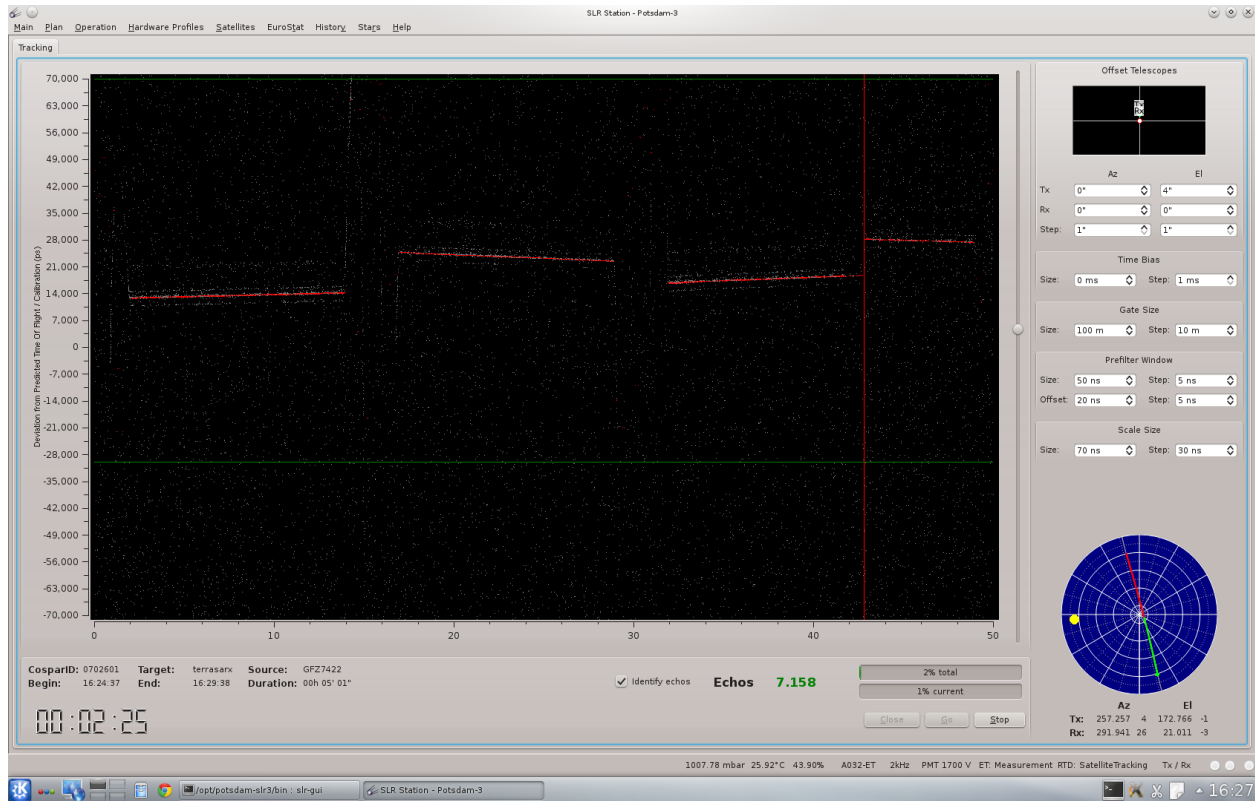
Figure 1. A screenshot showing the user interface of SCOPE while tracking TerraSAR-X and TanDEM-X satellites (automatic interleaving mode).

As a major component, the SCOPE software stack includes a SLR station hardware simulator. The SCOPE Simulator will serve as an early working base for the new SLR system in Metsähovi. It allows to verify all hardware drivers and interfaces against a hardware simulation, and to exchange the simulated devices step by step with real hardware components when they become available and are installed in the new SLR system. Also, demonstrations and training of operators will be performed with the simulator before commissioning of the complete SLR system.

Exchange of Operational Knowledge

Both SLR systems, at GFZ and FGI, will share the same operational software core and will therefore mutually benefit from software updates and improvements. This design goal and the availability of SCOPE source code at GFZ and FGI will support an easier exchange of operational knowledge between both SLR groups. In the long run it enables the groups to develop their own extensions for SCOPE and share them with other SCOPE users in the SLR community. Planning and development of new ideas and features can be combined and new algorithms can be verified at different systems.

Key Aspects of the SCOPE Software

- Stable and reliable operation at the SLR station in Potsdam since 2012

- Build on top of a state-of-the-art operating system with continuous long-term support

- Modern modular software design which allows extending the software for new SLR applications like space debris tracking or different automatic aircraft flight safety systems

- Flexibly exchangeable drivers for all hardware components like telescope, dome, range gate, laser, optical devices, rain & meteorological sensors, ... allowing an adaptation of the software to different SLR stations

- Configurable safety limits for hardware and operations like speed limits for dome and telescope, minimal sun distance, minimum tracking elevation, etc.

- Easy to use central operator interface to command and control all aspects of the station and the SLR operation.

In addition the SCOPE Station Simulator supports:

- Validation and verification of hardware drivers or software changes
- Troubleshooting of faults which result from interaction between different subsystems
- Training of new operators even without already existing hardware
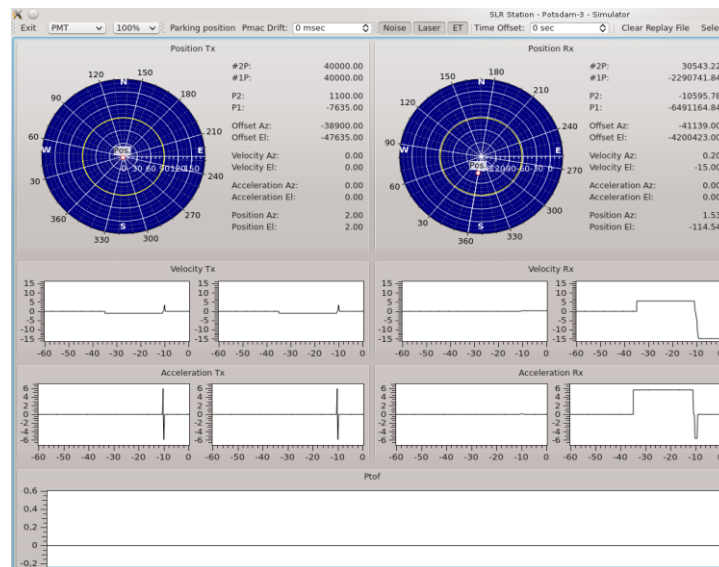
Figure 2.   SCOPE System Simulator for two telescope SLR station at GFZ/Potsdam.
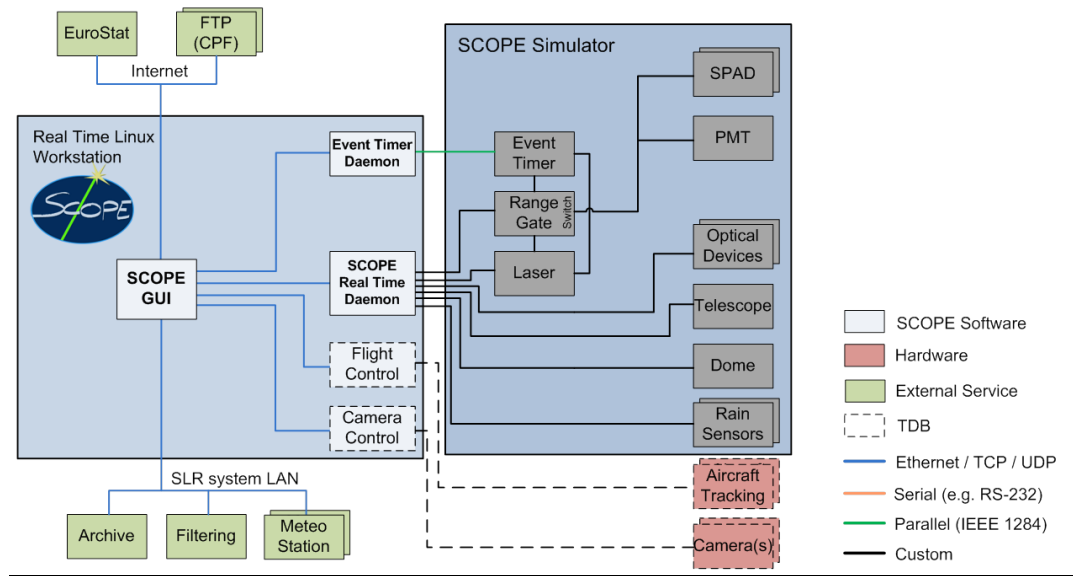
Figure 3. A block diagram of the SCOPE components.

Range Gate Upgrade: In addition to the integration of SCOPE, GFZ and DiGOS Potsdam GmbH (former business unit of SpaceTech) cooperate in upgrading the range gate which was initially designed at GFZ [2]. This upgraded range gate will be integrated at the GFZ SLR station and also delivered to FGI for the new Metsähovi SLR system. This range gate will include an ARM Cortex-M4 processor for a higher performance and a new firmware which will remove some limitations of the current version as well as allow a more flexible operation. With this new range gate the SLR stations will be able to perform space debris tracking for extended tracking capabilities. First tests show an increased accuracy and much better handling of changing operation parameters on the fly.

Conclusions and Future Work

The current version of SCOPE operates reliably since more than two years. It increased the observation performance of the Potsdam SLR station and simplified the work of the observers. In 2015 the integration of the software into the SLR system in Metsähovi will prove that its integrated modularity provides the needed flexibility for adaptation into other SLR systems.

Today, SCOPE is planned be enhanced to support space debris tracking and automatic star observation for mount model generation which will further increase the performance. Semi- or full autonomous operation is intended for the next major version of SCOPE.

References

[1] http://www.digos.eu/

[2] Grunwaldt, L., Weisheit, S., Steinborn, J., Upgrade of SLR station 7841 Potsdam, 18th International Workshop of Laser Ranging, Paper 13-Po56, Fujiyoshida 2013.