

Second EU-VGOS Workshop

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TU Wien Freihaus

Book of Abstracts

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Correlation technology / 1**Post-correlation polarimetric conversion: advantages for calibration and imaging****Author(s):** Dr. MARTI-VIDAL, Ivan¹**Co-author(s):** GONZALEZ GARCIA, JAVIER ²¹ *University of Valencia*² *IGN - Observatorio de Yebes***Corresponding Author(s):** imarvi2@uv.es

The calibration and imaging of VLBI observations in circular polarization basis is preferred, since the parallactic-angle correction reduced to a simple deterministic phase correction that commutes with all antenna-gain corrections. Circular polarization has indeed been the polarimetry basis in classical VLBI observations. Hence, conversion of the linear-polarization VGOS visibilities into a pure circular basis allows for a direct application of legacy Geodesy and Astronomy algorithms to VGOS observations.

Here we show how the “PolConvert” algorithm can be used to derive the cross-polarization gains of all VGOS antennas and use it to convert the DiFX products to circular basis. We also show preliminary broad-band fringe-fitting results and image reconstructions obtained from EU-VGOS observations.

Correlator reports / 2**Bonn Correlator Status Report****Author(s):** BERNHART, Simone^{None}**Co-author(s):** Dr. CHOI, Yoon Kyung ¹¹ *Reichert GmbH / BKG***Corresponding Author(s):** simone@mpifr-bonn.mpg.de

We will give a brief overview on the current status of correlated EU-VGOS sessions as well as an update on the e-transfer capabilities at the Bonn correlator.

Station technology / 3**Characterization single dish experiments with NASA VGOS stations**LEONID, Petrov¹¹ *NASA GSFC***Corresponding Author(s):** leonid.petrov@nasa.gov

In order to characterize VGOS antenna we have developed a concept of single dish experiment (SDE) and software that supports it. I will provide an overview of this activity and share results.

Correlation technology / 4**Embarrassingly parallel**Dr. KETTENIS, Mark¹¹ *JIVE***Corresponding Author(s):** kettenis@jive.eu

In order to achieve the VGOS goals, the correlator capacity will have to be scaled up significantly. Given the fact that CPU clock speeds have not increased significantly over the last decade, the

only way to achieve this is by parallelizing the workload. The most efficient way to do this is by eliminating dependencies between parallel tasks as much as possible. In this contribution I will discuss what this means for the way we record, distribute and process VLBI data.

Analysis I (Short-scan sessions) / 5

On the EU-VGOS "short-scan" sessions

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Within this presentation, we will give an overview of the short integration time sessions observed in 2020 as a base for discussions about appropriate analysis strategies and potential scientific results. In total, there have been eleven sessions out of which five are correlated and ready for analysis. The sessions were designed for testing the performance of the shorter scan durations for VGOS.

Currently, all IVS VGOS observations are schedules with a fixed 30 second integration time, independent of source brightness or station sensitivity. However, the VGOS goal is to rapidly increase the number of observations by reducing integration time down to five seconds. These sessions were designed as an initial test of short integration times.

The schedules were generated in a way, that the session was split into blocks utilizing different integration times with the motive to compare the performance of the individual blocks within a session. Furthermore, some additional restrictions were present when designing the sessions, such as storage limits leading to longer idle times between scans. Although a standard geodetic analysis of the session is possible and interesting, it does not reflect the special situation of the sessions. Therefore, it is worthwhile to discuss refined analysis strategies.

Analysis I (Short-scan sessions) / 6

Analysis of short scan EU-VGOS sessions

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In 2020 eleven EU-VGOS session were observed with particularly short integration times. Initially the main purpose of these sessions was to test how short VGOS scans can be in practice. Our aim was to investigate the suitability of these sessions for a regular geodetic analysis and an assessment of the quality of the results. We used the Vienna VLBI and Satellite Software (VieVS) for the analysis of these sessions. Six databases turned out to be useful for geodetic analysis. We present our results and discuss our parametrization. We conclude that Pseudo Stokes I fringe-fitting delivered usable databases and geodetic results are reasonable even for scan lengths down to 10 seconds.

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The EVN software correlator at JIVE (SFXC)

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While the SFXC correlator at JIVE is (currently) not a VGOS correlator, it has in recent years gained the capability to function as a geodetic correlator. This functionality has been successfully used to refine the positions of some of the EVN stations that don't take part in geodetic observation on a regular basis. The aim is also for SFXC to be able to correlate VGOS data. In this contribution we will present the geodetic capabilities of the SFXC correlator, focusing on how it differs from the DiFX correlator that is used at other correlation centers. We will also present an update on the correlation infrastructure at JIVE for comparison with reports from other correlators within the EU-VGOS collaboration.

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An update from the Yebes-13m station

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In this talk we report on the present status of the VGOS radio-telescope at Yebes and future plans.

Analysis II / 9

Comparison of single band databases and closure analysis for EU-VGOS observations

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In the talk, we will report the comparison of single band databases of each four bands both at the observable level and for the geodetic results. The results based on closure analysis of the broadband observables will also be reported and compared for different calibration and fringe fitting strategies used for the available EU-VGOS observations.

Analysis II / 10

Cable delay calibration of EU-VGOS data in the geodetic analysis

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The phase calibration reference signal of a VLBI station is carried by a cable from the maser in the control room to the phase calibration signal generator at the antenna room. Any changes in the length of the cable also introduce delays in the phase calibration signal. The phase calibration correction is applied at the fringe-fitting stage; therefore, the instrumental delays from the injection point to the sampler are corrected, and delays due to cable length changes of the uplink cable are introduced. The cable delay is measured at the station by the so-called Cable

Delay Measurement System (CDMS), or a proxy is estimated from the phase calibration signal during fringe-fitting (Pcmt). Both delays are stored in the vgosDb file. In this talk, we present a new feature of the Vienna VLBI Software (VieVS), which can select either CDMS or Pcmt to correct the group delays by the cable delays at the geodetic analysis. Furthermore, we will show the impact of either using CDMS or Pcmt on the geodetic results of EU-VGOS data.

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Vienna Correlator Status Report

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We give a status report of the Vienna Correlator and its capabilities to correlate EU-VGOS sessions. We will also include information about our network connection.

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Applying PolConvert to EU-VGOS Data

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VGOS data are observed and recorded in dual linear polarization. During the fringe-fitting process these two polarization directions have to be combined to Stokes I, taking into account the parallactic angle. Before the visibilities can be coherently added, the cross-polarization complex gains for each telescope have to be determined in a calibration step. In this talk I show how PolConvert can be used in practice to calibrate EU-VGOS data. PolConvert also transforms the visibilities from linear to circular polarization, which has further advantages for fringe-fitting. I will present recent results of applying PolConvert to short-scan EU-VGOS sessions.

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Wettzell station report

Mr. PLÖTZ, Christian¹

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Geodetic Observatory Wettzell: Current status of the Twin radio telescope Wettzell south (Ws).

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Wettzell VLBI correlator

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Geodetic Observatory Wettzell: Current status of the newly established VLBI correlator facility.

Planning of new sessions / 15

Current status and future plans for VieSched++

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Within this presentation, we will give a brief overview of the development status of the VLBI scheduling software VieSched++ as well as show our future plans. The last bigger update was published end of April and was related to integrating satellite observations. Since then, development has focused on smaller bug fixes and increased automation for operational use. The next bigger update is planned to incorporate VEX2 support in VieSched++. Currently, the use of .skd files instead of .vex files is a significant limitation in geodetic VLBI - especially for VGOS where it is almost impossible to generate new schedules without extensive expert knowledge. With the enhanced support of VEX2, it is required to also define new scheduling catalogs. The current sked-catalogs have a large number of limitations and several workarounds are necessary for both, SX and VGOS sessions. Many of those workarounds are not even documented. This talk aims to provide some background information to initiate further discussions regarding a transition from .skd to .vex files, improvements in scheduling, as well as new catalog designs.

Analysis I (Short-scan sessions) / 16

Analysis of EU-VGOS witch ASCOT and c5++

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We present the results from the analysis of EU-VGOS sessions using two different software packages. Various aspects are compared and discussed.

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The ultimate EU-VGOS calibration tool

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Yebes Observatory is about to develop a web server for the analysis and visualization of calibration data obtained during the EU-VGOS interferometric observations. For this, the first task will consist of the design and development of a database that contains the calibration information extracted from the Field System log files available on-line from the various radio telescopes that participate in the observations. Once the database has been built, the web application will allow

on-line access and analysis of this information, current and historical, from each of the radio telescopes, in the form of tables and plots. The tool will have an on-line help and documentation. This talk describes the project and its capabilities, and will ask for feedback and requirements from the group.

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Status update from stations Oe and Ow

Dr. VARENIUS, Eskil¹

¹ *Chalmers University of Technology*

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I will present the current status of the two VGOS antennas ONSA13NE (Oe) and ONSA13SW (Ow), located at Onsala Space Observatory in Sweden. I will note recent improvements and changes, and summarise known challenges as well as and future plans for changes and upgrades.

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Status update from Onsala VGOS correlator

Dr. VARENIUS, Eskil¹

¹ *Chalmers University of Technology*

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I will summarise recent, current and planned activities at the Onsala VGOS correlator. I will note some open questions and challenges that may be shared by others.

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The new "etransfer" etc/etd software: Why and how to use it?

Dr. VARENIUS, Eskil¹

¹ *Chalmers University of Technology*

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I'll give an introduction to the new etc/etd VLBI data transfer software. The software is intended to replace e.g. m5copy, and provides significantly faster data transfer rates for "multi-file" recordings, normally used within (EU)VGOS.

Planning of new sessions / 21

High-frequency fringe-tests with Onsala VGOS antennas

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In this talk I will present some preliminary results on fringe-tests done with the Oe-Ow baseline at frequencies above the usual VGOS band D. I will discuss what changes are needed compared to our "standard" VGOS system, and some ideas for how to deal with potential issues such as faint PCAL at high frequencies.

Analysis II / 22**An update on the ONTIE sessions**Dr. VARENIUS, Eskil¹¹ *Chalmers University of Technology***Corresponding Author(s):** eskil.varenius@chalmers.se

In this talk I will first review the results presented at the EVGA 2021; the short-baseline interferometry sessions carried out at X-band with VGOS antennas Oe and Ow plus the legacy S/X antenna On. Then I will present additional data taken recently, and discuss some open questions.

Planning of new sessions / 23**OTT quasar flux monitoring and amplitude calibration stability**Dr. VARENIUS, Eskil¹¹ *Chalmers University of Technology***Corresponding Author(s):** eskil.varenius@chalmers.se

I will present results from a recent campaign to measure quasar flux densities using the single ONSA13SW (Ow) and ONSA13NE (Oe) 75m baseline. During 2021 we conducted more than 60 short (20m) experiments in order to measure flux densities of a few bright sources. The aims were to a) check and monitor the Oe and Ow RF stability in the long and short term, b) assess the feasibility of doing regular flux monitoring using this single baseline, and c) verify recent DBBC3 multicast amplitude calibration features added to the VLBI Field-system version 10.

Station technology / 24**Fringes at 32Gbps and beyond**Dr. VARENIUS, Eskil¹¹ *Chalmers University of Technology***Corresponding Author(s):** eskil.varenius@chalmers.se

I will present lessons learned from 32 Gbps and 64 Gbps test observations carried out with the Oe and Ow antennas. I will discuss details in how to set up DBBC3 backend and flexbuff recorder for such datarates, and discuss possible near-future changes and/or upgrades.

Station reports / 25**Status on VGOS project at the Metsähovi Geodetic Research Station****Author(s):** Dr. ZUBKO, Nataliya¹**Co-author(s):** ESKELINEN, Joonas¹ ; Dr. KAREINEN, Niko¹¹ *Finnish Geospatial Research Institute***Corresponding Author(s):** nataliya.zubko@nls.fi

We present updates and progress on the VGOS project in Finland, the current status and plans.

Welcome / 26**Welcome**

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Opening remarks

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Santa Maria Station Report

Analysis I (Short-scan sessions) / 29

The single session geodetic analysis with nuSolve & Calc/Solve