ACor: Automated Observation Scheduling and Data Management

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16th European VLBI Network Symposium and Users' Meeting, 2-6 September 2024

Abstract

The Automatic Correlation System (ACor) is a web-based platform designed to enhance observation planning, data storage, and processing. It automates scheduling for both single-dish and interferometric modes using the Ventspils International Radio Astronomy Centre (VIRAC) radio telescope complex in Irbene, Latvia, which includes the RT-32, RT-16, and LOFAR radio telescopes. Key requirements for ACor include open access, web-based functionality, and organizing observation schedules involving researchers, radio telescope operators, and data processing specialists. This system integrates observational data into a structured database, streamlining data management and analysis workflows. If observation results are unsuccessful, the system automatically plans for rescheduling to optimize data collection efforts. By automating various tasks, ACor significantly boosts efficiency for researchers, radio telescope operators, and data processing specialists in their daily work. The comprehensive functionality of the ACor system, including its capabilities in observation planning, data storage, and analysis, are described in the poster. This poster will cover how the system integrates with the Irbene radio telescope complex, automates observation scheduling, and enhances data management, ensuring an optimized and efficient approach to observational data collection and processing.

Functional Requirements of the ACor System

- Save observations in the database for better organization.
- Streamline data management and analysis workflows.
- Accurately define observation parameters before execution.
- Correlate and calibrate data for accuracy.
- Modify database configurations as needed.
- Schedule weekly planning every Monday at 9:00 AM.
- Review observation groups, convert LST to GMT, and check antenna availability.
- Integrate with VIRAC Google Calendar and internal scheduling API.
- Organize events, allocate time slots, and compile VEX files.
- Dispatch VEX files to Flexbuff-1 server for execution.
- Support researchers monitoring observation parameters.
- Update observation statuses weekly based on recent data.
- Perform clock search, identify sources, verify data, and adjust GPS offsets.
- Automate data processing with ParselTongue, create FITS files, and display diagnostics.
- Store observation details and statuses for record-keeping.
- Enable manual selection of observation groups via UI.
- Create 'key file' for VLBI setup, input to pySCHED for VEX file generation.
- Run observations, correlate data, and process with custom pipeline.
- Arrange spectral windows considering source velocity and scan lengths.
- Generate files for telescope control.
- Correlate and process interferometric data.
- Automate tasks for increased efficiency.

An architecture of the ACor System

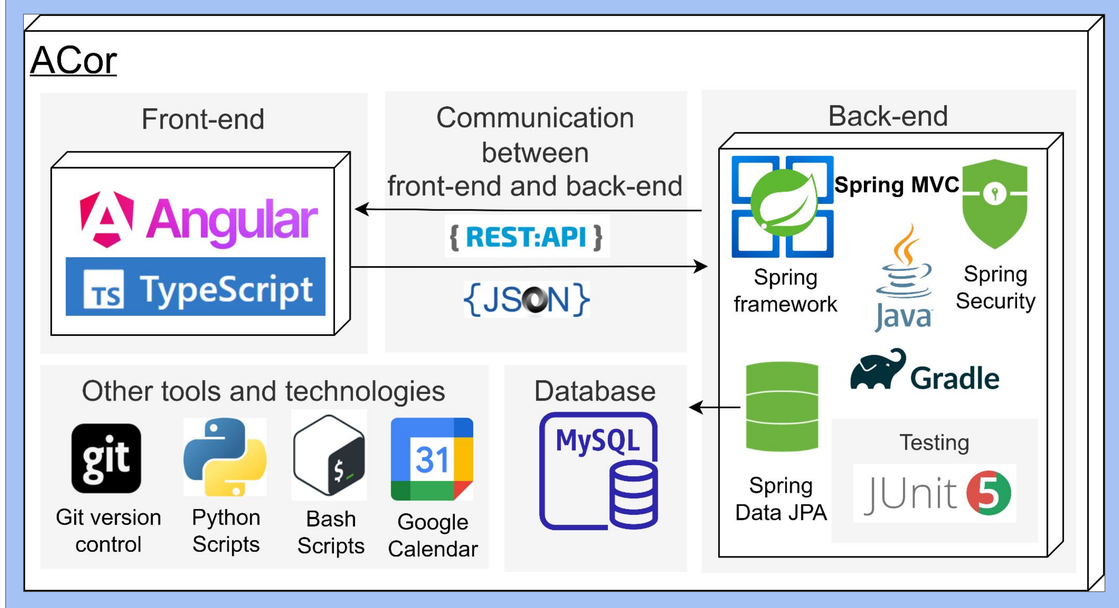

Figure 1. Technology used in the ACor development and testing processes

Description of the Database Tables Used for Data Storage in the ACor System

- **SPRING_SESSION**: Stores session information for user interactions.
- **SPRING_SESSION_ATTRIBUTES**: Stores attributes associated with session data.
- **correlation_type**: Defines types of correlation used in data processing.
- **correlator_info**: Stores information related to correlator configurations.
- **data_proc_pipelines**: Stores data processing pipelines.
- **data_processing**: Stores details of data processing tasks.
- **global_parameters**: Stores global parameters used across the system.
- **group_obs**: Manages observational groups with LST time.
- **obs_acceptance**: Stores acceptance status of observations and is used for automatic rescheduling.
- **obs_pipelines**: Stores information regarding pipelines used in specific observations.
- **obs_processing**: Stores processing parameters used in specific observations.
- **obs_project**: Stores project-related observation information.
- **obs_stations**: Associates stations with observations.
- **obs_users**: Manages users for observations.
- **observation**: Stores observational data.
- **observation_mode**: Defines modes of observation.
- **observation_params**: Stores parameters associated with observations.
- **observation_type**: Defines types of observations.
- **observation_virac_mode**: Manages VIRAC observation modes.
- **pipeline**: Defines data processing pipelines.
- **project**: Manages project details.
- **roles**: Defines user roles and permissions.
- **scan**: Stores scan data.
- **scan_obs**: Associates scans with observations.
- **source**: Manages source data for observations.
- **station**: Stores information about all stations.
- **station_parameters**: Stores parameters associated with observation stations.
- **user**: Manages user accounts and credentials.
- **user_info**: Stores additional user-related information.
- **user_roles**: Associates users with roles and permissions.

Automated Scheduler of the ACor System

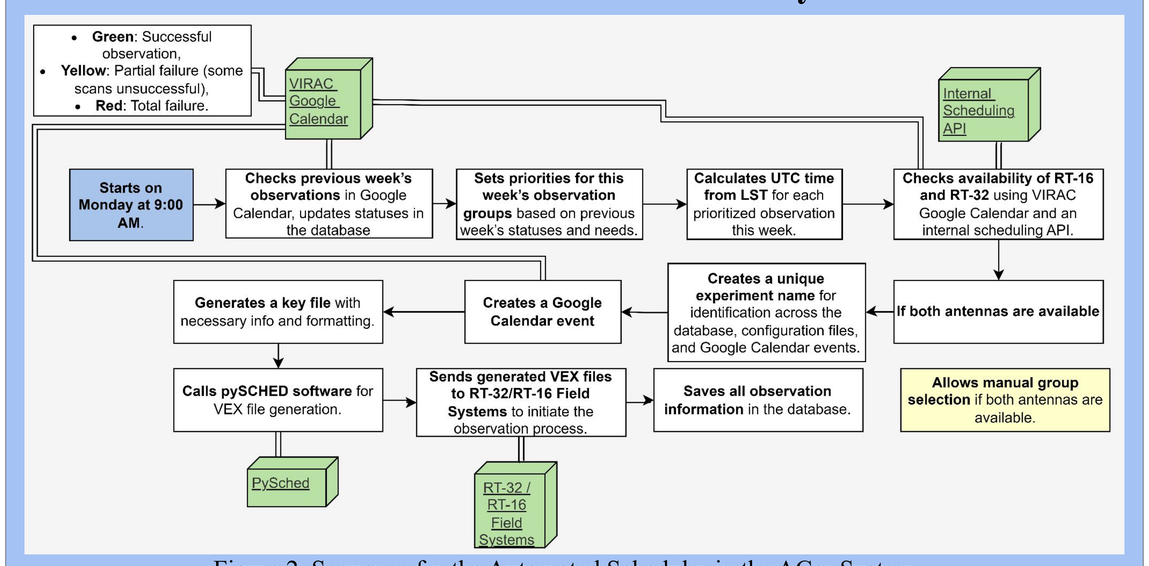

Figure 2. Sequence for the Automated Scheduler in the ACor System

The automated scheduler is a key tool in the IVARS project, enabling efficient management of observation campaigns with stable or slightly varying parameters. Every Monday at 9:00 AM, the system reviews predefined observation groups, converting LST to GMT, and checks the availability of RT-32 and RT-16 antennas using dedicated software. It integrates with the VIRAC Google Calendar and an internal API to schedule new observation events and generate VEX files, which are sent to the Flexbuff-1 server for execution. Observation statuses are color-coded (green, yellow, red) in the calendar and reviewed weekly to determine if rescheduling is necessary. Users can manually adjust observations based on antenna load and observation timing through a user-friendly interface, which displays detailed group information and allows for easy selection and scheduling.

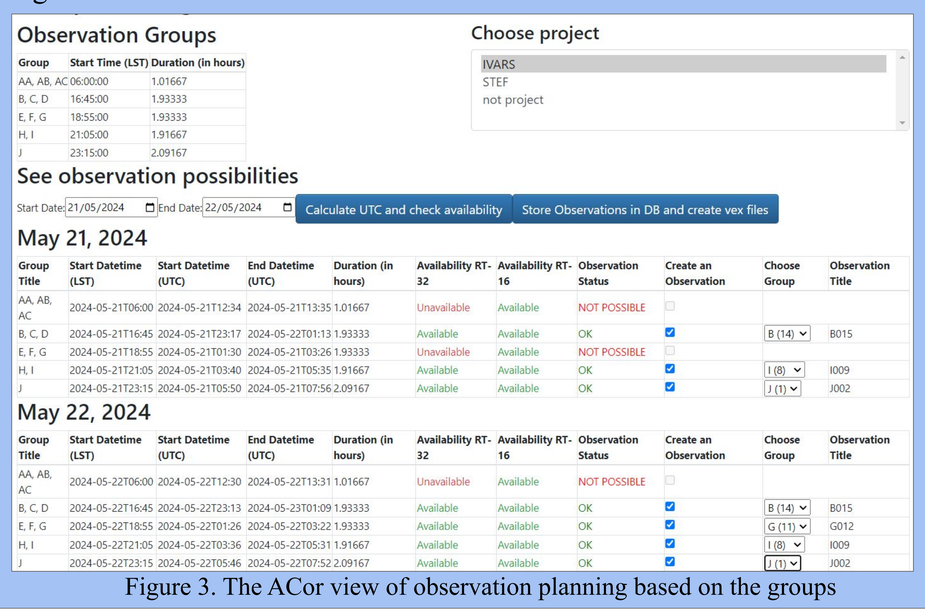

Figure 3. The ACor view of observation planning based on the groups

Conclusions and future work

By automating tasks such as converting LST to GMT, checking antenna availability, and generating scheduling events, the system significantly reduces manual effort and minimizes errors. It provides timely and accurate updates to observation statuses, effectively manages scheduling conflicts, and keeps comprehensive records. Additionally, systematic storage and organization of configuration details enhance the management of the observation processing workflow. This structured approach ensures seamless integration with processing pipelines, maintains consistency across data handling, and improves overall efficiency in managing and executing observations.

It is recommended to enhance the observation status setting by additionally integrating the data processing status. For example, by calculating the Signal-to-Noise Ratio (SNR) in the processed data, the system can evaluate the quality of the data. If the noise level is found to be unsatisfactory, the system should automatically flag the observation group for re-observation.

If you have any questions or are interested in the ACor system, please reach out to us at karina.krinkele@venta.lv. You can access the GitHub link via the QR code.

Acknowledgements

This research is funded by the Latvian Council of Science, project „A single-baseline radio interferometer in a new age of transient astrophysics", project No. lzp-2022/1-0083