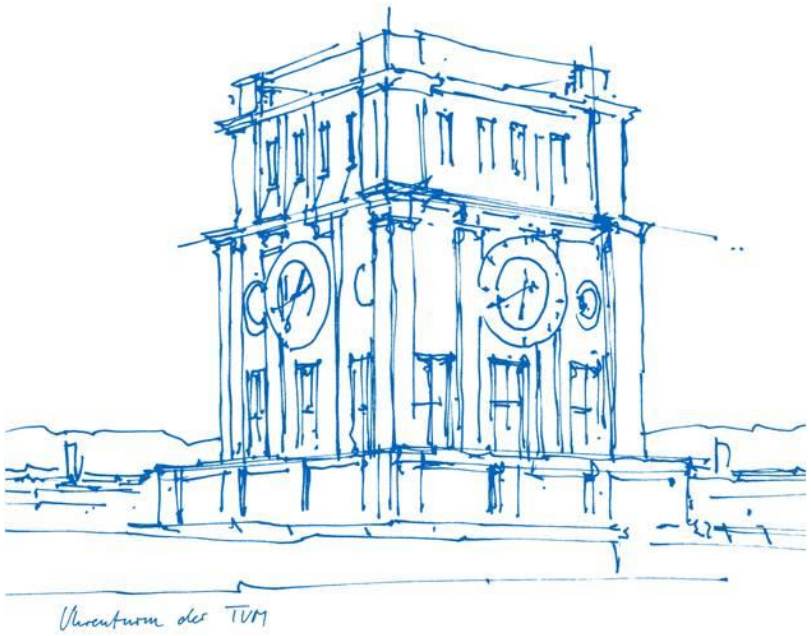
Astronomy Seminar Presentation

Group : Automation



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Introduction

The automation of the observatory is a key project aimed at enhancing efficiency, enabling remote operations, and ensuring the safety of valuable equipment.

By integrating automated control systems, weather monitoring, and data processing, the observatory can operate with minimal human intervention while maintaining high precision.

This presentation outlines the current status of automation, future plans, and areas where support and development are still required.

Fig.1 Munich Observatory Telescope

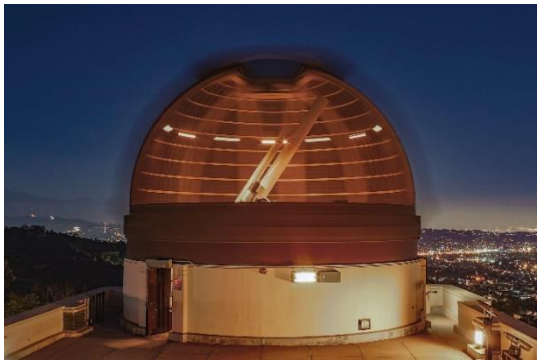

Fig.2 Observatory Dome

Automation Tasks

Several automation tasks have already been implemented to improve efficiency and ensure smooth operations at the observatory. This includes:

Telescope Control:

- Automated Pointing: The telescope can automatically slew (move) to desired celestial objects based on coordinates input by the software. This involves integration with a star catalog or sky map.
- Tracking: The telescope has a tracking mechanism that keeps objects in view as the Earth rotates, ensuring long-exposure images remain sharp.

Fig.3 Pointing Telescope

Automation Tasks

Data Collection and Archiving:

- Automated Imaging: The telescope and attached cameras are programmed to capture images during observation sessions. Exposure times, filters, and sequences are pre-configured for different types of observations (e.g., planetary, deep-sky).
- Data Storage: Images and metadata (time, location, conditions) are automatically stored and organized into a structured archive system, which can be accessed later for analysis.

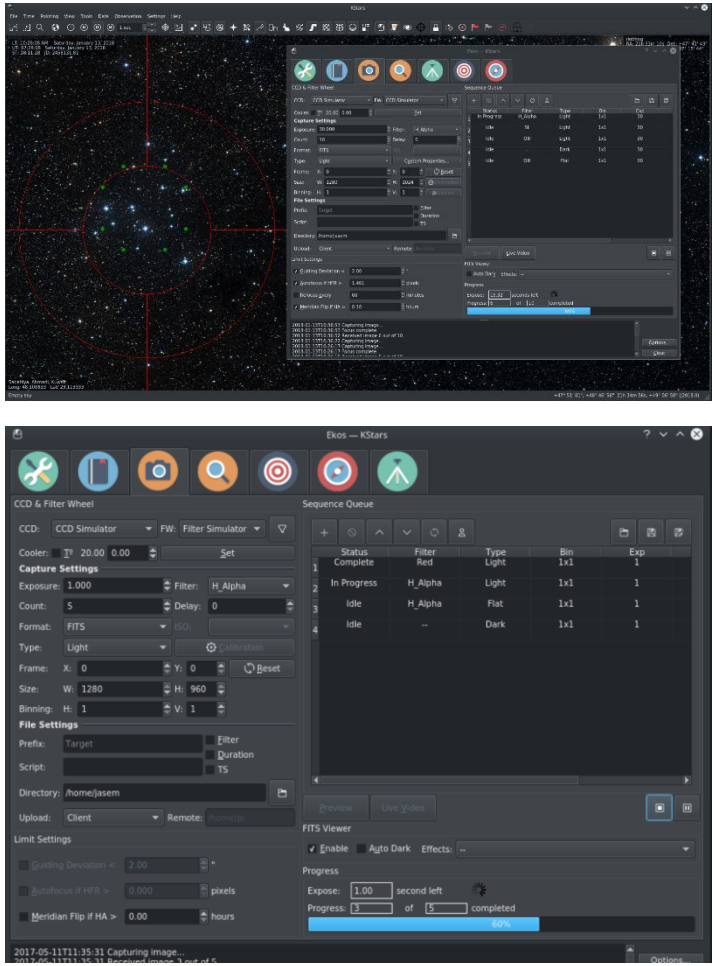

Fig.4 K-Stars software framework

Installation of the DAVIS Vantage Weather Monitoring Device

The Davis weather station continuously monitors real-time weather data like wind speed, temperature, humidity, and barometric pressure. This data is critical for safe telescope operation, especially for roof/dome automation.

Dome Control:

With the integration of the Davis station, if it detects high wind speeds, precipitation, or other unfavourable conditions, the system can automatically close the observatory's roof or dome. This protects sensitive telescope equipment from weather damage.

Fig.5 Davis instrument with console

Installation of the DAVIS Vantage Weather Monitoring Device

Scheduled Observations Based on Weather:

The data gathered from the Davis station can also be integrated into the observation scheduling system. If the weather forecast predicts clear skies, the system could schedule and initiate observation sessions automatically, pausing or aborting them in case of adverse weather

Fig.6 Davis instrument configuration

Installating Encoder

In the observatory, encoders play a critical role in providing precise feedback for the control and positioning of the telescope and other moving parts. Their primary function is to ensure the telescope can accurately track and point to celestial objects.

Azimuth and Altitude Control:

- Encoders are used to measure the exact rotation of the telescope in both horizontal (azimuth) and vertical (altitude) axes.

- This allows the telescope to be positioned precisely at the correct celestial coordinates when pointing at stars, planets, or other deep-sky objects.

Fig.7 Assembled Encoder

Fig.8 Rods for Encoder placement

Installating Encoder

Long Exposure Imaging:

Accurate tracking with the help of encoders is crucial for long-exposure astrophotography. Without precise feedback, even slight errors in tracking can cause images to blur, especially when capturing faint objects like galaxies.

Physical Limits and Boundaries:

Encoders help monitor the physical limits of the telescope's movement. For example, they ensure that the telescope does not over-rotate or move into a position that could damage the mount or collide with the observatory structure.

Fig.9 Encoder Placement

Installating Encoder

Dome Alignment: Encoders can also be used to synchronize the movement of the observatory dome (or roof) with the telescope's position. This ensures that the telescope's aperture aligns correctly with the dome opening as it tracks objects across the sky.

Remote Observation: In a fully automated observatory, encoders are essential for enabling remote operations. They provide real-time positional feedback to the remote operator, ensuring that the telescope is functioning accurately without requiring manual adjustments.

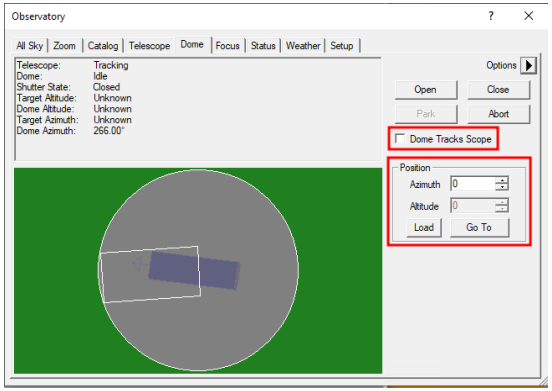

Fig.10 Automation software structure

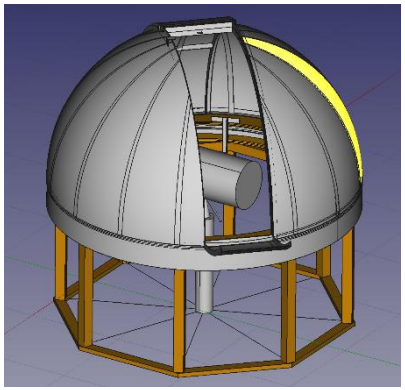

Fig.11 Dome alignment

Future Developements

- **Remote Interface Finalization:**
  - Building and testing the remote control interface that will allow users to interact with the observatory from afar needs further development.
- **Advanced Data Processing:**
  - Automating more advanced image processing workflows, such as on-the-fly data analysis, would help reduce manual work for astronomers.
- **Energy Efficiency Solutions:**
  - Finalizing and integrating smart energy management systems (including solar energy) to make the observatory more self-sustaining.
- **Automated Alerts and Reporting:**
  - Setting up detailed reporting on observatory performance, including weather data, system health, and observation outcomes.

Thank You