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## Calibration Pipeline for the CTAO Data Processing and Preservation System

Accurate calibration is essential for maximizing the scientific output of the Cherenkov Telescope Array Observatory (CTAO). The Calibration Pipeline, a core component of the Data Processing and Preservation System (DPPS), is part of the low-level offline reconstruction software. It is responsible for generating and maintaining high-precision calibration products. It encompasses the refinement of individual telescope calibrations, atmospheric corrections, and inter-telescope calibration, ensuring that CTAO data achieve the highest possible accuracy.

The pipeline integrates multiple data sources, including telescope calibration events, array elements monitoring and service data, as well as atmospheric measurements from FRAM, LIDAR, and external meteorological data. Using advanced data analysis techniques, the pipeline derives calibration coefficients, corrects instrumental biases, and tracks long-term stability.

The pipeline's key components include:

- Instrument Calibration: The pipeline analyzes calibration event data from individual telescopes to improve the in-situ calibrations performed during data taking, addressing uncertainties in baseline, gain, timing, and optical system precision and efficiency.
- Atmospheric Calibration: A best-fitting atmospheric description model is derived from FRAM, LIDAR, and external meteorological data. This model is then used to select or generate the most appropriate simulations, ensuring accurate event reconstruction.
- Inter- and Cross-Telescope Calibration: The pipeline compares air shower events observed by neighboring telescopes in the array, deducing the relative calibration coefficients of the telescopes.

To enable seamless data processing, the Calibration Pipeline interfaces with other DPPS components, including the Workload Management System, Simulation, Data Reconstruction, and Data Quality Monitoring pipelines.

This contribution presents the current status and development roadmap of the Calibration Pipeline, highlighting key advancements and future improvements. We discuss the challenges involved in implementing a scalable, automated, and high-precision calibration framework, as well as ongoing efforts to optimize its integration within the DPPS software package.

### Collaboration(s)

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