Backend update of the AlCaVal framework for validation of calibration and alignment conditions

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Duration: 8-12 weeks

Project Description

The alignment and calibration parameters of the CMS detector, also known as "conditions," are crucial for data quality and are stored in a database for online data acquisition and offline event reconstruction. These conditions continuously evolve due to factors such as faulty readout channels, detector aging, increased noise, and variations in sub-detector support systems (e.g., gas pressure, voltage, magnetic fields, and currents). Consequently, frequent updates and recalibration are necessary to ensure the recorded data accurately reflects real-life conditions.

Updated conditions must be validated before being appended to the database, along with their interval of validity. The AlCaVal framework is vital for this validation task in the CMS experiment. While the current validation pipeline is functional, its speed can be improved, a need that will become more critical with the increased intensity of the LHC beams requiring a faster turnaround. Additionally, detailed performance monitoring is currently lacking.

This project will address these issues by:

1. **Optimizing the AlCaVal backend pipeline:** The existing code for evaluating new conditions will be modified to reduce the overall processing time.
2. **Developing a monitoring dashboard:** Creating a visual tool to display statistics on how long each stage of the validation process takes and making it available to AlCaVal users.

These enhancements aim to significantly improve the efficiency and monitoring of the AlCaVal framework.

Software Deliverables

1. **Updated AlCaVal Backend Code:** Modified scripts and classes for the AlCaVal pipeline that show improved processing speed.
2. **Monitoring Dashboard:** A working web-based dashboard that displays timing information for the validation process statuses.
3. **Documentation:** Technical notes on the changes made to the pipeline and a guide for using the new dashboard.
4. **Final Report & Presentation:** A summary of the project work, results, and software produced, as required by IRIS-HEP.

Project Timeline (10 Weeks)

- **Weeks 1-3: Getting Started, Analysis & Early Development**
    - Learn the AlCaVal system, focusing on the code of the validation pipeline.
    - Identify slow parts of the pipeline; begin making first improvements.
    - Plan the dashboard and how it will get data.

- **Weeks 4-7: Main Development Work**
    - Implement key changes to speed up the pipeline; measure the improvements.
    - Build the dashboard: data collection, processing, and visual display of timings.
- **Weeks 8-10: Testing, Writing Up & Finishing**
    - Test the faster pipeline and the new dashboard.
    - Write down the technical details and how to use the new tools.
    - Complete the final report and prepare the presentation.