

Proposal of Simulation-Based Training in High-Energy Physics Multidetector Automation

Abstract

This research aims to facilitate the operator training for complex multidetector systems in high-energy physics, focusing on the ALICE detector at CERN. Safety rules and restricted access to live infrastructure support the offline training.

The study proposes a simulation-based platform that closely mirrors detector control systems and operational scenarios to enhance operator competence for the ALICE LHC Run 5 transition. Using a modular architecture, the system emulates front-end electronics and supervisory control, integrates IPbus and OPC UA protocols, and features adaptive engagement, performance monitoring, and fault scenarios. Validation, now underway using the Fast Interaction Trigger subsystem, shows early success in simulating control behaviors and giving quantifiable operator feedback. The platform offers scalable benefits for other detectors, supporting knowledge transfer and operational reliability. Current limitations involve fully emulating FPGA hardware and integrating new protocols.