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Autonomous discoveries using a modular ecosystem for adaptive anomaly detection in LHC triggers

Anomaly detection (AD) in the earliest stage of LHC trigger systems represents a fundamentally new tool to enable data-driven discoveries. While initial efforts have focused on adapting powerful offline algorithms to these high-throughput streaming systems, the question of how such algorithms should adapt to constantly-evolving detector conditions remains a major challenge. In this work, we introduce a modular ecosystem to develop and assess strategies for autonomous discovery that incorporates diverse components including: datasets with time-dependent effects, complex trigger menus, real-time control mechanisms, and cost-aware optimization criteria. We illustrate this framework with a novel benchmark based on reinforcement learning for AD triggers using public CMS datasets, aiming to encourage community-driven development towards a new generation of both intelligent and adaptive triggers.

Focus areas

HEP

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