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L1ExtraFromMCTruthProd

Complete:

Introduction

Beginning in 17X, this package is no longer maintained.

This EDProducer (`L1Trigger/L1ExtraFromMCTruthProd`) generates `L1Extra` objects and a `L1CMS.GlobalTriggerReadoutRecord` based on MC particles at generator level, bypassing all the detector simulation and trigger emulation. It is intended to be a temporary tool for seeding HLT algorithms. Detector acceptance and resolution are very crudely simulated. The L1 triggers being emulated are those that were used for the PTDR vol. 2.

Description of Algorithm

The default parameters and the modules necessary for running this EDProducer are given in the file `L1Trigger/L1ExtraFromMCTruthProd/data/l1extra-from-mctruth.cff`, which includes `l1extramctruth.cfi`.

Resolution and acceptance

The trigger resolution is modeled by independent Gaussian smearing of ϕ, η, and E for each particle. Although E_T, not E, is the relevant trigger variable, we do not smear this quantity directly because it is correlated with η. The smearing widths are separately specified by parameter for each particle type (e/γ, jet, μ), and these widths are fixed, independent of η and E_T. The default widths are the same for all particles: σ_ϕ = 0.1, σ_η = 0.1, σ_E = 5 GeV.

Detector acceptance is modeled as a simple η cut, also specified by parameter separately for the calorimeter (i.e. e/γ and jets, default = 5.0) and the muon chambers (default = 2.5). The cut is applied to the smeared η values. For jets, the boundary between the central and forward regions is defined by parameter, and the default value is 1.5.

Jet finding

Jet finding for generated particles uses the same algorithms and EDProducers as for reconstructed particles; one simply inputs `Candidate` list made by `HepMCCandidateProducer` instead of reconstructed `Candidate` objects. The particular choice of jet finding algorithm is controlled by parameter (default = midPointCone5GenJets). In the above .cff file, we do not allow `Candidate` objects (and, thus, jets) to be made from electrons, muons, neutrinos, K^0_Ls, and neutrons.

τ jets in the central region are identified by matching the unsmeared jet direction to the generated τ direction, with $\Delta\phi$ and $\Delta\eta$ tolerances specified by parameter (default = 0.35 for both).

The remaining jets are sorted by η into forward or central regions. Central, forward, and τ jets are ranked by E_T, and only the top 4 candidates of each type (maximum 12 total) are retained and inserted into the event. τ jets are inserted as different collection from forward and central jets, and the two collections are distinguished by instance label ("Tau" and "ForCen", respectively).

e/γ and μ

Electron, photon, and muon candidates are taken from the list of stable generated particles. Electrons and photons within the calorimeter acceptance are sorted into isolated and non-isolated e/γ candidate lists. Isolation is determined by the presence of nearby calorimeter energy deposits, and these are assumed to come from other e/γ or jet objects. The ϕ and η isolation windows are adjustable by parameter (default = +-0.35 for both). In evaluating Δϕ, possible wraparound by 2π is accounted for. e/γ candidates in each of the two categories (isolated and non-isolated) are ranked by E_T, and only the top 4 candidates in each category (maximum 8 total) are retained and inserted into the event.

Muons within their η acceptance are ranked by E_T, and only the top 4 candidates in the entire detector are retained and inserted into the event. All muons have their MIP bits set, and their isolation is determined as above for e/γ, except ϕ and η windows (default = +- 0.35 for both) can, in principle, be different from e/γ isolation.

MET calculation

Unlike with jets, we do not obtain the MET vector from `METProducer` using generated 4-momenta as input. Rather, the MET calculation is performed inside `L1ExtraFromMCTruthProd` in order to make use of the smeared particle 4-momenta and to exclude particles outside the η acceptance. Because the L1 MET uses only calorimeter information, we do not include muons in the calculation. We sum transverse momentum vectors for all observed e/γ and jet objects, not just the top 4 of each category.

Total E_T is determined from the same particles as for MET. Hadronic E_T is not straightforward to calculate from the generated particles, so it is set equal to the total E_T.

L1 trigger conditions

The above particle lists are meant to approximate the outputs of the GCT and GMT, which are input to the GT. For GT emulation, we evaluate the entries in the trigger menu (listed on the instructions pages below), and we construct a `L1ParticleMapCollection` with one `L1ParticleMap` for each trigger menu entry. For each entry, the index or position in the collection corresponds to the trigger type, as specified by the enum `L1ParticleMap::L1TriggerType`. The E_T threshold(s) or prescale of each trigger is adjustable by parameter, and the default values are those used in the PTDR vol. 2 (Table E.11). For H_T, we use the total E_T described above.

The global L1 decision is constructed by OR'ing all the trigger decisions. It is recorded in the `L1CMS.GlobalTriggerReadoutRecord`, which is inserted into the event.

Instructions for use

For `CMSSW_0_9_0_pre2` through `CMSSW_1_0_0`, see here

For `CMSSW_1_1_0_pre1` through `CMSSW_1_2_1`, see here

For `CMSSW_1_2_2` onward, see here

The trigger tables implemented are identical to those for `L1ExtraParticleMapProd`. View the release-by-release tables here.

Review Status

Editor/Review and date	Comments
Main.wsun - 04 Aug 2006	page author

Responsible: Main.wsun
Last reviewed by:

This topic: CMSPublic > SWGuideL1ExtraFromMCTruth
Topic revision: r15 - 2007-12-19 - WernerSun