Table of Contents

Module 9: Event Hypothesis

Introduction

This page documents the concept of **Event Hypotheses** and **Group-Dependent Analysis Layers** in the framework of the e-learning in CMS⌐ activity Using Physics Analysis Toolkit (PAT) in your analysis⌐.

The whole e-learning activity is based on the PAT as integrated in **CMSSW_2_2_3**.

Event Hypotheses

An "Event Hypothesis" is the hypothesis of a given composite physics hypothesis given a group of detector objects. This module will discuss some tools developed to make this process easier.

Naturally, this situation lends itself to specific PAG's and search groups to develop their own event hypothesis classes. In the 2.2.3 CMSSW version, there are several tools available from PAGs as well as from the Physics Tools Candidate Model itself, so we'll go through a few of them. This is not intended to be comprehensive, but merely to give you an idea of what tools exist so you can continue on your own to study them. At this point in the course, you should be very familiar with the PAT and analysis in general, these are intended for advanced use cases. There are three groups that have group-specific analysis layers that are compatible with PAT and up to date, the top group, the SUSY group, and the Particle Flow group.

Generic Event Hypothesis

The generic event hypothesis is handled by the Candidate framework. The CompositeCandidate class naturally accommodates event hypotheses. We discuss these in detail now.

First, we need a few definitions. The "name" of the hypothesis would correspond to the physics signature you're trying to represent (for instance, "Z"). The "roles" are the names of the daughters that play a specific role. In the case of a Z decay, it could be "muon1" and "muon2". While this doesn't serve a meaningful difference in the Z case, there are cases where the role will carry additional information (such as a mass hypothesis). This frequently arises in B physics (such as in the case of B_s to j/psi + phi).

The intrinsic nature of an event hypothesis is that it is most often hierarchical. The hierarchical structure of the Candidate class naturally handles this situation.

Very simple examples of this can be seen in the Analysis Starter Kit.

You can find the prescription for using this workbook here.

Assignment: Please reproduce the muon pt plot shown in the CompositeKitDemo section and post it to your elog.

Top Quark Analysis Framework (TQAF)

The Top Quark Analysis Framework (TQAF) was the precursor to the PAT, so it is naturally quite compatible with the PAT design. The event hypotheses in this case primarily deal with top quark decays (dileptonic, semileptonic, and all hadronic).

Please follow this tutorial here:

https://twiki.cern.ch/twiki/bin/view/CMS/SWGuideTQAFRecipes#CMSSW_2_2_X
https://twiki.cern.ch/twiki/bin/view/CMS/SWGuideTQAFTutorial

Assignment: Please go through the example posted here and post a plot of your choosing to your elog.

SUSY PAT

The SUSY group previously had its own implementation of an analysis framework, and the PAT was designed to implement this functionality as well.

Please follow this tutorial here:

https://twiki.cern.ch/twiki/bin/view/CMS/SusyPat

Assignment: Please go through the tutorial and run this file ⬀, then post a plot of your choosing to your elog.

Particle Flow to PAT (PF2PAT)

Particle Flow has recently provided a nice interface to PAT, called PF2PAT.

Please follow this tutorial here:

https://twiki.cern.ch/twiki/bin/view/CMS/WorkBookPF2PAT

Assignment: Please go through the example and post this plot here to your elog.

Official PAT Skims

We will also discuss the creation of the official PAT skims. The philosophy of this was to have several groups agree on an event content that will be centrally managed.

The final prescription for doing this is found here.

The official PAT-tuples can be found on DBS with the following search criterion:

```
find dataset where dataset like *08*PAT*USER
```

The results can be seen here ⬀.

There is a nice utility to measure the event size of your edm file here. The diskSize utility found in PhysicsTools/PatAlgos/test/diskSize.pl can be used to create size profiles of your files. This can be done with

```
$CMSSW_RELEASE_BASE/src/CMS.PhysicsTools/PatAlgos/test/diskSize.pl filename.root >& output.html
```

(Note: Instructions on how to get the proper graphics are found in the above twiki).

I suggest doing this for all of your analyses so that you can understand where your disk space is being used. If you don't need something, you can drop it, and reduce your event content size considerably.

Assignment: Please create a "standard" PAT-tuple and use the diskSize.pl script to create a size estimate. .

-- SalvatoreRoccoRappoccio - 06 Feb 2009

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