How to Rtrk Double Ratios

Introduction

One way to asses systematic uncertainties of jet substructure variables is the Rtrk methodology. The following is a brief instruction for the steps necessary to produce double ratios that serve as input for the final estimate of these uncertainties.

Running over

First Setup

Download the DeriveJMSR tool from git:

```
git clone ssh://git@gitlab.cern.ch:7999/amelzer/rtrk.git
```

Setup the newest release:

```
cd rtrk
setupATLAS
showVersions|grep AthAnalysisBase
lsetup 'rcsetup Base,2.4.19'
```

Compile everything:

```
rc find_packages
rc compile
```

Check that the GRL, the PRW config files and the lumicalc files are available in the data directory

Now you can run the code:

```
doJMSUncertainties OutputFolderName ConfigFiles/basicSettings.config inputFile.list [mode] [gridO
```

OutputFolderName: all histograms and root files with trees will be saved here
data/basicSettings.config : configFile containing e.g. the jet collections you want to run over and other variables you might want to set
inputFile.list: list with input files to run over e.g. /pnfs/desy.de/atlas/dq2/atlaslocalgroupdisk/rucio/mc15_13TeV/d3/44/DAOD_JETM8.08623892._000001.pool.root.1
[mode]: default is "local", optional "grid"
[gridOutputName]: e.g. user.jdoe.my_run_p0001.root (see naming convention)

Available Variables

Moment	xAOD Jet attribute names
N-subjettiness	`Tau1`, `Tau2`, `Tau3`, `Tau21`, `Tau32`, `Tau1_wta`, `Tau2_wta`, `Tau3_wta`, `Tau21_wta`, `Tau32_wta`
kT splitting scale	`Split12`, `Split23`, `Split34`
zCut	`ZCut12`, `ZCut23`, `ZCut34`
Dipolarity	`Dip12`, `Dip13`, `Dip23`, `DipExcl12`
Angularity	`Angularity`
kT Delta R	`KtDR`
kT Mass drop	`Mu12`
Planar flow	`PlanarFlow`

Energy correlations	`ECF1`, `ECF2`, `ECF3`, `C2`, `D2`
Thrust	`ThrustMin`, `ThrustMaj`
FoxWolfram	`FoxWolfram0`, `FoxWolfram1`, `FoxWolfram2`, `FoxWolfram3`, `FoxWolfram4`
Sphericity	`Sphericity`, `Aplanarity`
Shower deconstruction	`ShowerDeconstructionW`, `ShowerDeconstructionTop`

In case you add other variables please do not use underscores.

Configuration

Parameter	Explanation
JetAlgos	name of the calo jet container
TrackJetAlgos	name of the track jet container
skipEvents	Skips the first n events of a run. (only for debugging)
configDataPath	Directory where all PRW config files, lumicalc files and the GRL are.
ghost-matching	If `false` track jets and calo jets are matched with the dR criterion.
dRCone	The dR parameter that is used in case ghost-matching is set to `false`.
prwConfig	Prefix to identify PRW config files.
CalibJetConfig	Config file for jet calibration of jets that are evaluated.
Jets	Type of the evaluated jet.
CalibSmallRConfig	Config file for jet calibration of smallR jets that are used for cleaning only, since no jet cleaning was available for largeR jets at that time.

This should produce several .root files with a TTree. The Tree holds all activated variables for the leading and the sub leading jet with 5 prefixes `c`, `t`, `tc1`, `tc2` and `tc3`.
These are referring to calo jet, track jet and the three variations that are applied to MC only.
`tc1` covers the track reconstruction efficiency (global, PP0 and IBL), efficiency for dense environment and impact parameter resolution (including dead modules).
`tc2` covers the fake rate.
`tc3` covers the sagitta bias. (negligible)

Plotting

After you have retrieved your outputs. You will most likely need to merge it in order to have one .root file per sample and one for data.
In `DeriveJMSR/` you should see a directory `plotting/` with: `atlasStyleMacro.py`, `atlasStyleMacro.pyc`, `functions.py`, `functions.pyc`, `HistoCreator.py`, `merge_jet1_jet2_doubleFiles.py`, `merge_jet1_jet2_inclusive.py`, `rTrack_plottingMaker.py` and =run_histo_creator.py= `run_histo_creator.py` calls `run_histo_creator.py` with the specified cuts. Usually you bin these double ratios in pT and m/pT. The binning in pT comes for free, while for each m/pT bin an additional output file is generated.
`HistoCreator.py` produces for each variable a 2D histogram with the simple ratio X_Calo/X_Track. As well as some 1D histograms to check the continuity of the pT spectrum.
`merge_jet1_jet2_inclusive.py` merges the output of `HistoCreator.py` for the leading and sub leading jet if you run inclusive in m/pT.
`merge_jet1_jet2_inclusive.py` merges the output of `HistoCreator.py` for the leading and sub leading jet.
`rTrack_plottingMaker.py` calculates the mean of the simple ratio per bin and produces the 1D histograms as control plots and the 2D maps, that are used as input for the calculation of uncertainties.

To run everything:

```
setupATLAS
lsetup root
python run_histo_creator.py
python merge_jet1_jet2_doubleFiles.py
```

```
python rTrack_plottingMaker.py
```

(run_histo_creator.py will take quite some time though.)

Settings

In `run_histo_creator.py`:
Choose if you like to run inclusive or binned in m/pT.
In `HistoCreator.py`:
To set the normalization (`sliceWeight_...`) you need to look up the cross section and the filter efficiency on ami.
The product is then divided by the total number of processed events for JZXW samples or by the sum of weights for JZX samples.
To add another generator put it in `types`. You need to add it as well in `QCD_weights` and in `files_dic` to avoid key errors.
New Variables can be added in `variables`. Here you specify the axis of the 2D histograms separated by a colon. (y-axis:x-axis)
In `bin_dic` you specify the binning of these histograms (#bins x-axis, start, end, #bins y-axis, start, end)
The binning of the x-axis for histograms ending with `/1e3` will be overwritten with values that are set in `binLowE` (bin edges).
In `rTrack_plottingMaker.py`:
In `filDic` you specify the input files. In `m_pt_s` you set the variables for which you would like produce maps.
With `pt_mass_vectors_nBins` you ensure that the inputs are filled in the right bins.
In `variables` you specify the variables for which you would like to see the control plots.
Other dictionaries specify layout and labeling of the plots.

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