Boost 2013 Report Title

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Abstract Abstract for BOOST2013 report

1 Introduction

Jet substructure has been around a while now, and it's
time to study the correlations between the plethora of
observables that have been developed and used. Previous BOOST reports [1,2,3] studied some of these things.

2 Monte Carlo Samples

Give details about how the samples we use have been
generated.

3 Jet Algorithms and Grooming Approaches

Describe the jet algorithms and grooming approaches
that we will use in the report. Give the nomenclature
that we will use to refer to e.g. the groomed mass in
the rest of the report.

4 Substructure Variables/Taggers

Describe the specific substructure variables and tagging approaches that we will be using in this report
e.g. n-subjettiness, Q-jets, HTT, JH tagger. Give the
nomenclature that we will use to refer to these variables/taggers in the rest of the report.

5 Boosted W-Tagging

In this section we study the performance of various jet
algorithms in combination with jet substructure variables/taggers in terms of the identification of a boosted
hadronically decaying W signal. For each jet algorithm
we produce Receiver Operating Characteristic (ROC)
curves that elucidate the performance of various variables that are capable of providing discrimination between a hadronic W signal and a QCD jet. These variables are then combined in a Boosted Decision Tree
(BDT) and the performance of the resulting BDT discriminant explored through ROC curves to understand
the degree to which variables are correlated and exploiting the same information. These studies are repeated in

different kinematic regimes, to explore both the performance and correlations as a function of the jet boost,
and where substructure approaches may break down.

5.1 Methodology

These studies use the $X \to WW$ samples as signal and
the XXX samples to model the QCD background.

Jets are reconstructed using the XXX jet algorithms
described in the previous section. The following event
selection is then applied to these samples....(presumably
this will vary depending on which kinematic bin is used,
as will the actual samples used - maybe summarize in
a table).

Show some basic distributions of the background
versus signal - groomed jet pT, groomed jet mass for
the different algorithms.

Go on to explain how we produce the ROC curves.

5.2 Performance at Moderate Boosts

(this section is to cover the W-tagging performance for
jet p_{T} 200-300 GeV and 500-600 GeV using $\sqrt{s} = 8$
TeV samples)

5.2.1 Single Variable Performance

Figure 1 shows the single variable ROC curves in the
p_{T} 500 GeV bin for the anti-k_{T} R=0.8 algorithm, compared to the ROC curve for a BDT combination of all
the variables. One can see that the best performant single variables for a reasonable signal efficiency are the
groomed/filtered masses, which all have a similar level
of performance with the exception of the soft drop mass
with $\beta = -1$. *Would be good to split this into two plots,
one using the masses and one for other variables, or
somehow make the mass and other variable curves more
distinct from one another by using same colour for all
the mass curves.*

We want to look also at:

- *Dependence on R. So have the same single variable
  ROC for e.g. R=1.2, R=0.4. Then possibly have another plot which compares the best single variable
  (e.g. groomed mass) for different R.*
- *Dependence on pT. Again want to repeat the plot for
  different kinematic bins, and then have a plot which
  compares the best performance in each kinematic bin
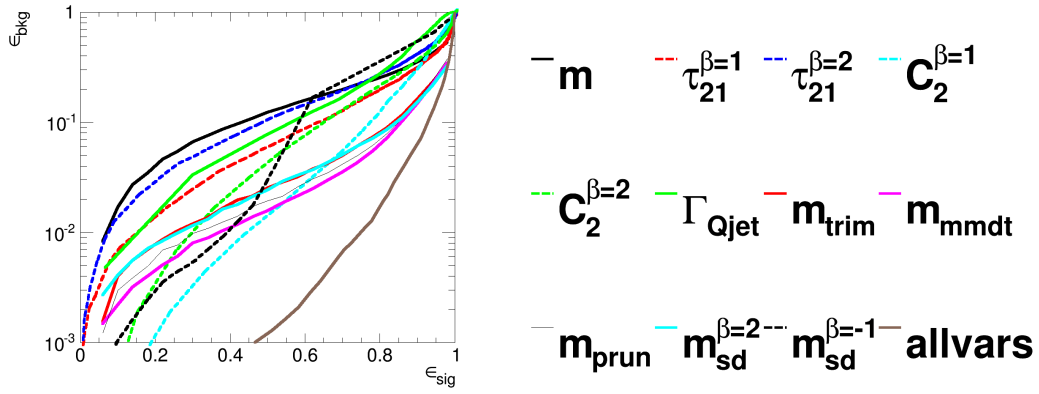 to see the dependence of performance on kinematics.*

Fig. 1 The ROC curve for all single variables considered for W tagging in the p_T 500 GeV bin using the anti-k_T R=0.8 algorithm.

5.2.2 Combined Performance

Figure 2 shows the BDT combinations of each mass variable with every other variable considered in the p_T 500 GeV bin using the anti-k_T R=0.8 algorithm. *Can we drop the combinations of mass + mass from these plots to make them clearer? Also would be good to put the single variable mass curve on these plots, so you can see how much improvement the combination gives, and the "all variables" curve.*

No combination with other variables can recover the poor performance of the ungroomed mass and the soft drop mass with $\beta = -1$. The other groomed/filtered masses are all most improved by combination with the $C_2^{\beta=1}$ energy correlation function. *Now show a plot which compares on one plot the best combined performance for each mass + X. e.g. mass + $C_2^{\beta=1}$, and compared also to the all variables curve. This plot is just for one R and one kinematic bin.*

Repeat these studies for different R and different kinematic bins. Finally make plots which compare best combined performance for different R and kinematics.

Do we want to look at other combinations of variables which don't involve mass? Practically I think we will always be making mass + X though.

5.3 Performance at High Boosts

(this section is to cover the W-tagging performance for jet p_T 1-1.1 TeV and > 1.5 TeV using $\sqrt{s} = 14$ TeV samples)

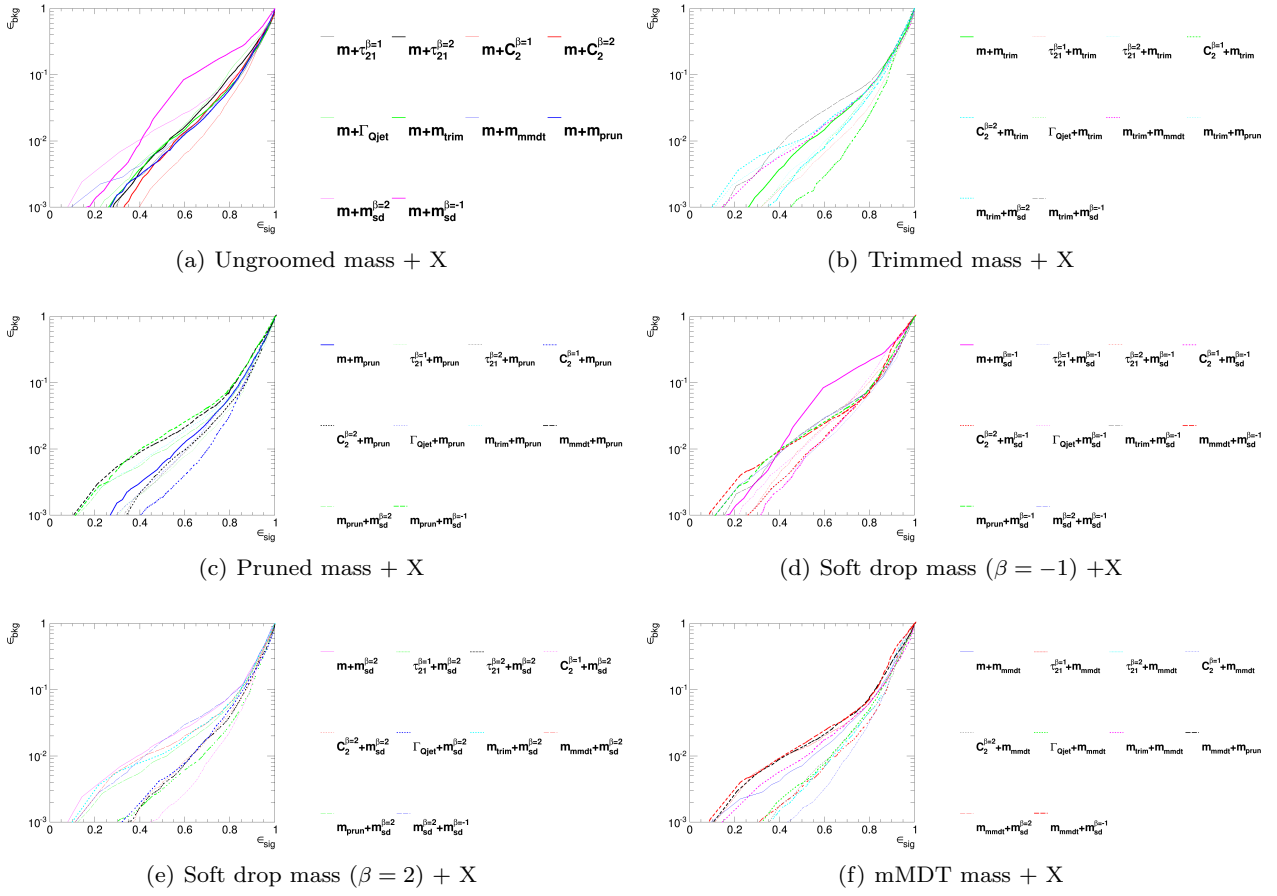*Maybe we don't need to divide into different medium/high boost sections.*

(a) Ungroomed mass + X

(b) Trimmed mass + X

(c) Pruned mass + X

(d) Soft drop mass ($\beta = -1$) +X

(e) Soft drop mass ($\beta = 2$) + X

(f) mMDT mass + X

Fig. 2 The BDT combinations of each mass variable with every other variable considered in the p_T 500 GeV bin using the anti-k_T R=0.8 algorithm.

6 Top Tagging

Top tagging studies go here.

7 Quark-Gluon Tagging

q/g tagging studies go here.

8 Summary & Conclusions

This report discussed the correlations between observables and looked forward to jet substructure at Run II of the LHC at 14 TeV center-of-mass collisions eneergies.

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