

BOOST 2016: 8th International Workshop on Boosted Object Phenomenology, Reconstruction and Searches in HEP



Contribution ID: 6

Type: not specified

Using wavelets for pile-up mitigation in hadron collisions

Wednesday 20 July 2016 09:50 (20 minutes)

Measuring inclusive quantities, both global (missing and sum transverse energy) and local (jet mass and sub-structure), after the high luminosity LHC upgrade will be extremely challenging, and will require new pile-up mitigation techniques that correct more than local jet energies. To this end, one can use the fact that pile-up has no angular structure while hard processes are characterised by small-angle emissions and are therefore highly sparse in the frequency domain. Using wavelet functions, intermediates between a standard pixel basis and a Fourier basis, which are localised in position ($y - \phi$) as well as frequency (angular) space, we can naturally and efficiently perform an event-wide classification of signal and pile-up particles by filtering in the frequency domain. In this talk, we will motivate the use of wavelets in high energy physics, describe the procedure behind a wavelet analysis, and present a few concrete methods and results. In particular, using a generator-level overlay of signal and pile-up events, we demonstrate that, using wavelet techniques, a significant improvement in e.g. $\tilde{\mu}$ missing transverse energy reconstruction may be possible even up to $\langle \mu \rangle$ of 300 or beyond.

Summary

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Session Classification: Plenary