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Using wavelets for pile-up mitigation in hadron collisions

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Measuring inclusive quantities, both global (missing and sum transverse energy) and local (jet mass and substructure), 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.˜missing transverse energy reconstruction may be possible even up to $\langle\mu\rangle$ of 300 or beyond.

Summary

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