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A novel image cleaning technique for the VERITAS telescopes

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In addition to capturing the Cherenkov signal triggered by extensive atmospheric showers, cameras from imaging atmospheric Cherenkov telescopes are also subject to signals from the night sky background and electronic noise. Image cleaning methods are employed to eliminate noise-contaminated pixels which do not have information regarding the shower. If not effectively removed, these noisy pixels can introduce significant bias effects during image parameterization. Conventionally, the Very Energetic Radiation Imaging Telescope Array System (VERITAS) employs the double-pass filtering method, in which a $5\sigma/2.5\sigma$ signal threshold is applied for core and neighbouring pixels, respectively.

I present the implementation of the Optimised Next Neighbour Image cleaning technique to the VERITAS reconstruction. Unlike the conventional method, cleaning cuts are determined in the parameter space composed of the minimum charge of a group of pixels and by the time difference in pulse arrival time within neighbouring pixels. With the novel technique, events with energy
$lesssim$ 100 - 300 GeV which were suppressed by the traditional method can now be reconstructed. I show that effective areas of the array increase by a factor of $\sim$ 3 below
$lesssim$ 100 GeV for a particular Monte Carlo configuration. In addition, I show that this method increases the excess counts below
$lesssim$ 100 GeV by a factor of $\sim$ 2.5 for a Crab Nebula dataset consisting of $>$ 300 hours. The validation of the Optimised Next Neighbour Image cleaning is realised by comparisons between Monte Carlo simulations and Crab Nebula data. A systematic error of 4\% below 1 TeV is found against 2\% with the double-pass method. In summary, the Optimised Next Neighbour Image cleaning has proven to be an effective approach for image-cleaning since it lowers the energy threshold of the array and increases gamma-ray rates in the GeV range, which is especially advantageous for sources presenting faint and soft spectra.

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