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WITHDRAWN - (G) Astrophysical foreground cleanup using non-local means

To create high-fidelity Cosmic Microwave Background (CMB) maps, current component separation methods rely on availability of information on different foreground components, usually through multi-band frequency coverage of the instrument. Internal linear combination (ILC) methods provide an unbiased estimators for CMB which are easy to implement, but component separation quality crucially depends on the signal to noise ratio of the input maps. We have implemented a non-linear filter which significally improves signal to noise ratio for astrophysical foreground maps, while having minimal signal attenuation. We develop an efficient non-linear filter along the lines of non-local means used in digital imaging research which is suitable (and fast enough) for application to full resolution Planck foreground maps, and evaluate its performance in map and spectral domains. Noise reduction is achieved by averaging "similar" pixels in the map. We construct the rotationally-invariant feature vector space and compute the similarity metric on it for the case of non-Gaussian signal contaminated by an additive Gaussian noise. The proposed filter has two tunable parameters, and with minimal tweaking achieves a factor of two improvement in signal to noise spectral density in Planck dust maps. A particularly desirable feature is that signal loss is extremely small in all cases, which we confirm both on noisy dust and high signal to noise CMB maps.

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