Single frequency CMB polarized foreground marginalization with a single training image

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Abstract

With a single simulated training image and using wavelet phase harmonic augmentation, I will present polarized Cosmic Microwave Background (CMB) marginalization in a high-dimensional likelihood-free (Bayesian) framework. We demonstrate robust foreground removal using only a single frequency of simulated BICEP-like data. Using Moment Networks we are able to estimate the pixel-level posterior probability for the underlying $\{E,B\}$ signal and validate the statistical model with a quantile-type test using the estimated marginal posterior moments. This work validates such an approach in the most difficult limiting case: pixel-level, noise-free, highly non-Gaussian dust foregrounds with a single training image at a single frequency. For a real CMB experiment, a small number of representative sky patches would provide the training data required for full cosmological inference. These results enable robust *likelihood-free*, simulation-based parameter and model inference for primordial B-mode detection using observed CMB polarization data.
Discussion: I will discuss this work as a problem that can only be solved with Machine Learning, but requires a Bayesian approach for principled cosmological inference. This work also raises general questions regarding data augmentation and posterior probability validation.

Slides: in PDF and keynote
Video: https://youtu.be/7BaN3pNfXS4

Keywords: Likelihood free inference, Bayesian, Simulation based inference, CMB, Augmentation

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