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Cosmological Information in Perturbative Forward Modeling

Friday, 8 November 2024 10:00 (40 minutes)

I discuss how well perturbative forward modeling can constrain cosmological parameters compared to conventional analyses. In perturbation theory the field-level posterior can be computed analytically in the limit of small noise. In the idealized case where the only relevant parameter for the nonlinear evolution is the nonlinear scale, I argue that information content in this posterior is the same as in the n-point correlation functions computed at the same perturbative order. In the real universe other parameters can be important, and there are possibly enhanced effects due to nonlinear interactions of long and short wavelength fluctuations that can either degrade the signal or increase covariance matrices. I discuss several different parameters that control these enhancements and show that for some shapes of the linear power spectrum they can be large. This leads to degradation of constraints in the standard analyses, even though the effects are not dramatic for a ΛCDM-like cosmology. The aforementioned long-short couplings do not affect the field-level inference which remains optimal. Finally, I show how in these examples calculation of the perturbative posterior motivates new estimators that are easier to implement in practice than the full forward modelling but lead to nearly optimal constraints on cosmological parameters.

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