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Optimal Transport Reconstruction of Baryon Acoustic Oscillations

We present a model-independent, weighted semi-discrete optimal transport algorithm to reconstruct the Lagrangian positions of proto-halos from their evolved Eulerian positions. Tests with state-of-art cosmological simulations show that the positions of proto-halos are reconstructed accurately, without having to assume a background cosmology. The algorithm, which makes use of a mass estimate of the biased tracers, but is robust to errors in this estimation, recovers the shape and amplitude of the initial pair correlation function of the tracers, enabling sub-percent precision in the BAO distance scale that is not tied to a cosmological model. In principle, our algorithm also allows direct and independent determinations of the bias factor and the smearing scale, potentially providing new methods for breaking the degeneracy between the bias factor b and σ_8.

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