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ABSTRACT

1. INTRODUCTION

2. METHOD

2.1. *3D Weak lensing*

Assuming a flat universe, the lensing convergence at redshift plane z_s is

$$\kappa(\vec{\theta},\chi_s)=\frac{3H_0^2\Omega_M}{2c^2}\int_0^{\chi_s}d\chi_l\frac{\chi_l\chi_{sl}}{\chi_s}(1+z_l)\delta(\chi_l\vec{\theta},\chi_l),\quad(1)$$

where c is the speed of light, z_l is the redshift evaluated at comoving distance χ_l. H_0 and Ω_M are the Hubble parameter and matter density parameter at redshift equals zero, respectively. $\delta(\vec{r})=\rho(\vec{r})/\bar{\rho}-1$ is the matter fluctuation.

The convergence field at redshift (κ) can be related to the shear field (γ) at the same redshift plane via a 2D convolution

$$\gamma(\vec{\theta},\chi_s)=\frac{1}{\pi}\int d^2\theta' D(\vec{\theta}-\vec{\theta}')\kappa(\vec{\theta}',\chi_s),\qquad(2)$$

where

$$D(\vec{\theta})=\frac{1}{(\theta_1-i\theta_2)^2}.\qquad(3)$$

The shear field (γ) is pixelized into N_{zs} tomographic bins γ^1,...,$\gamma^{N_{zs}}$ of size $N_{ys}\times N_{xs}$ where N_{ys} and N_{xs} are the number of pixels on the 2D transverse Cartesian coordinates. Similarly, the density contrast field (δ) to be reconstructed is also binned into $N_{zl}\times N_{yl}\times N_{xl}$ pixels. The discrete shear field and the discrete density contrast field can be viewed as finite size vectors γ_μ and δ_α. The measured shear is related to the matter density contrast by a 2D transverse convolution (equation (2)) and a 1D line-of-sight convolution (equation (1)), which can be expressed in a matrix notation

$$\gamma_\mu=\mathbf{P}_{\mu\nu}\mathbf{Q}_{\nu\alpha}\delta_\alpha+\epsilon_\mu,\qquad(4)$$

where $\mathbf{P}_{\mu\nu}$ represents the transverse convolution and $\mathbf{Q}_{\nu\alpha}$ represents the line-of-sight convolution and ϵ_μ represents measurement noise including the contributions of shape noise and pixel noise.

2.2. *Sparsity*

2.3. *Wavelets*

3. APPLICATION

3.1. *Mock shape catalog*

3.2. *HSC shape catalog*

4. SUMMARY