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Halo Occupation Distribution estimation for the upcoming LSST data

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The next generation of surveys, in particular the Rubin Observatory Legacy Survey of Space and Time (LSST), will enable high signal-to-noise measurements of galaxy clustering across a broad range of environments and cosmic scales. The halo occupation distribution (HOD) framework provides a powerful statistical link between galaxies and the dark matter structures and is key to testing galaxy formation models and constraining cosmology. Robust methods to estimate the HOD are therefore essential.
In this work, we evaluate the performance of an HOD estimation algorithm tailored for deep photometric surveys. We extend a halo-based group finder, originally designed to combine spectroscopic and photometric data, to operate using imaging data and photometric redshifts alone. Using a realistic mock galaxy survey from the cosmoDC2 catalogue, we implement a background subtraction technique to mitigate projection effects and apply an iterative centroiding method to improve group center identification.

We assess the method's ability to recover halo populations using completeness and purity metrics. Our results provide a quantitative benchmark for HOD reconstruction in LSST-like data, demonstrating the potential of photometric surveys to map halo population. This approach contributes to ongoing efforts to connect galaxy populations to their evolving large-scale environments in the era of multiwavelength survey synergy.

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