THE NEW ERA OF DNF

FROM LSST TO EUCLID VIA RAIL AND COSMOHUB

Toribio San Cipriano, L. & De Vicente, J.

MOTIVATION

Photometric redshifts (photo-z's) are essential for obtaining cosmological insights from extensive imaging surveys, such as LSST and Euclid. Among the various methods available, the Directional Neighborhood Fitting (DNF) algorithm has demonstrated its ability to provide accurate and reliable photo-z estimates, being a reference on Dark Energy Survey (DES) for several years.

Our goal is to bring DNF into a new era of large-scale cosmology, making it **more accessible** and reproducible.

DNF ALGORITHM

The Directional Neighborhood Fitting (DNF) algorithm is a nearest-neighbor method for photometric redshift (photo-z) estimation, developed at CIEMAT.

DNF models the local relationship between photometric observables (magnitudes or colors) and spectroscopic redshifts by computing the best-fit hyperplane within a galaxy's directional neighborhood in feature space.

This approach captures non-linear correlations providing accurate and robust photo-z estimates.

A full description of the method can be found in De Vicente et al. 2016, MNRAS, 459, 3078.

ACCESSIBILITY

DNF PERFORMANCE WITHIN RAIL

RAIL is an open-source framework developed by the LSST Dark Energy Science Collaboration (DESC) to provide a unified, scalable environment for training, evaluating, and applying photometric-redshift algorithms.

It standardizes data input/output, metrics, and workflows, enabling fair comparisons among methods under LSST-like conditions.

DNF has been fully implemented within RAIL, allowing its integration into LSST pipelines and large-scale validation experiments.

Recent benchmarking in the RAIL DP1 study (Zhang et al. 2025, arXiv:2510.07370) shows that DNF:

- Achieves bias < 0.005 and scatter < 0.1, satisfying LSST Y1 requirements.
- Performs among the top ML-based algorithms, with tight scatter and low outlier rates.
- Shows the lowest bias and scatter at high redshift.

Within RAIL, DNF demonstrates accuracy, stability, and readiness for LSST-scale cosmology.
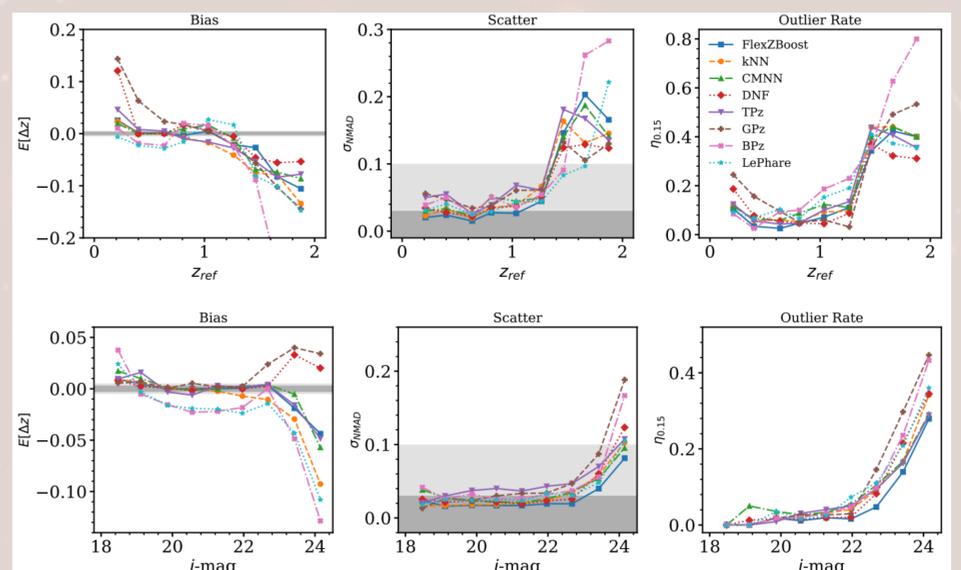
Zhang et al. 2025, arXiv:2510.07370

GITHUB AND COSMOHUB

The **DNF is publicly available through GitHub**, allowing full transparency and reproducibility.

Moreover, CosmoHub is an interactive web platform for cosmological data access, visualization, and analysis hosted at the Port d'Informació Científica (PIC). **DNF is now integrated within CosmoHub**, enabling users to compute photometric redshifts directly from survey catalogs like Euclid.

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