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Aligning the photometric and spectroscopic redshift space with domain adaptation

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Neural networks have achieved remarkable success in the estimation of photometric redshifts. However, their effectiveness is significantly
compromised by the presence of sample bias in the training datasets. These networks are predominantly trained on galaxies
with spectroscopically confirmed redshifts, using these observations as proxies for the actual redshift values. This approach introduces
a selection bias, as spectroscopic samples capture only a fraction of the diverse galaxy population observed in wide-field survey data.
In this study, we discuss the application of domain adaptation techniques to enhance the accuracy of photometric redshift predictions
for wide-field observations. Domain adaptation aims to uncover and align latent features common to both the source (spectroscopic)
and target (wide-field) domains, minimizing discrepancies in their feature distributions. Our investigation uses the Euclid-like wide survey
dataset from the photo-z challenge in Euclid Collaboration et al. 2020, to test the impact of domain adaptation. We observe a
reduction in the photo-z scatter by approximately 15 percent at the faint end ($i > 24$), where the spectroscopic data are notably scarce.
Domain adaptation also demonstrably enhances photo-z predictions in regions of the color space that are underrepresented by the
spectroscopic sample. Additionally, our methodology facilitates the prediction of the probability distribution of photometric redshifts
enabling the implementation of quality cuts for the final photo-z estimates.

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