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Galaxy redshift estimations with transfer and multi-task learning

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Dark energy has ushered in a golden age of astronomical galaxy surveys, allowing for the meticulous mapping of galaxy distributions to constrain models of dark energy and dark matter. The majority of these surveys rely on measuring galaxy redshifts through a limited set of observations in broad optical bands. While determining redshift is theoretically a straightforward machine learning problem, the practical challenge lies in the constraint of a small selected training sample, coming from spectroscopic surveys.

This challenge is particularly pronounced in the context of the PAUS survey, a 40 narrowband survey, which seeks to enhance the precision of photometric redshifts by an order of magnitude. In this study, we present a novel approach to address this limitation by leveraging transfer learning from simulations. While increasing the overall number and galaxy types, the challenge is a calibration mismatch between observed and simulated data. Different training methods are developed to address this issue.

Additionally, the Euclid satellite is engaged in an extensive sky survey, covering a significantly larger area compared to the relatively small sub area encompassed by PAUS. The weak lensing measurements require a tight control of the photo-z bias. Multi-task learning is a technique to improve neural network training from simultaneously solving multiple tasks, which is a general approach that can be applied to a wide range of problems. Employing multi-task learning and predicting both Euclid photo-z and corresponding PAUS observations, we have developed an innovative method to enhance Euclid photo-z accuracy. With this method we improve the results, but it's not completely intuitive how it works. Here, we delve into the underlying mechanisms responsible for these improvements.

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Session Classification: 4.1 Pattern recognition, Image analysis & Uncertainty quantification

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