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Redshift estimation using machine learning and photometric probability evaluation through K-d tree.

Spectroscopic redshifts (z) are obtained through the spectra of astronomical objects, this process is time-consuming, expensive, and frequently impossible for large numbers of galaxies due to telescope time limitations. Thus, in order to find this parameter z, in this work, we use the photometry of galaxies to determine this same quantity. Photometric redshifts can be evaluated through the empirical method which is using machine learning and data analysis. In our work, we used a sample of accurate spectroscopic information from the VIMOS Public Extragalactic Redshift Survey (VIPERS) that mapped the distribution of about 60,000 galaxies at 0.5<z<1.2$ as the training set to estimate the photometric redshift of almost 700 million galaxies from the Dark Energy Survey (DES). We used three machine learning methods: the Artificial Neural Network for photometric redshifts (ANNz2), the Gaussian processes for photometric redshifts (GPz), and a code written by us using a deep learning application programming interface written in Python called Keras. However, DES galaxies are not a representative set from VIPERS, so the estimated redshift of some of the galaxies would not be precise at all. In order to identify such galaxies, we used a space-partitioning data structure (K-d tree) to divide the galaxies along with the k-nearest neighbors algorithm. Consequently, we were able to evaluate the probability of each DES galaxy being photometric similar to the VIPERS galaxies.

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