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Target Selection for a redshift limited survey with Machine Learning

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The WAVES survey of the upcoming multi object spectroscopy facility, 4MOST, has a key science goal of probing the halo mass function to fainter magnitudes as compared to previous surveys like GAMA. This objective, along with constraints on fibre-hour availability, shapes the criteria for selecting galaxies to be observed by WAVES, categorised into two sub-surveys: “”wide”” and “”deep””. The surveys will be both flux-limited and redshift limited. The WAVES-wide survey intends to target ≈ 0.9 million galaxies with Z band (central wavelength 0.88 μm) magnitude Z ⊠ 21.1 mag and a redshift z ⊠ 0.2. For the WAVES-deep, the conditions are Z ⊠ 21.25 mag and z ⊠ 0.8. The selection of galaxies with desired completeness for spectroscopic redshift measurements without a prior idea of the redshift is challenging. The general solution to such a problem is the photometric redshift estimation using the magnitude and color measurements of the target. However, such estimates typically have errors of σz ⊠ 0.02 which might be too large for efficient target selection.
Our research intends to use machine learning classification to predict the probability of a source falling within the redshift limit as required by the WAVES survey, rather than estimate each object’s photometric redshift. This way, each potential target will have a probability attached that it lies below the required redshift threshold, which will help optimise the survey planning. We use supervised machine learning algorithms such as xg boost, our data being ugriZYJHKs broad-band photometry from KiDS+VIKING, as well as ancillary VST+VISTA observations. The redshift label for calibration is derived from an extensive sample of spectroscopic redshifts including wide-angle and deep surveys overlapping with KiDS and the ancillary fields. Our current results indicate that we should be able to achieve the completeness of 90% of the targets with our methodology which is close to the survey success criteria.

Presenter: KAUR, Gursharanjit

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