Contribution ID: **722** Type: **Talk in the parallel session**

Deep Learning in Searching the Spectroscopic Redshift of Quasars

Wednesday, 7 July 2021 06:30 (20 minutes)

Study the cosmological sources at their cosmological rest-frames are crucial in order to track the cosmic history and properties of the compact objects. In view of increasing data volume of existing and upcoming telescopes/detectors we here apply the 1−dimensional convolutional neural network (CNN) to estimate the redshift of quasars in Sloan Digital Sky Survey IV (SDSS-IV) catalog from DR16 quasar-only (DR16Q) of eBOSS on a broad range of signal-to-noise ratios. The CNN takes the flux of the quasars as an 1−dimensional array and their redshift as labels. We compare and contrast our results and the configuration of our network with the existing CNNs both for spectroscopic and photometric redshift predictions for the similar training samples. The accuracy of our CNN in predicting redshift in the range of $0 \leq$~z~≤ 5.45 is 98.3% for the velocity difference for redshift, $|\Delta\nu| < 6000$ km/s and 99.4% for $|\Delta\nu| < 12000$ km/s. For spectroscopic redshift prediction by QuasarNet, which utilizes a CNN to identify at least two emission lines in the quasar's spectra, the accuracy is 99.8% for both $|\Delta\nu| < 6000$ km/s and $|\Delta\nu| < 12000$ km/s. Finally, we show that, thanks to multiple convolutional layers, with different kernel sizes in order to search for both the \textit{global} and \textit{local} patterns in the flux, our CNN provides a prediction as accurate as the one of QuasarNet even by masking the prominent emission lines present in spectra.

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Session Classification: Machine Learning in Astronomy: AGN, Transient Events, Cosmology and Others

Track Classification: Active Galactic Nuclei: Machine learning in astronomy: AGN, transient events, cosmology and others