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Multi-frequency variabilities: blazar classification and statistical properties

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Blazars are a class of active galactic nuclei whose jets are aligned with the observer's line of sight. They are powerful multi-frequency emitters that exhibit rapid and violent variation. Based on optical emission lines, blazars are classified into two subclasses which are BL Lacertae objects (BL Lacs), and flat spectrum radio quasars (FSRQs). Various studies have shown that besides using emission lines, it is possible to use blazar variability to classify blazars into the aforementioned subclasses. We are investigating the use of blazar variability for blazar classification by using it as inputs in machine learning algorithms. In this work, we use the 5th edition of the Roma-BZCAT catalog as a reference. Optical and radio light curves are taken from 3 facilities, namely, Zwicky Transient Facility (ZTF), Gravitational-wave Optical Transient Observer (GOTO), and Owen Valley Radio Observatory (OVRO), observed during 2019-2020. From the data, we study the statistics of blazars variability which in turn are used to inform features extraction for machine learning. We will report on the results of the study, challenges, future opportunities, and discuss the classification performance. There are 766 BL Lacs and 1288 FSRQs in the analysis, each of which has at least 10 data points in both g and r band of the ZTF data. The light curves from the entire observation period are used to find the relation between g-r color evolution and the fractional variability in the r band. The pearson correlation of the relation is 0.73, while the spearman correlation is 0.76. The correlation values suggest that when blazars are more active in the g band, the variabilities in the r band tend to be less.

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