
Considerations for optimizing photometric classification of supernovae from the Rubin Observatory

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Abstract

Survey telescopes such as the Vera C. Rubin Observatory will increase the number of observed supernovae (SNe) by an order of magnitude; however, it is impossible to spectroscopically confirm the class for all the SNe discovered. Thus, photometric classification is crucial but its accuracy depends on the not-yet-finalized observing strategy of Rubin Observatory's Legacy Survey of Space and Time (LSST). We quantitatively analyze the impact of the LSST observing strategy on SNe classification using simulated multi-band light curves from the Photometric LSST Astronomical Time-Series Classification Challenge (PLAsTiCC). First, we augment the simulated training set to be representative of the photometric redshift distribution per supernovae class, the cadence of observations, and the flux uncertainty distribution of the test set. Then we build a classifier using the photometric transient classification library `snmachine`, based on wavelet features obtained from Gaussian process fits, yielding similar performance to the winning PLAsTiCC entry. We study the classification performance for SNe with different properties within a single simulated observing strategy. We find that season length is important, with light curves of 150 days yielding the highest performance. Cadence is also crucial for SNe classification; events with median inter-night gap < 3.5 days yield higher classification performance. Interestingly, we find that large gaps (> 10 days) in light curve observations do not impact performance if sufficient observations are available on either side, due to the effectiveness of the Gaussian process interpolation. This analysis is the first exploration of the impact of observing strategy on photometric supernova classification with LSST.

Keywords: Cosmology, Supernovae, software, Classification, Light curve classification, Astronomy data analysis, Open source software, Astronomy software

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