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Machine learning classification of baseband data of CHIME FRBs

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Fast Radio Bursts (FRBs) are enigmatic astrophysical phenomena that manifest as millisecond radio pulses. While the origin of FRBs is still unknown, observations confirm that some FRBs repeat and some do not apparently. In addition to the repetition nature, repeaters are known to show distinct physical properties from non-repeaters: broader pulses with narrower bandwidths for repeaters compared with non-repeaters. This might suggest different origins of these two types, indicating the importance of accurate classification of FRBs. However, the limited capability of the current radio telescopes causes difficulties in long monitoring of FRBs continuously to identify repeating FRBs. In addition, due to the limited telescope sensitivity, some faint repeating FRBs are missed, and hence, they could be misclassified as non-repeaters. The potential misclassified FRBs are known as repeater candidates. Since it is difficult to monitor all FRBs continuously, an alternative approach to the classification has been awaited. To overcome these issues, researchers have identified machine learning as a useful method to address these misclassified non-repeaters. In previous studies, researchers subjected CHIME/FRB catalogue 1 for machine learning using uniform manifold approximation and projection (UMAP). They have reported 188 repeater candidates out of 474 non-repeater in CHIME/FRB catalogue 1. In this work, we use CHIME/FRB baseband 1 catalogue which has significantly improved the positional accuracy (~10 arcsec for the best case) and time resolution of 140 FRBs from CHIME/FRB catalog 1. This improvement leads to more accurate measurements of fluence (only upper limits on fluences for CHIME cat1 while measured fluences for baseband data), duration, and position, etc. compared with the 1st CHIME/FRB catalogue that is used for previous machine learning studies. This enhanced dataset provides a valuable opportunity to refine the classification of FRBs and potentially validate previous findings. Therefore, The main object of our work is as follows: i) To assess the consistency of repeater candidate identification with previous work. ii) To identify new repeater candidates. iii) relationship between the current and previous results. We found 15 repeater candidate signals from 122 non-repeating sources of CHIME baseband catalogue. Among them 14 candidates are reported as candidates in the previous machine learning study, and another 1 new candidate identified in our work. The main objective of our work was achieved successfully. Furthermore, one of our repeater candidates has been confirmed as a repeater by the CHIME/FRB Collaboration.

Section

Galaxy/Extragalactic

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