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ML Methods For Space Debris Detection in Bistatic Radar Data

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Over the last half-century, the exponential increase of satellite launches has led to a significantly large population of debris objects in Earth's orbit, particularly in the Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO) regimes. Their subsequent detection and monitoring have thus become ever more pertinent, with facilities such as the BIstatic RAdar for LEo Survey (BIRALES) space debris radar regularly used for detecting new NORAD objects and tracking confirmed bodies in the LEO regime. The current detection pipeline installed at BIRALES employs a Multi-beam streak detection strategy (MSDS) algorithm to identify and segment radar streaks in spectrogram data indicative of debris objects. It achieves 90% recall of the track information at a 2dB signal-to-noise ratio (SNR). However, the MSDS's relatively slow computation time will pose a problem once BIRALES is scaled to a larger array. We aim to leverage the power of machine learning to develop a streak detection and segmentation model able to improve on the performance seen by the MSDS algorithm, both in terms of the recall and false positive rates, as well as being able to maintain a level of solid performance at lower SNR levels. The preliminary tests we will present here focus on applying a shortlist of ML streak segmentation and localisation model architectures on BIRALES observational data and comparing their performance with the MSDS.

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