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Towards foundation model for astrophysical source detection: An End-to-End Gamma-Ray Data Analysis Pipeline Using Deep Learning

The increasing volume of gamma-ray data from space-borne telescopes, like *Fermi*-LAT, and the upcoming ground-based telescopes, like the Cherenkov Telescope Array Observatory (CTAO), presents us with both opportunities and challenges. Traditional analysis methods based on likelihood analysis are often used for gamma-ray source detection and further characterization tasks. A key challenge to analysing data from these telescopes arises due to background contamination; consistent of interstellar emission for *Fermi*-LAT and cosmic ray background for CTAO data, which obscures the faint source population.
Here we will present our results from an end-to-end Deep Learning (DL) based pipeline for detection, localization and further characterization tasks of gamma-ray sources. We extend our AutoSourceID (ASID) pipeline, a DL-based pipeline initially tested with Fermi-LAT simulated data and optical data (MeerLICHT), to include results for CTAO simulated data for Galactic Plane Survey (GPS) observation. We will also present a preprocessing step designed with Deep Neural Net for denoising tasks which can potentially decrease the source detection threshold. Training on data from different telescopes to capture a broad representational space of the gamma-ray sky, this end-to-end pipeline - from denoising to detection and characterization - could potentially serve as a foundational model for gamma-ray astronomy by offering a generalizable framework for other surveys.

AI keywords

Deep Neural Nets; Pattern Identification; Foundational Model

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Track Classification: Foundation Models