Optimizing neural network techniques in classifyingFermi-LAT-ray sources.

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This study is the follow on of a first study (B-FlaP) applied to 3FGL catalog (https://arxiv.org/pdf/1607.07822.pdf / https://arxiv.org/abs/1705.09832/arXiv:1808.05881)

Machine learning is an automatic technique that is revolutionizing the scientific research with innovative applications and the Artificial Neural Networks (ANN) is a powerful machine

learning method widely use in astrophysics. In ten years of operation Fermi detected more than 5000 gamma-ray sources but the number of uncertain sources has exceeded 50% of the detected sources.

ANN algorithms were applied to classify Fermi uncertain sources when strict classifications were not available significantly improving the number of classified objects.

In the **first step** of this study we optimized the precision and effectiveness of an ANN machine learning method. **CAT III paper was submitted to MNRAS** (ann_v5_MNRAS.pdf) .

EbandFluxes.pdf -

An interesting set of parameters that we considered was the time integrated fluxes in different energy bands. This set of parameters contains information of average spectral index, hardness ratio and peak energy. We considered five different energy bands : 100-300 MeV, 300-1000 MeV, 1-3 GeV, 3-10 GeV, 10-100 GeV. It is interesting to note that in the range of flux ~ 10^-10 and energy bands from 100-300 MeV up to 1-3 GeV mostly BLLs are present while for energy band 10-100 GeV FSRQs are more numerous for the lower values of fluxes, around ~10^-15. It is also notable that majority of BLLs and FSRQs have different slopes across all energy bands

SrvsX.pdf

3FGL BLLacs and FSRQs radio flow / X-ray flux ratio histogram. A BLL clean area is distinguished by ratio values minor than 4 x 10^13. We used also this parameter to optimize the algorithm

Using the optimized version of the original algorithm the selecting performance improved of 79 %. The final result of this study applying the algorithm to 3FGL BCUs left 16 uncertain blazar sources instead of 77 in https://arxiv.org/abs/1607.07822

In the **second step** we will apply the ANN algorithm to 4FGL BCUs and AGN - like sources selected from unassociated gamma-ray sources. TeV candidates selection for IACTs observation will complete this study.

The information above is mostly old.

The paper has been published on Oct. 2019 in MNRAS. All the details are in the paper. The Pubboard link: https://www-glast.stanford.edu/cgi-prot/pub_download?id=1677