Improving the Hydra Classifier for Data Acquisition at GlueX

Manav Bilakhia[1] (Student), Colin Gleason[1] (Advisor), Matthew Anderson[1] (Advisor), Thomas Britton[2] (Advisor), Torri Jeske(Advisor)[2]

[1]Union College, Schenectady, [2]Thomas Jefferson National Accelerator Facility

GlueX and Hydra

- GlueX studies QCD by searching for exotic mesons[1]
- Hydra is an extensible framework for training, managing, and evaluating AI
- Hydra aims to aid and support shift crew with identifying data anomalies
- Approximately 5 TB in 3 hours

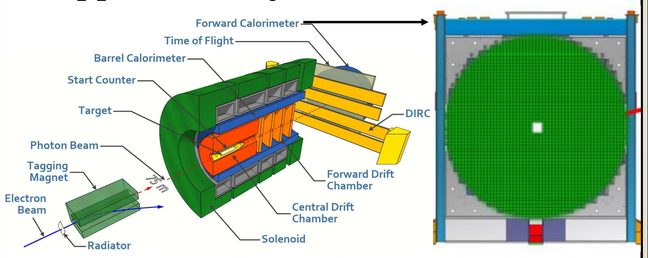


Figure 1: the GlueX detector (Left). The FCAL Sub-Detector (Right)

- Electronics in the FCAL:
  - 2,800 channels
  - Up to 16 channels in a fADC
  - Up to 18 fADCs in a DAQ Crate
  - A total of 12 DAQ crates in the detector
- FCAL's Hydra model has five different labels, two of which are 'Good' and 'Bad'[4]
- Extend the "Bad" category for the FCAL such that Hydra can tell which fADC or DAQ crate is broken
- Failure modes are easily visible in the occupancy plot

Examples of Good and Bad Plots

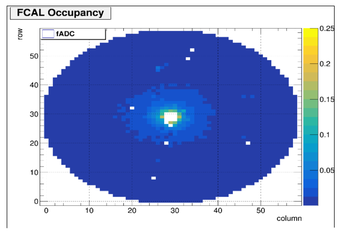


Figure 2(a): Good

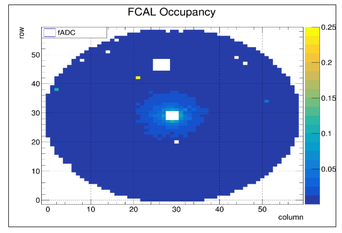


Figure 2(b): BAD fADC12_13

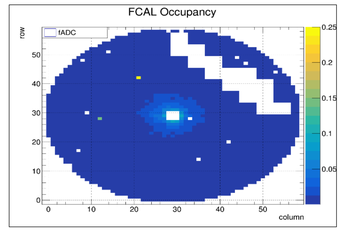


Figure 2(c): Bad Crate_17

Research Questions

- Can our model recognize these plots that have broken electronics as bad? (Experiment 1)
- Can we develop a non-machine learning algorithm that can be used to identify what subcategory of bad the image falls under? (Experiment 2)

Problem: Imbalanced Dataset, Solution: The Knockout Plugin

- The Knockout plugin uses old runs to emulate a missing electronic component
- Can Hydra learn that this is a bad image? (Exp 1)

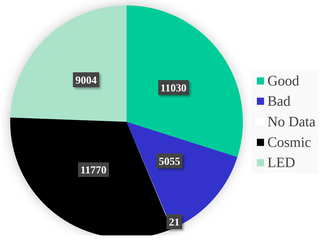
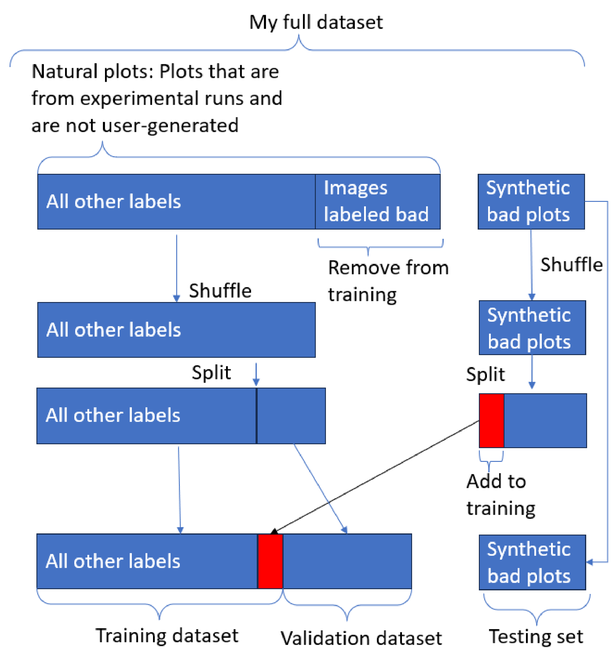
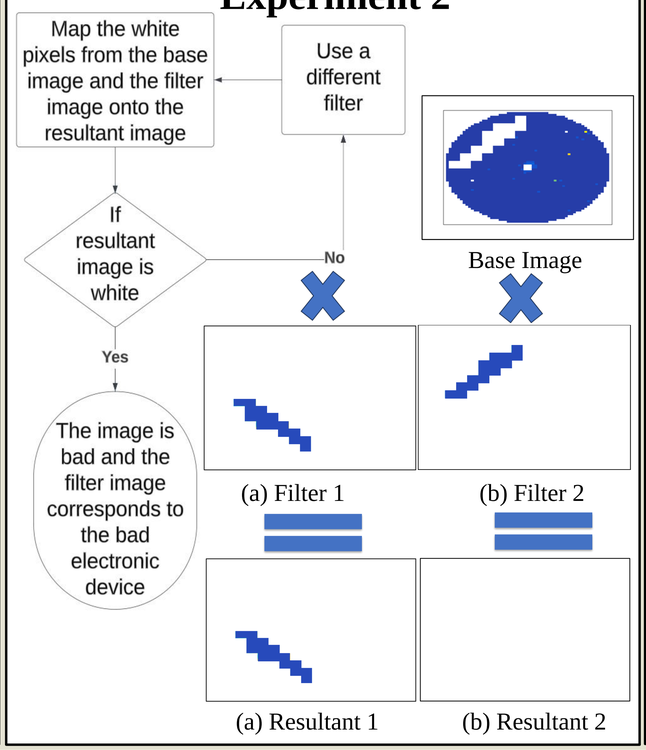


Figure 3: Plot classifications

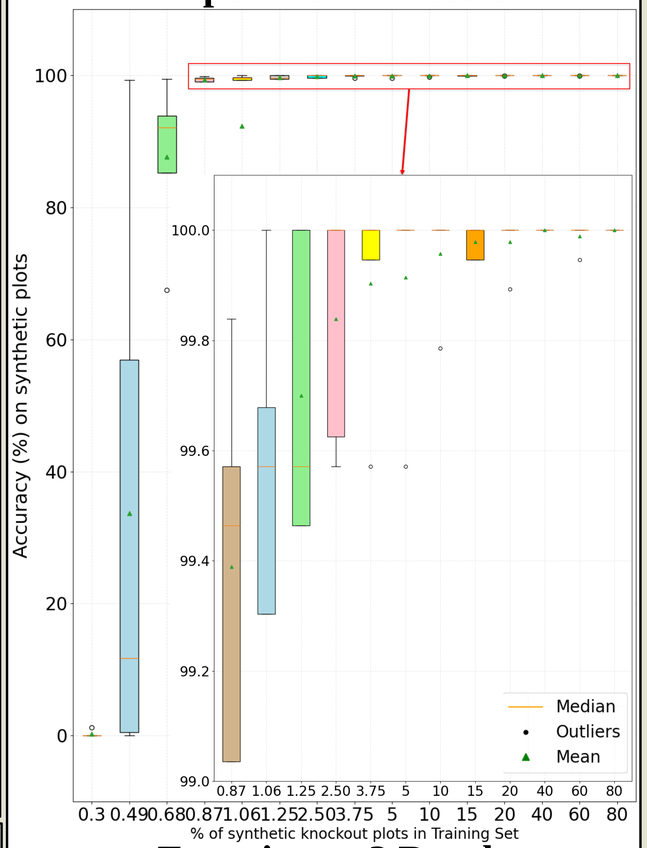
Experiment 1



Experiment 2



Experiment 1 Results



Experiment 2 Results

	Algorithm Good	Algorithm Bad
Good	11030	0
Bad	1275 → Effectively 0	5646

- Perform K-fold Cross-Validation (Experiment 1)
- Add more filters to experiment 2
- Add >1% of synthetic bad plots in Hydra's training set
- When Hydra flags a plot as bad, run it as the base image in Exp 2

GlueX Acknowledgements: gluex.org/thanks

Acknowledgments and References