

Monitoring Plot Anomaly **Detection With Hydra** Thomas Britton (tbritton@jlab.org) David Lawrence (davidl@jlab.org) Kishansingh Rajput (kishan@jlab.org)



The Challenge

- Every run produces an initial 22 plots. More thorough monitoring is performed offline and produces 109 plots. With a run lasting ~3 hours every day there are between ~175 and 875 plots to look at.
 - To preserve sanity I looked at closer to 175 plots a day, but there is no reason a machine couldn't aid in looking at all of them...
- Often times a single plot being "off" is not an indication of problems. Need to look at all the plots to determine cause and severity
 - <u>Trigger studies</u>: Often look like big problems but are not. Can be hard to catch when shift logs have scant details





Introducing Hydra

7/26/21

- Hydra aims to be an extensible framework for training and managing A.I. for near real time monitoring
 - If you need it to tell a dog from cat
 I can have hydra do that, without
 system modification, now

U.S. DEPARTMENT OF

 Most importantly, Hydra allows me to embrace my inner sloth:



Koboldpress.com



Hydra Fast Facts

- Hydra looks at a finer time scale then any higher level monitoring the shift crew performs. Approximately every minute
 - Because who hits reset?
- Operates (conservatively) at about 3-4Hz
 - From receiving an image to action ~300ms. Most of the time spent on model inference
 - Inference accounts for ~71% of the total processing time and is driven primarily by model size (
- Currently focused on **go/no-go decisions**

ENERGY

Doctor classifying you as sick with no diagnosis as to what you are sick with. Refinement underway

HydraRun also saw the FDC problem, which I probably would have missed inspecting it by eye.



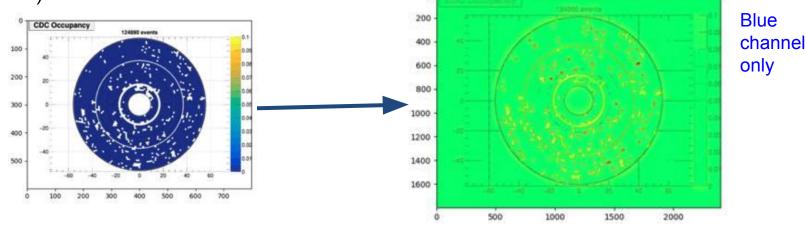
Koboldpress.com



7/26/21

Layer-wise Relavance Propagation

- Better than knowing that an image is "Bad" is knowing <u>why</u> it is bad
 - Layer-wise Relevance Propagation (LRP) takes the output vector and 'back-propagates' it through a model to the input pixels' weights
 - Whether a given contributes to (+) or detracts from (-) from a label
 - Has the negative of being channel dependent (e.g. is it the redness of a pixel or...?)





U.S. DEPARTMENT OF

Hydra Future Development

Classification splitting

- From a doctor saying "you are sick" to actually diagnosing a condition
- Custom, optimized models
 - Inference accounts for ~71% of the total processing time and is driven primarily by model size
- Ability to actually **take corrective action** as needed
 - Will require trust and more data on in situ running
- More plot types!!
 - Data types too





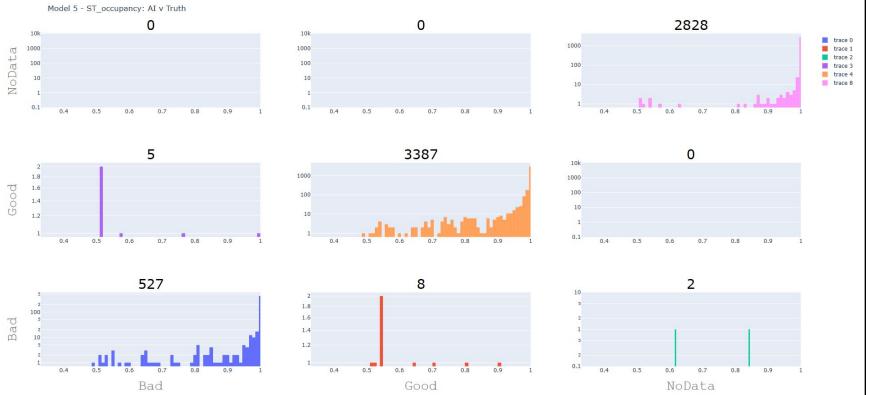


Backup Slides





Preliminary Results (Start Counter)





6/16/20

8



Preliminary Results (FCAL)

@ Q+[] P D D X # 1 = = 🖬





6/16/20 9



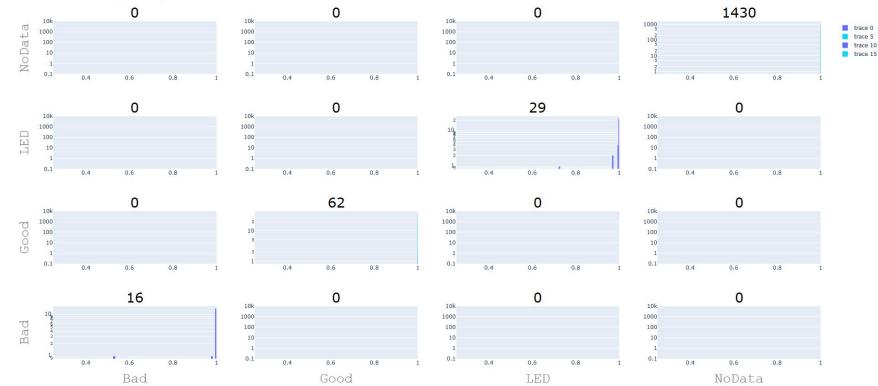
Preliminary Results (DIRC)

Model 7 - DIRC_occupancy: AI v Truth

U.S. DEPARTMENT OF

(d)

CJSA





Preliminary Results (BCAL)

Model 11 - BCAL occupancy: AI v Truth 2951 0 0 0 0 10k 10k 10k 10k NoData 1000 1000 1000 1000 1000 trace 0 100 100 100 100 100 trace : 10 10 10 10 trace 2 1Q 1 1 1 1 trace : 0.1 0.1 0.1 0.1 trace (0.4 0.6 0.8 0.4 0.6 0.8 0.4 0.6 0.8 0.4 0.6 0.8 0.2 0.4 0.6 0.8 trace 12 HotChannel trace 13 445 0 0 7 0 trace 17 10k 10k 10k trace 18 1000 1000 1000 100 trace 24 100 100 100 10 10 10 10 1 1 1 0.1 0.1.2 0.1 0.1.2 0.4 0.8 0.4 0.6 0.4 0.6 0.8 0.2 0.4 0.6 0.8 0.4 0.6 0.8 2109 0 0 0 4 10k 10k 10 10k Good 1000 1000 1000 1000 100 100 100 100 10 10 10 10 1 1 1 0.1.2 0.1 0.1 0.1 0.4 0.6 0.8 0.4 0.6 0.8 0.2 0.4 0.6 0.8 0.4 0.6 0.8 0.4 0.6 0.8 237 0 0 0 0 U 10k 10k 10k 10k Cosmic 100 1000 1000 1000 1000 100 100 100 100 10 10 10 10 1 1 1 1 0.1.2 0.1.2 0.1.2 0.1.2 0.4 0.6 0.8 0.4 0.6 0.8 0.2 0.4 0.6 0.8 0.4 0.6 0.8 0.4 0.6 0.8 876 3 0 1000 10 10k 1000 Bad 100 100 10 10 1 0.1.2 . . 0.1 0.1 0.1 0.2 0.4 0.6 0.8 0.4 0.8 0.4 0.4 0.6 0.8 0.4 0.6 0.8 0.6 0.8 Cosmic HotChannel Bad Good NoData



6/16/20 11

U.S. DEPARTMENT OF

CJSA

Preliminary Results (FDC)

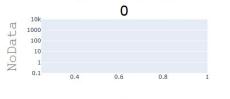
1000

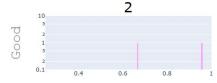
100

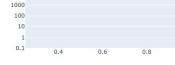
10

0.4

Model 16 - FDC_occupancy: AI v Truth







10k

10k

1000

100

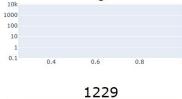
10

0.1

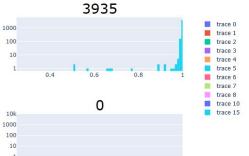
0.4

0

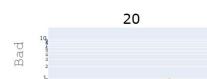
0



0



0.8



0.4

U.S. DEPARTMENT OF



0.6

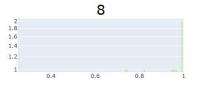
0.8



0.6 0.8

0.1

0.4



0.6



0.6

SJSA

0.8









6/16/20 12

Preliminary Results (TOF)

10k

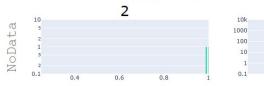
1000

100

10

0.4

Model 20 - TOF occupancy: AI v Truth

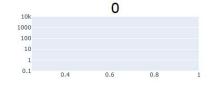


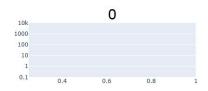
0

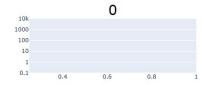
0.6

0.8

CJSA

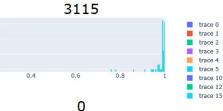


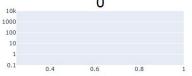




7705

0.8





1000

100

10



0.4

10k

1000

100

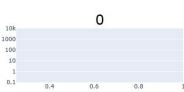
10

1

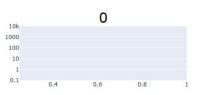
0.1

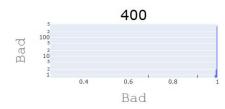
Good



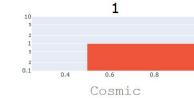


0.6

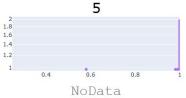




U.S. DEPARTMENT OF









6/16/20

13