

Computer Vision for Data Quality Monitoring

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Introducing Hydra

- 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

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

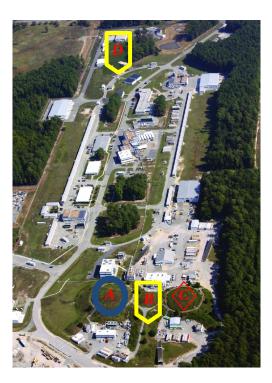


Koboldpress.com



Deployed site wide

- Instance of Hydra deployed in <u>all</u> <u>halls</u>
 - Fully in B and D
 - In A but not being fully utilized
 - Technically in Hall-C
 - Working to make its adoption more green-field







Challenges

• Differing protocols

- Not everyone is set up to provide images, or in the granularity required
- Differences in scale
 - GlueX has about a dozen plots.
 CLAS has 81
- Requires some degree of buy-in from disparate groups







Back End

11/28/23

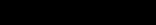
- Hydra is supported by a MySQL database which holds both training data and operational data
- Model configurations are also stored/read from the database
- Saves a snapshot of every inference and training

 A whole host of data to analyze and utilize

CJSA

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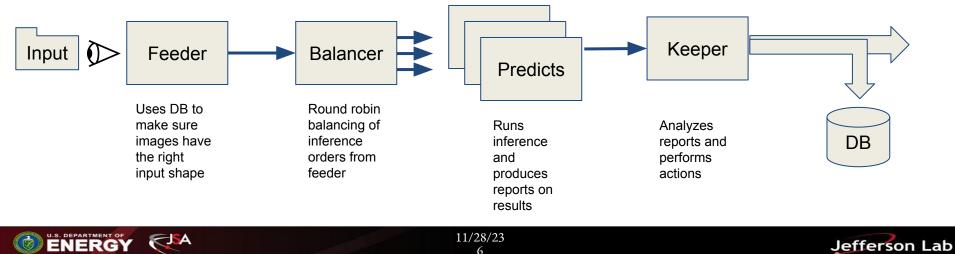




Hydra System

- Parasitic to normal operations
 Meant to <u>aid</u> not replace!
- Feed images into the input directory and Hydra handles the rest

Messages passed via 0MQ allowing for more distributed deployment



Self-sustaining

11/28/23

- The goal is to provide a system which is more or less self-sustaining
 - Further Education

ENERGY

- Unbiased, configurable, sampling
- Unconfirmed, Bad examples
- How is a model performing?
 If labeling is up-to-date we can leverage the unbiased selection to compute a trailing accuracy





Self-sustaining cont.

- Possible to trigger retrainings based on changes in the running accuracy
 Other conditions?
- Developing methods to enable better administration of the Hydra system
 Monitoring Hydra

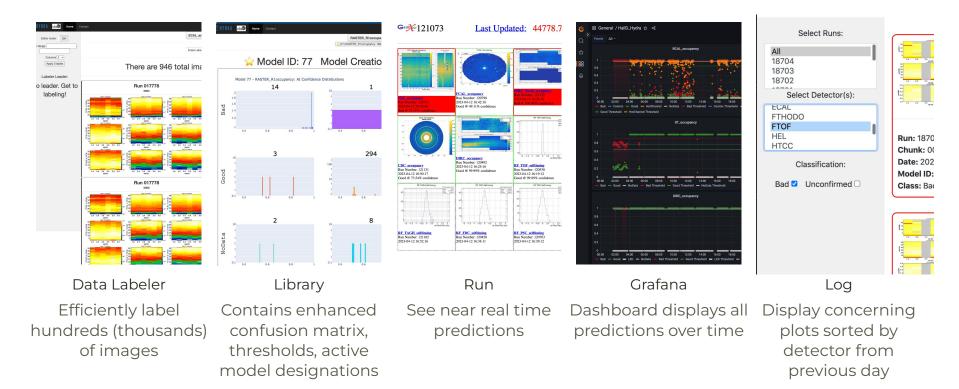






HYDRA: Front End

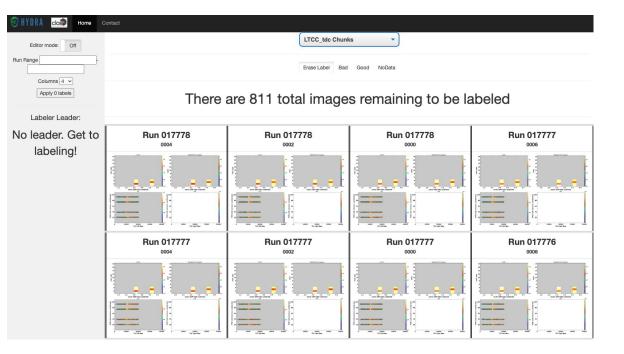
Web based for user convenience.



HYDRA: Data

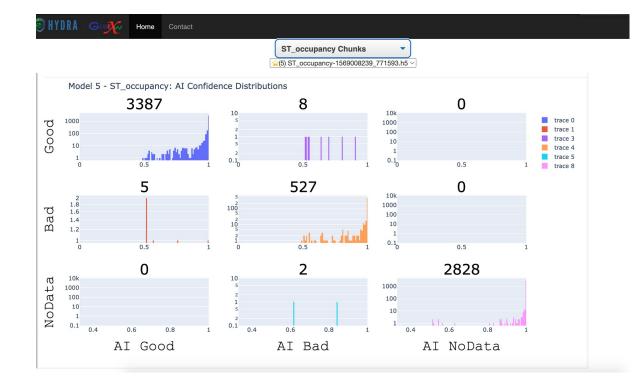
Labeler

Efficiently label multiple monitoring plots. Labels and images are automatically uploaded to database.



HYDRA: Library

Visualize model performance, thresholds, active models, etc.



Enhanced confusion matrix

Each cell contains Al confidence distribution and total counts

HYDRA: Run

Watch predictions in real time from anywhere

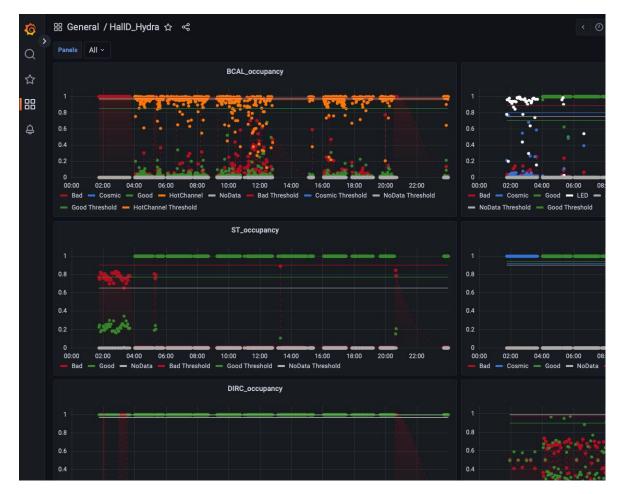
GradCAM visualizations are optional

🕑 HYDRA 🤊 Guile 120262 Last Updated: 5.00 second(s) ago showing 13 / 13 frames CDC Occupat 6 10 15 20 25 30 35 40 45 **BCAL** occupancy FDC occupancy Run Number: 121174 **CDC** occupancy Run Number: 120262 2023-04-12 09:42:27 Run Number: 120924 2023-04-12 09:42:39 Good @ 80.23% confidence 2023-04-12 09:38:25 Acceptable @ 78.08% confidence Good @ 89.65% confidence **RF TOF Self timing** unt of fa125 itrigger time errors **DIRC** occupancy fa125 itrig FCAL occupancy Run Number: 121266 **RF TOF** selftiming Run Number: 121013 Run Number: 120810 2023-04-12 09:41:48 Run Number: 120397 2023-04-12 09:29:04 2023-04-12 09:38:13 LED @ 94.99% confidence 2023-04-12 09:40:36 Good @ 99.28% confidence Cosmic @ 55.65% confidence Good @ 99.99% confidence RF TAGH Self timing **RF FDC Self timing** RF PSC Self timing COF SatDets' relined PSOFF SelfLets1 retires Entries 36697 Mean -0.001674 Etd Dev 9.57206 Ditoles 5170771 Mean -0.001124 Did Dev 8.07645 Entries 225051 Mean -0.001835 Did Dev 8.67467 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 Δt (First Pair) (ns -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 At (First Pair) (n -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 (First Pair) (ns **RF TAGH selftiming RF FDC** selftiming **RF PSC selftiming** Run Number: 120638 Run Number: 120838 ERun Number: 120299 2023-04-12 09:33:50 2023-04-12 09:38:00 2023-04-12 09:40:12 10

HYDRA:

Grafana Dashboard

Look at any prediction over time.



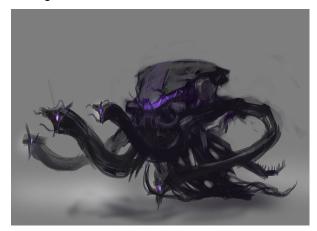
HYDRA: Log

See 'Bad' or 'Unconfirmed' images from previous runs, separated by detector. Easily identify when a particular problem started



Other Future Hydra developments

- <u>Siamese model(s)</u>
 - Two step processing
 - First a generic anomaly approach
 - Second is a diagnostic step in the face of anomalies
- <u>Masking</u>
 - Ability to ignore parts of an image in inference
 - known/accepted problems aren't considered
- <u>Kubernetization</u>
 - Use Kubernetes for easier maintenance/deployment
- <u>AI human interface improvements</u>
 - Enable non AI experts to maintain/manage the hydra system



Chang Woo Lee





Hydra alarmed on the FA125 itrig errors. Indeed, during run 101072 after about 8.8 M events, the error occurred. We immediately ended the run and restarted R 101073. The error had cleared. Kudos to Thomas, Naomi and Hydra!

p.s. We plan to change the SD board within the next hour.

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

Hydra alarm on fa125_itrig during Run 101076

Questions?



Jefferson Lab