Neural Architectures and Data Processing Pipelines for Irradiation Experiments

from the Automatic Assessment of Proposals to the Monitoring of the Beam Quality

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1. Introduction to IRRAD facility

IRRAD Proton Facility

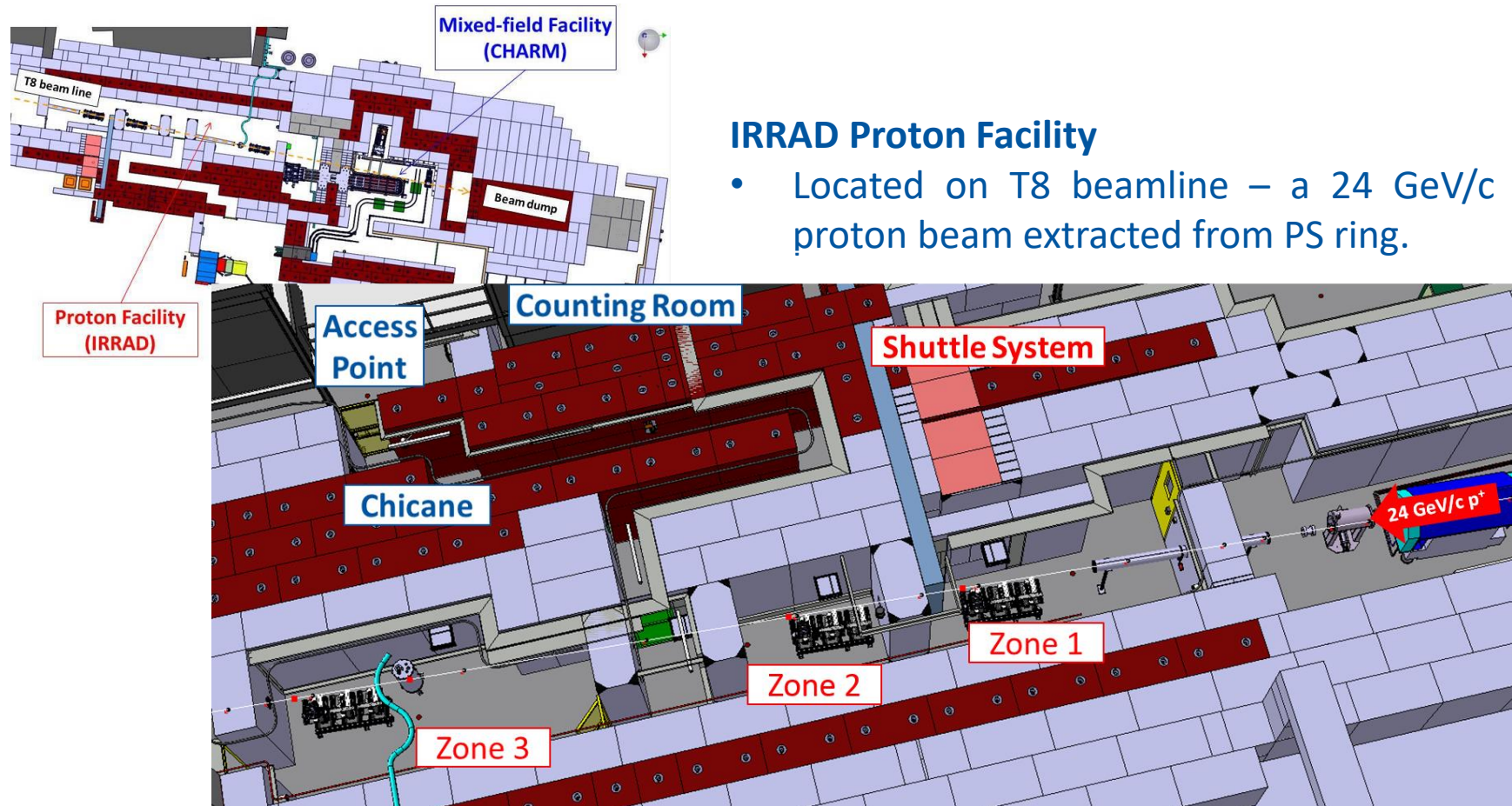- Located on T8 beamline – a 24 GeV/c proton beam extracted from PS ring.

Fig. 1. The location and layout of the IRRAD facility. Divided into three zones and equipped with a shuttle system, it is a place for electronic qualification and radiation hardness assessment.

2. Automatic Assessment of Experimental Proposals

Goal

- Support to facility users – to prepare better experiments
- Support to User Selection Panels – to prepare better reviews
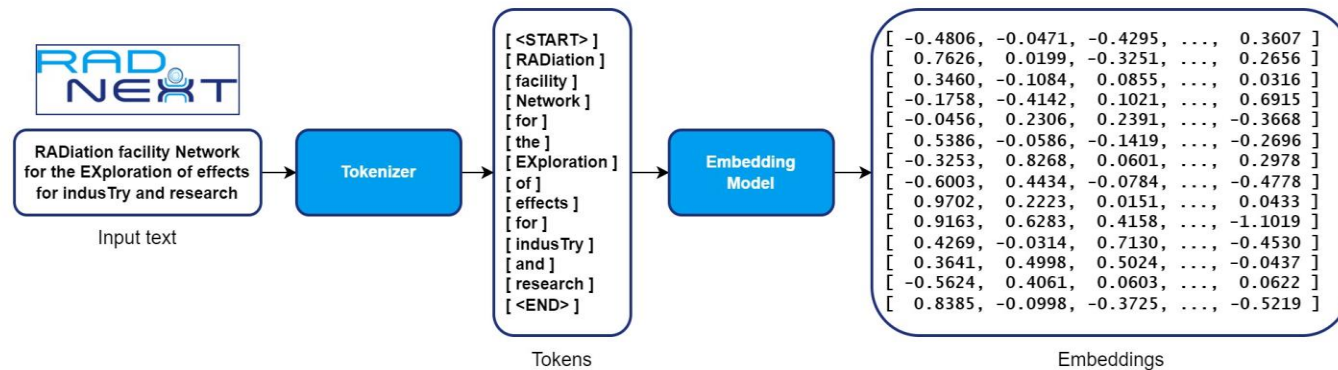
Simple goal – yet lots of challenges

Fig. 2. An illustration of embeddings creation of a short text. The result is a real vector obtained with the transformer architecture.

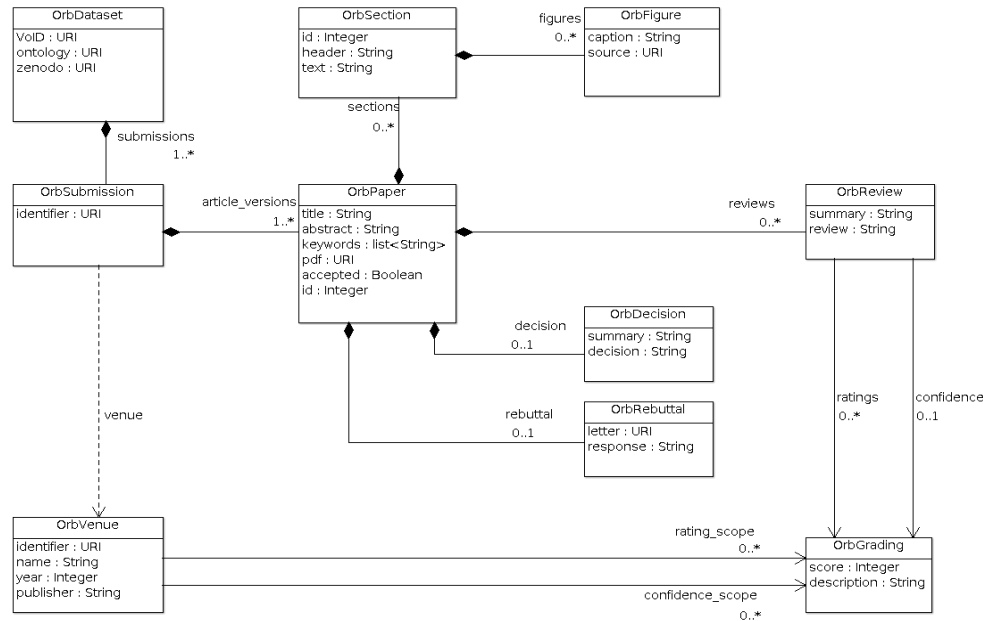# 2. Automatic Assessment of Experimental Proposals

Fig. 3. The UML diagram presents the architecture of the ORB dataset. It is the third iteration involving resources like OpenReview, Sci-Post and PeerJ.

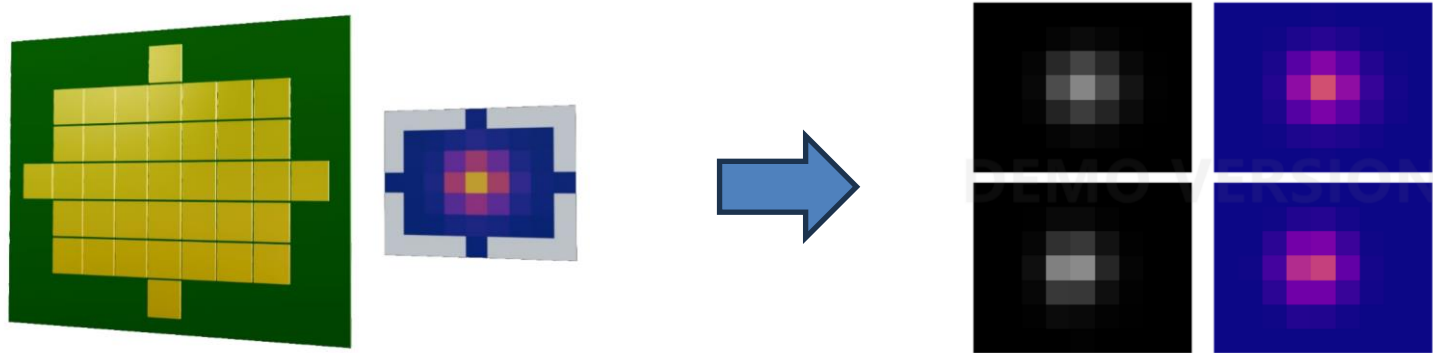| Values of MAE (Mean Absolute Error) for the final and confidence scores and their variances			
Score error	Score variance error	Confidence error	Conf. variance error
0.87	0.78	0.40	0.30

3. Transverse Beam Profile Monitoring

Fig. 4. New BPM DAQ (Data Acquisition) electronics is used to monitor the beam profile. The existing data was used to create custom dataset for anomaly detection.
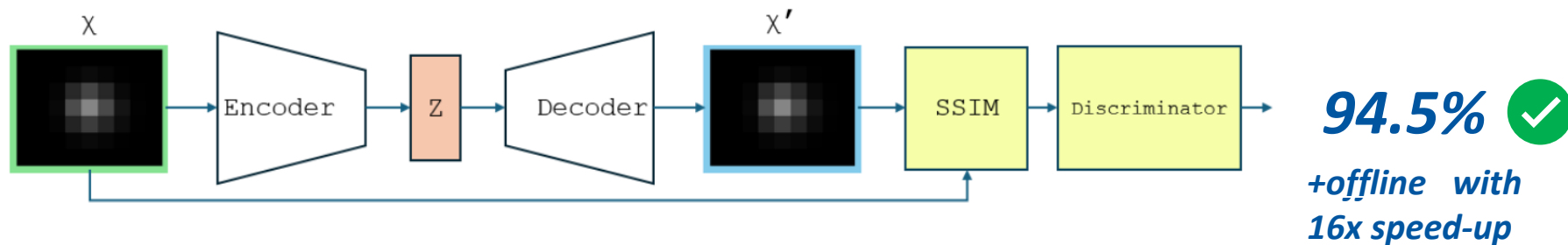

94.5% ✅

+offline with 16x speed-up

Fig. 5. A Convolutional Autoencoder with SSIM (Structural Similarity Index Measure) metric provides the foundation for real-time anomaly detection - an off-centred beam.
One problem is that a „good" profile is sometimes mistaken for an off-centred.

Links and available resources

1.   ORB Gitlab repository
     https://gitlab.cern.ch/irrad/orb-dataset

2.   „The Open Review Based dataset" arXiv preprint
     https://arxiv.org/abs/2312.04576

3.   „ML-Based Classification and Evaluation of the Bean
     Profile Patterns" – Euro-Labs report
     https://web.infn.it/EURO-LABS/wp-
     content/uploads/2024/08/EURO-LABS_MS29_final.pdf

Acknowledgements

www.radnext.web.cern.ch

www.web.infn.it/EURO-LABS

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