Status of results in TA5

PUNCH TA5 Meeting

17/07/2025

M. Kramer   A. Redelbach

Deliverables (so far)

Starting point: Finalization of deliverables and recent reporting requests

- D-TA5-WP1-1: Report on the impact of on-line filtering on the discovery potential
- D-TA5-WP2-1: Curation and metadata schemes for dynamic filtering
- D-TA5-WP2-2: Strategy concept for identifying highly complex (multi-parametric) signals in huge data streams
- D-TA5-WP2-3: Test environment for identifying highly complex (multi-parametric) signals in huge data streams
- D-TA5-WP2-4 Generic tools to both convert trained neural networks into efficient HLS/VHDL FPGA firmware optimised for a real-time, low-latency environment and to establish comparable software solutions
- D-TA5-WP3-1: Specifying the concept of a dynamic archive

- Collection in Gitlab:
  https://gitlab-p4n.aip.de/punch/intra-docs-content/-/tree/master/files/TA5/Documents_deliverables

Documents (Reports, Zenodo)

- Deliverable reports:
  - D-TA5-WP1-1
  - D-TA5-WP2-1
  - D-TA5-WP2-2
  - D-TA5-WP3-1
  - Available: https://results.punch4nfdi.de/?md=/docs/Documents/deliverable-reports.md

- Zenodo:
  - D-TA5-WP1-1 https://zenodo.org/records/11658437
  - D-TA5-WP2-1 https://zenodo.org/records/10692169
  - D-TA5-WP2-3: Planned, not yet uploaded
  - Assigment to PUNCH4NFDI community in Zenodo

ML on FPGAs – document with results and recommendations

TA5 WP2-4 report
Generic Tools for Artificial Neural Network Implementation on Field Programmable Gate Arrays

Christian Kahra[4], Ramesh Karuppusamy[1], Andrei Kazantzev[1], Yunpeng Men[1], Andreas Redelbach[3], Christian Schmitt[4], Arno Straessner[2], and Johann C. Voigt[2]

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Contents

Evaluated different tools to implement neural network inference on FPGA for different applications: hls4ml, direct VHDL implementation, specialized hardware (Versal AI engines)

→ No feedback/extra comments received

→ To be sent to EB/MB tomorrow

→ Presentation in FairMAT meeting

Open datasets

Robust realtime identification of dispersed radio astronomical signals that last much less than a second is challenging. Here we explore the utility of machine learning techniques to identify such signals and use data taken on the **Crab pulsar using the Effelsberg 100m Radio Telescope**.

Data corresponds to the frequency range of 1240-1510 MHz, and contains **20 minutes of the pulsar signal**. In addition, the DM-time data generated by the realtime pipeline, the associated Tensorflow CNN model is included and the training dataset are included. The data are intended for machine learning tasks focused on single-pulse detection and classification.

Nice example for a fast ML use case

https://edmond.mpg.de/dataset.xhtml?persistentId=doi:10.17617/3.HQYC8O

ML-PPA

Many developments:
New modules SA, Tutorial Project

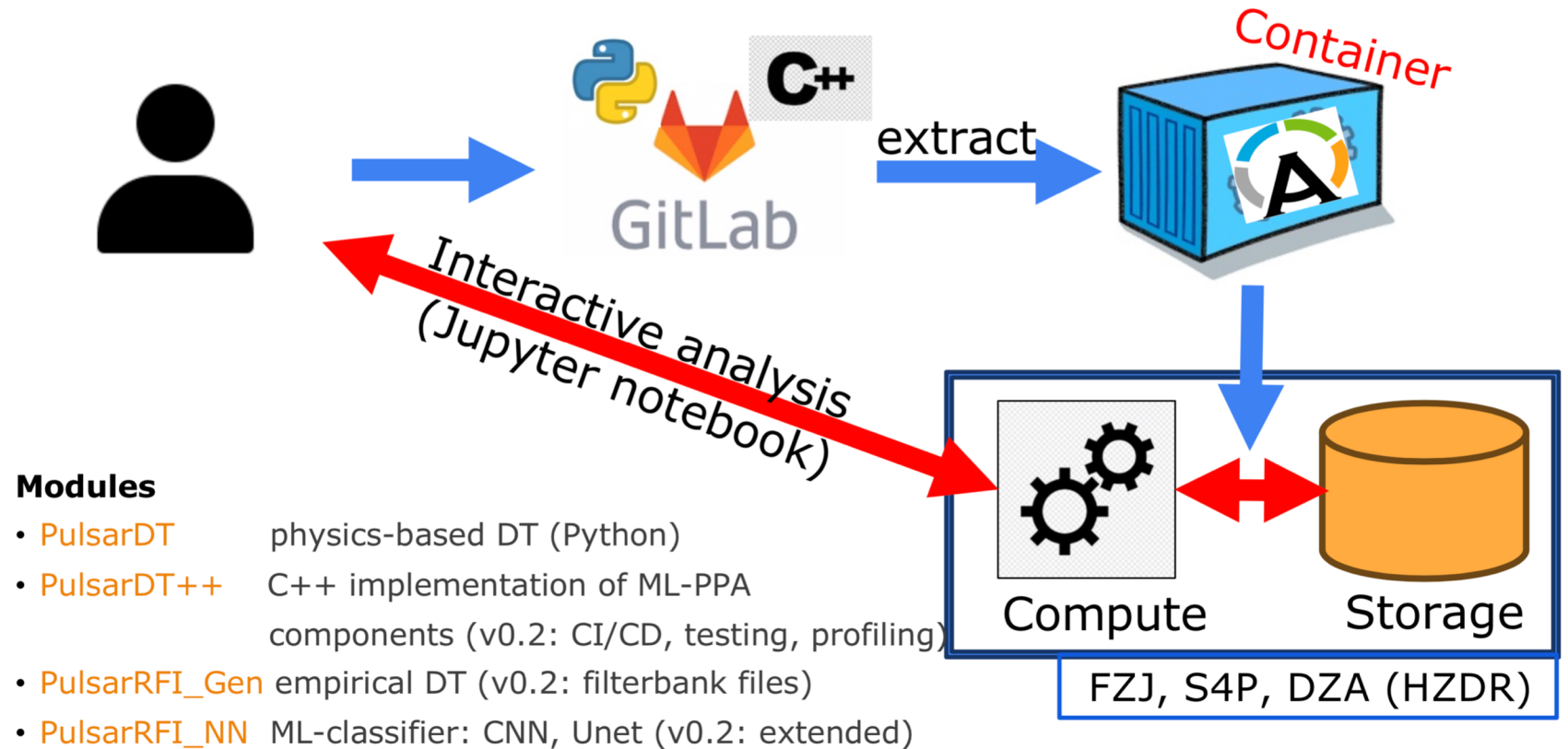Demonstration of a working setup for ML-PPA on C4P

Availability of simulated datasets?

Connection to TA5-WP4 deliverables

Porting common off-line packages (e.g. CASA) to a memory-based computing prototype to prepare analysis of "data monster"

ML-PPA v0.2**: workflow**   (https://gitlab.dzastro.de/punch/ml-ppa)

Modules
- PulsarDT   physics-based DT (Python)
- PulsarDT++   C++ implementation of ML-PPA components (v0.2: CI/CD, testing, profiling)
- PulsarRFI_Gen empirical DT (v0.2: filterbank files)
- PulsarRFI_NN ML-classifier: CNN, Unet (v0.2: extended)

Visibility and availability of results

- Useful for further developments, collaborations, PUNCH 2.0

- PUNCHLunch presentations:
  - Effelsberg prototype
  - Dynamic archiving
  - ML-PPA

For discussion