TA5 FPGA Deliverables

26.09.2024

FPGA Workshop Review

- 2nd PUNCH4NFDI TA5 Workshop on Machine Learning and Data Processing on FPGAs https://indico.desy.de/event/45348/
- September 18-19 at TU Dresden

- 27 participants registered, 15 people in person

- 7 "TA5" talks, 4 invited talks, 1 tutorial

- many interesting discussions

- city tour, dinner, tourist attractions

Deliverables 2024-2025

- Deliverables related to FPGA activites:

***Deliverables**:*

- **D-TA5-WP2-1 (31 Mar 2022):** Curation & metadata schemes for dynamic filtering.
- **D-TA5-WP2-2 (31 Mar 2022):** Strategy concept for identifying highly complex (multi-parametric) signals in huge data streams.
- **D-TA5-WP2-3 (30 Sep 2023):** Test environment for identifying highly complex (multi-parametric) signals in huge data streams using MeerKAT data.
- **D-TA5-WP2-4 (30 Sep 2024):** Generic tool to convert trained neural networks into efficient HLS/VHDL FPGA firmware optimised for a real-time, low-latency environment.
- **D-TA5-WP2-5 (30 Sep 2025):** Algorithms for massively parallel real-time sorting, clustering and pattern recognition on specialised hardware.
- **D-TA5-WP2-6 (30 Sep 2025):** Algorithms and Machine Learning methods for filtering and selecting relevant transient/anomalous signals.
- **D-TA5-WP2-7 (30 Sep 2026):** Pipeline for anomalous signal detection with low false-alarm probability for multi-messenger follow-up.

- TA5 person power to small to provide and maintain a public generic tool (hardware dependence, ...)
- hls4ml provides already a framework for the community which is used and developed
- proposal to prepare a "TA5 FPGA ML practical guide":
  - experience with hls4ml from user perspective
  - hls4ml prototype documentation: Bonn, ... and recommendations
  - experience with Xilinx AI engines and recommendations
  - document prototype of CNN implementation in VHDL and provide recommendations

- report by Mainz group at FPGA workshop

- Dortmund currently not active, but plans for 2025
- Dresden has started some basic activity, student project

***Deliverables**:*

- **D-TA5-WP5-1 (30 Sep 2024):** Development and implementation of machine learning prototypes for anomaly detection, predictive maintenance and process control.
- **D-TA5-WP5-2 (30 Sep 2024):** Interference recognition and mitigation schemes for transient discovery leading to a “robust” triggering system for multi-messenger follow-up.
- **D-TA5-WP5-3 (30 Sep 2026):**Expansion of the concept to a generalized toolkit for predictive maintenance and anomaly detection.
- **D-TA5-WP5-4 (30 Sep 2026):** Evaluation of false-alarm rates and improvements via machine learning, dynamic queries, on-line feedback and modification of archive metadata