

TA5 FPGA Introduction

A. Straessner, J.C. Voigt

10.06.2024

- Doodle has converged to week of September 16-20
- We now reserved a meeting room at TU Dresden for September 18-19
- We suggest to start the workshop on Wednesday morning and continue until Thursday lunch time → Travel on Tuesday and Thursday
- If all happy with this suggestion, we can start preparing an agenda and invite people (participants, speakers)
- Topics suggested:
 - ANN models for FPGA: frameworks (Tensor Flow, ...), ...
 - pipeline from idea to realisation in firmware
 - quantization aware training
 - OneAPI (replacement of HLS for Intel)
 - generic tool for FPGA machine learning: simple accelerator PC card (Alveo, ...)
 - ATLAS tracking
 - large data I/O possible between FPGAs
 - experience FPGA farm?
 - hls4ml: from compiled network to FPGA implementation, data access, ...
 - Versal AI engines

- Contribution to TA5 report:

• Deliverables related to FPGA activities:

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.

- machine learning training environments
- CNN-to-VHDL conversion, hls4ml examples, ...

- ??? (some activity started at TUD)
- ???

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