Taskarea 4:
Real-time Data Analysis and Selection

Status and things to do

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Taskarea4 – definition

- Real-time and irreversible decision to select and drop data is key feature of TA4
- Later stages of data analysis and storage directly depend on its reliability and efficiency

Summary in proposal:
In the first steps of each data analysis, the amount of data to be analyzed must be considerably reduced step by step for technical reasons. Task Area 4 deals centrally with the question of how this necessary reduction can be achieved in real-time with a minimum loss of physically relevant information. Also using prototyping and demonstrator setups for hardware-software-code design, special intelligent algorithms and methods for data quality assurance will be developed. The focus of these developments is on exemplary problem solutions that can be applied in the entire community.

Working groups

- DESY (T.Ferber, F.Gaede)
- TU Dortmund (J. Albrecht, B. Spaan)
- Uni Dresden (A. Straessner)
- FIAS (A. Redelbach)
- Kirchhoff-Institute Heidelberg (H.C. Schulz-Coulon)
- Uni Mainz (V. Buescher)

Each group has defined their references and also resources/infrastructure

Work packages

1. Algorithm optimisation for specialized hardware (FPGA, GPU, TPU)
2. Real-time feature extraction and pattern recognition
3. Hierarchical data selection systems
4. Prototyping and demonstrator setups
5. Machine-learning methods for data quality assurance

Deliverables (version 24/09/2019)

Work package 1

Deliverable	Group
A generic tool that converts trained neural networks into efficient High Level Synthesis (HLS) and VHDL firmware implementations	Dresden
A generic toolkit to efficiently implement neural networks on FPGAs	Mainz
Algorithms for noise reduction, pile-up correction and treatment of highly saturated signals	Heidelberg
Massively parallel sorting and selection algorithms	Mainz
GPU-accelerated track reconstruction	DESY, FIAS

Work package 2

Deliverable	Group
Fast online clustering and pattern recognition algorithms, possibly using novel machine learning methods for pattern recognition.	DESY, DO
Generic anomaly detection based triggers	DESY DO
Generic, massively parallel clustering algorithms	Mainz
Deep learning based software tools to optimize signal-to-noise ratios in detector data streams in real-time	Dresden
Generic interfaces to de-contextualize raw data	FIAS
Development of generic algorithms for efficient local and track reconstruction	FIAS

Work package 3

Deliverable	Group
Development of generic real-time analysis framework with physics objects	Heidelberg
Development of efficient online data processing framework	FIAS

Work package 4

Deliverable	Group
Generic data injection and verification tool which resembles the input data streams and verifies the correct processing by the FPGA. The tool will be flexible such that the data streams can either be injected into FPGA hardware or be connected to firmware simulation programs.	Dresden
Generic electronics module providing a FPGA with high-I/O receivers and transmitters	Mainz
Algorithms aiming at an optimized load balance will be developed, deriving the decision where to execute a certain algorithm on the current and predicted load of the nearby CPUs and GPUs.	Dortmund
Development of generic algorithm to optimise hard/software co-design issues for CPUs which include GPU or FPGA features.	Dortmund

Work package 5

Deliverable	Group
Machine learning solutions for anomaly detection, prediction of detector performance and changes in calibration constants	Dortmund
Anomaly detection tools for predictive maintenance and process control, based on internal and external parameters	Dortmund

FTE plans (version 24/09/2019)

Work package	Year 1	Year 2	Year 3	Year 4	Year 5	Total in T
Work package 1	1.57	1.57	1.57	1.57	1.57	**7.85**
D-TA4-WP1-1-DD	0.33	0.33	0.33	0.33	0.33	**1.66**
D-TA4-WP1-2-MZ	0.37	0.37	0.37	0.37	0.37	**1.85**
D-TA4-WP1-3-HD	0.5	0.5	0.5	0.5	0.5	**2.5**
D-TA4-WP1-4-MZ	0.37	0.37	0.37	0.37	0.37	**1.85**
Work package 2	4.36	4.36	3.86	3.36	3.36	**19,4**
D-TA4-WP2-1-DESY+DO	1.0 + 0.33	1.0 + 0.33	1.0 + 0.33	1.0 + 0.1	1.0 + 0.1	**6.2**
D-TA4-WP2-2-DESY+DO	1.0 + 0.33	1.0 + 0.33	0.5 + 0.33	0.5 + 0.31	0.5 + 0.31	**5.11**
D-TA4-WP2-3-MZ	0.37	0.37	0.37	0.37	0.37	**1.85**
D-TA4-WP2-4-DD	0.33	0.33	0.33	0.33	0.33	**1.65**
D-TA4-WP2-5-F	0.5	0.5	0.5	0.25	0.25	**2.0**
D-TA4-WP2-6-F	0.5	0.5	0.5	0.5	0.5	**2.5**
Work package 3	1.0	1.0	1.0	1.0	1.0	**5.0**
D-TA4-WP3-1-HD	0.5	0.5	0.5	0.5	0.5	**2.5**
D-TA4-WP3-2-F	0.5	0.5	0.5	0.5	0.5	**2.5**
Work package 4	1.37	1.37	1.37	1.37	1.37	**6.85**
D-TA4-WP4-1-DD	0.33	0.33	0.33	0.33	0.33	**1.6**
D-TA4-WP4-2-MZ	0.37	0.37	0.37	0.37	0.37	**1.85**
D-TA4-WP4-3-DO	0.33	0.33	0.33	0.33	0.33	**1.6**
D-TA4-WP4-4-DO	0.33	0.33	0.33	0.33	0.33	**1.6**
Work package 5	0.66	0.66	0.66	0.66	0.66	**3.3**
D-TA4-WP5-1-DO	0.33	0.33	0.33	0.33	0.33	**1.66**
D-TA4-WP5-2-DO	0.33	0.33	0.33	0.33	0.33	**1.66**
Total project funds	9.0	9.0	8.5	8.0	8.0	**42.5**

Agreement on 24/09/2019

Recent reductions affect DESY, Dortmund, FIAS and Mainz

FTE plans (update)

Work package	Year 1	Year 2	Year 3	Year 4	Year 5	Total in T
Work package 1	1.57	1.57	1.57	1.57	1.57	**7.85**
D-TA4-WP1-1-DD	0.33	0.33	0.33	0.33	0.33	**1.66**
D-TA4-WP1-2-MZ	0.37	0.37	0.37	0.37	0.37	**1.85**
D-TA4-WP1-3-HD	0.5	0.5	0.5	0.5	0.5	**2.5**
D-TA4-WP1-4-MZ	0.37	0.37	0.37	0.37	0.37	**1.85**
Work package 2	4.36	4.36	3.86	3.36	3.36	**19,4**
D-TA4-WP2-1-DESY+DO	1.0 + 0.33	1.0 + 0.33	1.0 + 0.33	1.0 + 0.1	1.0 + 0.1	**6.2**
D-TA4-WP2-2-DESY+DO	1.0 + 0.33	1.0 + 0.33	0.5 + 0.33	0.5 + 0.31	0.5 + 0.31	**5.11**
D-TA4-WP2-3-MZ	0.37	0.37	0.37	0.37	0.37	**1.85**
D-TA4-WP2-4-DD	0.33	0.33	0.33	0.33	0.33	**1.65**
D-TA4-WP2-5-F	0.5	0.5	0.5	0.25	0.25	**2.0**
D-TA4-WP2-6-F	0.5	0.5	0.5	0.5	0.5	**2.5**
Work package 3	1.0	1.0	1.0	1.0	1.0	**5.0**
D-TA4-WP3-1-HD	0.5	0.5	0.5	0.5	0.5	**2.5**
D-TA4-WP3-2-F	0.5	0.5	0.5	0.5	0.5	**2.5**
Work package 4	1.37	1.37	1.37	1.37	1.37	**6.85**
D-TA4-WP4-1-DD	0.33	0.33	0.33	0.33	0.33	**1.6**
D-TA4-WP4-2-MZ	0.37	0.37	0.37	0.37	0.37	**1.85**
D-TA4-WP4-3-DO	0.33	0.33	0.33	0.33	0.33	**1.6**
D-TA4-WP4-4-DO	0.33	0.33	0.33	0.33	0.33	**1.6**
Work package 5	0.66	0.66	0.66	0.66	0.66	**3.3**
D-TA4-WP5-1-DO	0.33	0.33	0.33	0.33	0.33	**1.66**
D-TA4-WP5-2-DO	0.33	0.33	0.33	0.33	0.33	**1.66**
Total project funds	9.0	9.0	8.5	8.0	8.0	**42.5**

Agreement on 24/09/2019

Recent reductions affect DESY, Dortmund, FIAS and Mainz

4.2	**3,87**	**3,87**	**3,37**	**2,863333333**	**2,863333333**	**16,83666667**
DESY	1,5	1,5	1	1	1	6
Dortmund	0,666666667	0,666666667	0,666666667	0,41	0,41	2,82
Mainz	0,37	0,37	0,37	0,37	0,37	1,85
FIAS	1	1	1	0,75	0,75	4,5
Dresden	0,333333333	0,333333333	0,333333333	0,333333333	0,333333333	1,666666667
4.4	**1,37**	**1,37**	**1,37**	**1,37**	**1,37**	**6,85**
Dortmund	0,666666667	0,666666667	0,666666667	0,666666667	0,666666667	3,333333333
Mainz	0,37	0,37	0,37	0,37	0,37	1,85
Dresden	0,333333333	0,333333333	0,333333333	0,333333333	0,333333333	1,666666667
4.5	**0,666666667**	**0,666666667**	**0,666666667**	**0,666666667**	**0,666666667**	**3,333333333**
Dortmund	0,666666667	0,666666667	0,666666667	0,666666667	0,666666667	3,333333333
4.1	**1,573333333**	**1,573333333**	**1,573333333**	**1,573333333**	**1,573333333**	**7,866666667**
Heidelberg	0,5	0,5	0,5	0,5	0,5	2,5
Mainz	0,74	0,74	0,74	0,74	0,74	3,7
Dresden	0,333333333	0,333333333	0,333333333	0,333333333	0,333333333	1,666666667
4.3	**1**	**1**	**1**	**1**	**1**	**5**
Heidelberg	0,5	0,5	0,5	0,5	0,5	2,5
FIAS	0,5	0,5	0,5	0,5	0,5	2,5

Status and next steps

- Main text parts in relatively good shape
- Plans to finalize deliverables and milestones (ideally today)
- Service perspective is also focus for today
- Input/guideline needed for
  - Synergies
  - Risks and mitigation
- No feedback from „Participants“ yet
- Decline of FTEs over the years- is there a procedure to get FTEs from „backbone“?
- Is there an option for final improvements in our text beyond 30/09/2019?