Dortmund ESRs

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ESR-projects in the 2016 application

Fellow	Host	Ph.D.	Start	Duration	Deliverables
ESR9	Dortmund	Yes	Month 6	36	1.1,1.5,4.2,4.3
Work Package: WP1, WP4				**Doctoral programme:** Dortmund	

Project Title: Automatic optimisation of detector reconstruction and calibration

Objectives: The LHC experiments need to process unprecedented data rates in real time. In practise, the majority of all data (in LHCb: 99.9%) is rejected in the trigger system synchronously to the LHC running. To keep the physics reach to a maximum, the analysis strategy of the LHC experiments moves to a more and more complex event analysis in the trigger system. Examples of this are present also in by ESR2 and ESR14. A prerequisite for this analysis in the trigger is the alignment and calibration of the detector in real time.
LHCb is pioneering the real-time alignment and calibration among LHC detectors and runs such a system for parts of the detector already since 2015. ESR9 will extend this concept of real-time alignment and calibration and develop a framework for the long term monitoring and adjustment of the total detector performance, so that the detector can use its own measured performance to adjust its reconstruction algorithms while respecting time constraints, and achieve optimal performance. ESR9 will collaborate closely with ESR8 and ESR11. ESR9 will benefit from the trigger and reconstruction expertise of Dr. J. Albrecht and the data analysis expertise of Prof. B. Spaan. ESR9 will have a secondment at CERN and one at Yandex, to develop details of both the HEP aspect and the industrial applications of the project.

Expected Results: ESR9's main result will be a package for the automated monitoring, alignment, and calibration of current and upgraded HEP detectors (deliverables **1.1** and **4.2**). In addition, ESR9's research is expected to yield up to two original research papers, concerning the developed algorithms (deliverables **1.5** and **4.3**) . ESR9 will receive a PhD in experimental HEP.

Secondments: Yandex, 6 months, Dr. P. Serdyukov Yandex school of data analysis and research project in industrial monitoring of real-time systems. CERN, 3 months, Dr. S. Stahl, lectures and tutoring in charged particle reconstruction.

.. Basically, develop a framework for the long term monitoring and adjustment of the total detector performance, so that the detector can "self-calibrate"

Complete event interpretation

Fellow	Host	Ph.D.	Start	Duration	Deliverables
ESR10	Dortmund	Yes	Month 6	36	2.5,3.2,3.4
Work Package: WP2, WP3				**Doctoral programme:** Dortmund	
Project Title: Probabilistic real-time data analysis					
Objectives: Because of the volumes of data which will be produced in the LHCb upgrade, almost every proton-proton collision will be of potential interest to some physics analysis, either as a signal or as a control sample. About 300 kHz of beauty and 1 MHz of charm mesons will decay inside of the LHCb detector. In such an environment, the traditional keep/reject approach to triggering becomes too crude, since one is not distinguishing against background but rather between different types of signals based on the physics priorities. ESR10 will develop triggers based on a probabilistic classification of events, which will enable the decision to keep or reject an event to be made more efficient. The approach here is to select the event based on the full hit pattern in all subdetectors, in contrast to the traditional selection based on high level particle hypotheses that are based on reconstructed tracks. ESR10 will collaborate closely with ESR6 and ESR8 and will benefit from the trigger and reconstruction expertise of Dr. J. Albrecht and the data analysis expertise of Prof. B. Spaan.					
Expected Results: ESR10's research is expected to yield up to two original research papers (deliverables **2.5** and **3.4**). concerning the developed classifiers as well as a prototype trigger selection based on the probabilistic classification of events. ESR10 will implement the classifiers within the LHCb trigger system (deliverables **3.2**). ESR10 will receive a PhD in experimental HEP.					
Secondments: CERN, 3 months, Dr. F. Teubert and S. Stahl, tutoring in physics analysis and event reconstruction, CNRS, 3 months, Dr. V. Gligorov, tutoring and lectures on trigger design and real-time reconstruction, NYU, 3 months, Prof. K. Cranmer, tutoring and lectures on statistics.					

.. Basically, investigate if a trigger decision (pre-selection ??)
can be done based on event properties rather than reconstructed objects.

New projects?

- Search for LFV and LFU in unflavoured mesons
  → need to develop MVA based trigger selections
  main challenge: rates are in some modes >> 1 per event
  - Need to perform full analysis online
  - Develop generic MVA based selection for online analysis
  - E.g. ρ^0, ϕ, $\eta^{(')}$, J/ψ, Y(1S)

- More projects depend a bit on where we want to go
  - Basically all real time analysis is based on fast online reconstruction
  - Given the (lack of) improvement in CPU power, we should invest in fast algorithms for event reconstruction
  - But also: many interesting projects in trigger level analysis and the connected field of monitoring & real time calibration