



Advanced Machine Learning. Flash Simulation and bleeding edge applications

FlashSim: April status report

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External Partner





Who we are

Staff members:

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- Francesco Vaselli ^c, Scuola Normale Superiore di Pisa
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- Benedetta Camaiani ^g, Università di Firenze
- Alkis Papanastassiou ^g, Università di Firenze
- Antonio D'Avanzo ^e, Università di Napoli

External collaborators:

- Andrea Rizzi ^c, Università di Pisa

Ongoing activities

ALICE - Timing-based vertex-reconstruction validation for the triggerless DAQ

ATLAS - Fast simulation

ATLAS - 4D reconstruction algorithms

ATLAS - Anomaly detection for full-hadronic final states

CMS - Flashsim

CMS - Theory-independent classifiers for CMS using domain adaptation

CMS - Data anomaly detection for data validation and certification

LHCb - Lamarr (Flashsim) - PID and Calorimetry

LHCb - Lamarr (Flashsim) - Tracking

LHCb - Parametrization of Cherenkov detector path in RICH detectors

LHCb - Flash simulation of resistive solid-state detectors

LHCf - Reconstruction of multiple calorimetric clusters

Simulation
Reconstruction
Monitoring
Data analysis



Infrastructure for training

- Uploaded to GitHub the Helm chart of the Kubernetes platform to access GPU resources in cloud: <https://github.com/landerlini/ai-infn-platform>

Features:

- JupyterHub with IAM token authentication
 - POSIX interface INFN Cloud MinIO
 - Multi-node distributed filesystem based on NFS
 - Rudimental batch system, tested for Geant4-based simulations and for PINN training
 - cvmfs (public repositories, only)
 - DNS registered: <https://hub.ai.cloud.infn.it>
 - Serving order of 20 users on a monthly basis (majority working on projects of relevance for WP2)
 - Leonardo resources that we would like to exploit via offloading were assigned (200 kHours)
- **The offloading mechanism towards Leonardo is currently our focus** (thanks WP5!)
 - 4 flagship use-cases tested on development clusters (see below).



KPIs

| KPI ID | Description | Acceptance threshold | 2024-02-13 |
|------------|---|----------------------|--|
| KPI2.2.1.1 | N_{MC} billion events obtained from ML-based simulation, as demonstrated by official links in experiments' simulation databases | $N_{MC} \geq 1$ | 1 M events (completed: 0.1%) |
| KPI2.2.1.2 | N_{EXP} experiments have tested a machine-learning based simulation | $N_{EXP} \geq 2$ | 1 experiment (completed: 50%) |
| KPI2.2.1.3 | Machine-learning use-cases tested in the context of the CN were presented at N_{CONF} international and national events | $N_{CONF} \geq 3$ | 5 use-cases (since Sept. '23) (completed: 167%) |
| KPI2.2.1.4 | N_{UC} different machine-learning use-cases were tested in the context of the CN and made available in git repositories | $N_{UC} \geq 5$ | 4 use-cases (completed: 80%) |

List of conferences for KPI2.2.1.3

- L.A., Generative models at the LHC, ALPACA workshop 2023, Trento
- B. Camaiani, Example of adaptation domain in High Energy Physics, XAI 2023, Milano
- A. Papanastassiou, “Anomaly detection with autoencoders for data quality monitoring in HEP”, XAI 2023, Milano
- *Lamarr: implementing the flash-simulation paradigm at LHCb*, ACAT 2024
- F. Simone, *Anomaly detection for data quality monitoring of the CMS detector*, AISSAI 2024
- F. Corchia, *Tecniche computazionali avanzate per la simulazione veloce del calorimetro dell'esperimento ATLAS*, IFAE 2024

`N_EXP += 1`

LHCb Lamarr + CMS FlashSim talks next week at EuCAIFCon.

LHCb Lamarr talk accepted at ICHEP. LHCf talk accepted at ICHEP.

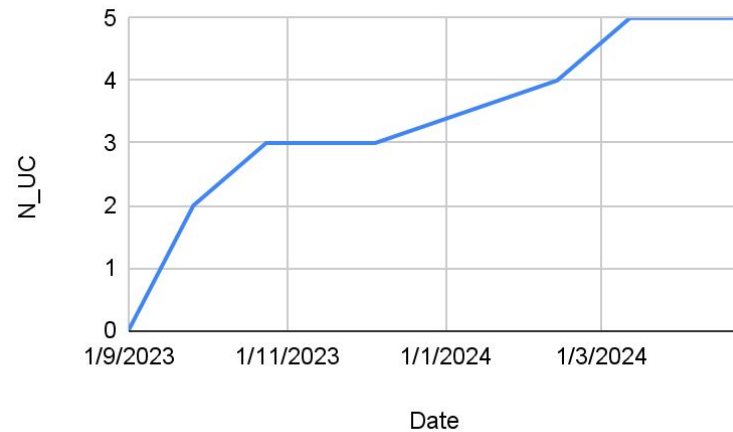
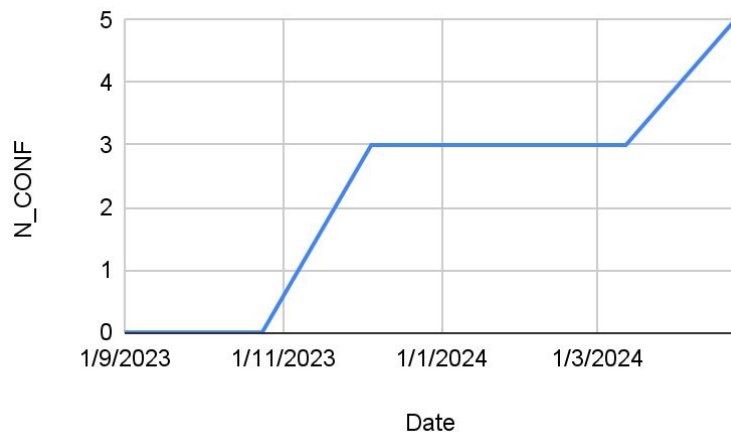
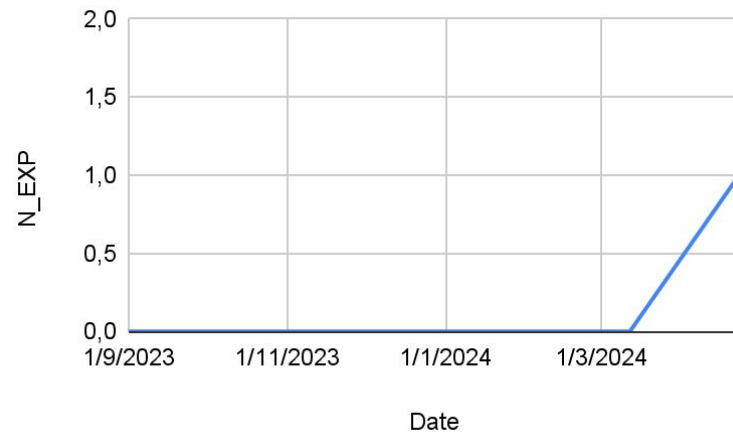
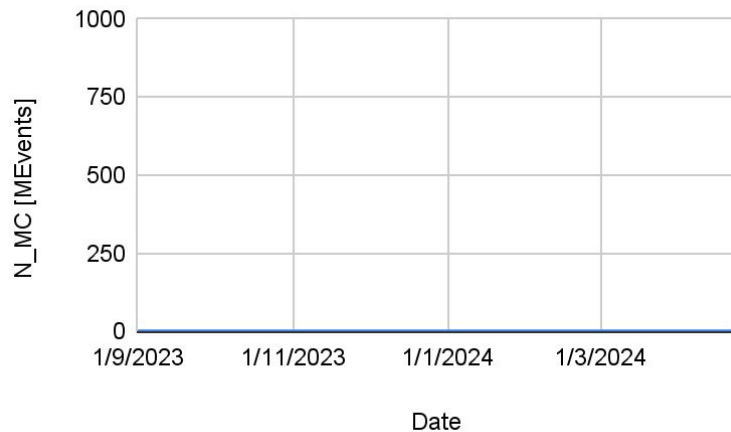


List of use-cases tested on the platform (%)

- Lamarr, the ultra-fast simulation option for the LHCb experiment (tracking parametrizations)
- Lamarr, the ultra-fast simulation option for the LHCb experiment (particle identification and neutral reconstruction parametrizations)
- Theory-independent classifiers for the data analysis with the CMS experiment
- Machine-learning-based simulation of the response of resistive solid-state detector to the charge generated by a traversing minimum-ionizing particles



KPIs



Conclusion

Focus is still on infrastructure and resource provisioning.

DataCloud is migrating from MinioGW to RadosGW which will hopefully perform better.

Next week we will have two presentations submitted by CMS and LHCb at EuCAIFCon on Flash Simulation techniques, completing KPI2.2.1.2 (experiments testing FlashSim).

Please consider registering to the [workshop](#) of AI_INFN in Bologna, 11-12 June.

1st AI-INFN User Forum

11–12 Jun 2024
INFN CNAF
Europe/Rome timezone



- Overview
- Timetable
- Contribution List
- Call for Abstracts
- Participant List
- Registration

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