Matteo Bunino

Digital Twin & Computing Engineer

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QUALIFICATIONS

M.Sc. Data Science & Engineering - Politecnico di Torino & EURECOM (double degree), 2022 – Grade: 110 cum laude / 110

B.Sc. Computer Engineering - Politecnico di Torino, 2019 – Grade: 108 / 110

KEY STRENGTHS

Digital twin design and development for scientific applications • Requirements capture, system architecture and design (HPC/AI and digital twins) • Deployment of AI-driven digital twins on heterogeneous HPC • Distributed AI workflows (PyTorch, TensorFlow, Horovod, DeepSpeed, Ray) • Energy benchmarking on GPUs (Nvidia, AMD) and Arm • Hyperparameter optimization • HPC and cloud workload orchestration (SLURM + Singularity, Kubernetes + Docker) • Cloud–HPC observability and energy optimization (Prometheus, Kepler, PUE analysis) • Software development and coordination in EU projects (interTwin Task 6.5 lead, ODISSEE contributor) • Technical writing (e.g., EU deliverables), conference presentations, event organization.

TECHNICAL SKILLS

Digital twin frameworks: Nvidia Omniverse for 3D visualizations, ExaDigiT (ORNL)
HPC & cloud: itwinai, SLURM, interLink, Kubernetes, Prometheus, Kepler, Grafana
AI and MLOps: PyTorch, TensorFlow, Horovod, DeepSpeed, Ray, Kubeflow, MLflow
Containers & CI/CD: Docker, Singularity/Apptainer, Dagger, GitHub Actions
Programming & Scripting: Python, Go, C++, Bash

WORK EXPERIENCE

Fellow (Jan 2023 - present) - *CERN, Geneva, Switzerland*

• Main developer of itwinai in interTwin (Task 6.5 lead), an abstraction layer for distributed AI on HPC systems, combining hyperparameter optimization and reducing engineering overheads for scientists; validated itwinai on HPC by integrating four scientific digital twin use cases from physics (e.g., MLPF) and three from Earth observation; optimized use case code scalability on HPC.
• CERN openlab digital twin expert: led technical discussions with Nvidia, Google, and Imperial College; coordinated two digital twin projects: digital twin of the LHC infrastructure with Nvidia Omniverse, and digital twin for data quality monitoring at CMS ECAL in collaboration with Imperial College.

- Digital twin HPC benchmarking: measured performance and energy consumption of scientific digital twin AI workloads across different European HPC centres: LUMI (AMD MI250X), Deucalion (Arm Fujitsu A64FX), Jülich (Nvidia A100/V100), and Vega (Nvidia A100).
- Cloud-HPC integration via interLink, enabling large-scale AI workloads using the Ray Kubernetes operator and cross-infrastructure container CI/CD with Dagger (presented at KubeCon EU 2025).
- Contributed to EC-funded ODISSEE project by collecting use case requirements and assessing digital twin frameworks for modelling and optimizing data centre operations (e.g., ExaDigiT); assessed Energy Aware Runtime (EAR) for energy-aware job execution; liaised with project partners (SURF, LHCb, NextSilicon, SiPearl).
- Visualization of energy and resource utilization telemetry (Prometheus) on Grafana dashboards.
- 3D visualizations with Nvidia Omniverse for interactive digital twins.
- Digital twin events: organized a Birds-of-a-Feather (BoF) session on digital twins at ISC 2025 (speakers: Nvidia, SURF, CINES, ECMWF, CERN); presented work on cloud-HPC integration and itwinai at ISC 2024, CHEP 2024, and PASC 2025.
- Supervised 4 summer students and 3 technical students in digital twin projects; supported the recruiting of new fellows.
- EC-funded projects: interTwin (2023 - 2025), ODISSEE (2025 - present)

Cyber Security Data Scientist (Jun 2022 - Dec 2022) - *Huawei, Munich, Germany*
Co-designed and co-developed a malware analysis framework based on large language models (LLMs); Scaled AI workloads to Huawei Cloud. Filed periodic technical progress reports; Graph machine learning; Natural language processing.

Research Intern (Sep 2021 - Feb 2022) - *Huawei, Munich, Germany*
Developed a proof-of-concept that uses Reinforcement Learning (RL) to automate the reverse engineering of evasive malware, improving the efficiency and accuracy of dynamic malware analysis. Find my thesis here.

SELECTED TALKS AND PUBLICATIONS

- Bunino M. et al. "itwinai: Enabling Scalable AI Workflows on HPC for Digital Twins in Science" - EPJC, 2025, DOI: https://doi.org/10.1051/epjconf/202533701361

- Bunino M. et al. "Testing AI Containers for Digital Twins in Science: a Cloud-HPC Workflow" - KubeCon EU 2025

- BoF organiser & speaker, Shaping the Future of Scientific Digital Twins: Tales from Physics, Climate Research, and Data Centre Operations, ISC 2025

- BoF speaker, Synergistically Integrating HPC and Cloud, ISC 2024

LANGUAGES

Italian: Native   **English**: Fluent   **French**: Conversational