



Contribution ID: 440

Type: **Talk**

Integrating High-Performance Computing and Deep Learning for Big Data-Driven Cyberinfrastructure: A Framework for Scalable AI Research in African Research Institutions

Wednesday, 3 December 2025 12:00 (20 minutes)

The proliferation of Artificial Intelligence (AI), data-driven research, and digital transformation has increased the global demand for powerful computing infrastructures capable of processing and analyzing enormous volumes of data. High-Performance Computing (HPC) has emerged as the cornerstone of this evolution, enabling researchers to perform complex simulations, accelerate model training, and analyze Big Data at unprecedented scales. Yet, across many African universities, access to such advanced computing capabilities remains severely limited, constraining the ability of scientists to participate meaningfully in global AI and data science innovation. This paper explores the strategic integration of HPC technologies with deep learning architectures to establish a sustainable, Big Data-driven cyberinfrastructure model tailored for African academic environments.

Drawing inspiration from the ongoing efforts at the University of Mpumalanga (UMP) and the Council for Scientific and Industrial Research (CSIR), the study proposes a framework that connects HPC systems with scalable AI workflows in areas such as agriculture, climate modelling, energy, and cybersecurity. The framework emphasizes distributed GPU-accelerated clusters, containerized computing environments, and job scheduling mechanisms that allow multiple research teams to run parallel deep learning experiments efficiently. Beyond the technical dimension, the paper highlights the importance of local capacity development, collaboration, and institutional investment as key drivers for long-term sustainability. By showcasing how HPC can shorten AI model training times, enhance predictive accuracy, and improve data management efficiency, this research demonstrates that advanced computation is not merely a luxury for developed nations but an attainable enabler of scientific independence for African universities.

The findings underscore that the convergence of HPC and AI can transform research productivity, foster interdisciplinary collaboration, and support evidence-based policymaking in sectors critical to Africa's development. Ultimately, the paper advocates for the creation of a federated HPC-AI ecosystem across African institutions, allowing shared access to computational resources, open datasets, and research expertise. Such an ecosystem would democratize access to cutting-edge technologies, close the digital divide, and position African researchers as active contributors to the global knowledge economy rather than passive consumers. Through this integrative perspective, the paper not only offers a technical blueprint for HPC-AI synergy but also presents a vision for empowering scientific innovation, data sovereignty, and technological resilience within the African higher education landscape.

Presenting Author

Email

Student or Postdoc?

Institute

Registered for the conference?

CHPC User

CHPC Research Programme

Workshop Duration

Primary author: Dr OGUNLEYE, Olalekan Samuel (University of Mpumalanga)

Presenter: Dr OGUNLEYE, Olalekan Samuel (University of Mpumalanga)

Session Classification: HPC Applications

Track Classification: Machine Learning and other AI techniques