EAGE

**EUROPEAN
ASSOCIATION OF
GEOSCIENTISTS &
ENGINEERS**

Fifth EAGE Workshop on High Performance Computing for Upstream

HETEROGENEOUS HPC: CHALLENGES, CURRENT & FUTURE TRENDS

6-8 SEPTEMBER 2021 • ONLINE

- **Technical Programme**

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TECHNICAL COMMITTEE

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Vincent Etienne (Co-chair)	Saudi Aramco
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Andrew Jones	Microsoft
Diego Klahr	Total
Fabrice Dupros	ARM
Gaël Youinou	CGG
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Nicola Bienati	Eni
Paulo Souza	Core Scientific
Philippe Thierry	Intel
Rached Abdelkhalek	Nvidia
Rajesh Gandham	StoneRidge Technology
Saber Feki	KAUST
Shintaro Momose	NEC Corporation
Suha Kayum	Saudi Aramco

WORKSHOP OVERVIEW

High-Performance-Computing plays a leading role in our current energy business and will be of critical importance for a successful energy transition. Looking across multiple industries, our business undoubtedly exploits the largest High-Performance-Computing capacity. HPC helps in seeking higher productivity, lowering costs and making better use of huge amounts of data through high-performance simulation and data analytics. Algorithms performing as fast as possible on the best available hardware have a direct impact on many of the decisions shaping our business. This is particularly true in this post COVID world. Achieving this goal, through the various forms of HPC, from Supercomputers on premise to elastic and versatile solutions on the cloud, is the underlying theme of this fifth instance of the EAGE HPC for Upstream: *"Heterogeneous HPC: Challenges, Current and Future Trends"*.

In upstream, simulation and modelling are our principal mechanisms for the accurate location of hydrocarbons and their optimal production. The reliance on data for making better business decisions at a lower cost is becoming critical. Seismic data are explored using traditional imaging algorithms such as Reverse Time Migration (RTM), Full Waveform Inversion (FWI) and Electromagnetic Modeling (EM) to illuminate the hidden subsurface of the earth and reservoir simulation is used to optimally produce fields and predict the time evolution of assets. Both are highly compute-intensive activities, which push the leading edge of HPC storage, interconnect and calculation. The industry is evolving on several fronts. Changes in the underlying hardware with the advent of coprocessing or accelerator technologies and many-core CPUs are challenging practitioners to develop new algorithms and port old ones to reap the most performance from modern hardware. The explosion of data and the recent rapid development in machine learning (ML) are leading to non-traditional ways of interpreting seismic and reservoir data. The emergence of significantly faster reservoir simulation technology is breathing new life into multi-resolution and uncertainty quantification workflows.

The ability to create and mine these data relies on the optimal utilisation of supercomputers. This is the result of various synergies between industries, companies, departments and, most importantly, people. HPC IT departments (or even HPC cloud solution providers) are focused on minimising turnaround times for various workloads, but also deploy the various computing architectures in a cost competitive fashion while adapting to the fast-paced innovation in the semiconductor industry. Research groups and software application teams in both academia and industry develop new algorithms and keep abreast with the latest while adapting and optimizing existing or new production frameworks to the latest parallel programming model, language and architecture. The workshop brings together experts in order to understand state-of-the-art key applications employed in the upstream industry and anticipate what ambitions are enabled by increased computational power.

The 3-day workshop will feature oral presentations, lightning talks, panel sessions and keynotes from the leading experts in the industry, as well as insightful open discussions embedded into the workshop technical programme. Due to potential travel implications and safety reasons, EAGE and the technical committee have decided that the Fifth EAGE Workshop on High Performance Computing for Upstream will be converted into a fully online event. While we were looking forward to connecting with the community in person in Milan, we are confident that alongside a strong technical committee, we are able to deliver an excellent technical programme in a virtual setting. We look forward to welcoming you on the 6-8 September 2021 for the fifth edition of this workshop series!

TECHNICAL PROGRAMME

All times are in CEST (Central European Summer Time)

Oral Presentations | Monday, 6 September

Session Chairs: V. Etienne (Saudi Aramco) & F. Dupros (Arm)	
14:00	**Welcome Address from Workshop Co-chairs Vincent Etienne & Amik St-Cyr**
14:10	**Keynote -** Stuart Midgley (DUG)
14:50	**HP01 - Leveraging GPUs for matrix-free optimization with PyLops -** M. Ravasi[1]* [1]King Abdullah University of Science and Technology
15:20	**HP02 - Up-to-date assessment of 3D frequency-domain full waveform inversion based on the sparse multifrontal solver MUMPS -** P. Amestoy[1]*, A. Buttari[2], L. Combe[3], M. Gerest[4], J.-Y. L'Excellent[1], T. Mary[5], S. Operto[6], C. Puglisi[1] [1]MUMPS Technologies, ENS Lyon; [2]CNRS-IRIT; [3]UCA - CNRS - GeoAzur; [4]EDF; [5]Sorbonne University - CNRS - LIP6; [6]UCA - CNRS - GeoAzur
15:50	**Break**
16:00	**Keynote: Attacking Energy Challenges with AI -** Marc Hamilton (NVIDIA)
16:40	**HP03 - Hybridized discretizations for seismic wave simulations -** L. Gao[1]*, D. Keyes[2] [1]UT Austin; [2]KAUST
17:10	**HP04 - Toward High Performance Asynchronous RTM with Temporal Blocking and Buffered I/O -** L. Qu[1]*, H. Ltaief[1], D. Keyes[1] [1]KAUST
17:40	**Break**
17:50	**Panel Discussion on Accelerated Computing** Moderator: Andrew Jones (Microsoft) Panelists: Mazda Sabony (AMD) Saber Feki (KAUST) Issam Said (NVIDIA) Rajesh Gandham (Stone Ridge Technology) Nicolas Dubé (Hewlett Packard Enterprise)
18:50	**Virtual Coffee & Open Discussion**
19:20	**End of Day 1**

Oral Presentations | Tuesday, 7 September

Session Chairs: G.Youinou (CGG) & J. Phillips (ExxonMobil)	
14:00	**Introduction to Day 2**
14:05	**Keynote: The modernization of HPC applications for the cloud era -** Marco Aldinucci (University of Torino)
14:45	**HP05 - HPC in The Cloud MVP -** J. Pontvianne[1]*, D. Klahr[2], D. Cooper[2] [1]Total SE; [2]Total EP Research & Technology USA, LLC
15:15	**HP06 - HPC workload management for full resource utilization -** N. Bienati[1]*, L. Bortot[1], C. Fortini[1], J. Panizzardi[1] [1]Eni
15:45	**HP07 - Leveraging DAOS file system for seismic data storage -** M. Moawad[1]*, A. Nasr[1], O. Marzouk[1], K. ElAmrawi[1], P. Thierry[2], J. Lombardi[2], M. Chaarawi[2] [1]Brightskies Inc.; [2]Intel Corp.
16:15	**Break**
16:25	**Keynote -** Jean-Marc Denis (Atos/Bull & European Processor Initiative (EPI))
17:05	**HP08 - Cloud Elasticity Combined with Innovative Assisted History Match Accelerates Reservoir Risk Assessment -** C. Cosson[1]*, T. Taha[1], P. Ward[1], S. Tadepalli[2], D. Tishechkin[2] [1]Emerson Automation Solutions; [2]AWS
17:35	**HP09 - GEOSX: a multiphysics, multiscale, reservoir simulator for HPC -** H. Gross[1]* [1]Total EP Research & Technology USA, LLC

18:05	**Break**
Lightning Talks	
18:15	**LT01 - Performance Evaluation of Stencil Calculation in RTM Code -** S. Momose[1], Y. Kubo[1]*, M. Ikuta[1] [1]NEC Corporation
18:25	**LT02 - Nonlinear Preconditioning for Two-phase Flows -** L. Luo[1]*, X. Cai[2], D. Keyes[1] [1]King Abdullah University of Science and Technology; [2]University of Macau
18:35	**LT03 - Improving GPU throughput of reservoir simulations using NVIDIA MPS and MIG -** R. Gandham[1]*, Y. Zhang[1], K. Esler[1], V. Natoli[1] [1]StoneRidge Technology
18:45	**LT04 - Toward an application of quantum computing in geophysics -** M. Dukalski[1]* [1]Aramco Overseas Company B.V.
18:55	**LT05 - MPI + DPCPP for scalable and portable RTM -** A. Ayyad[1]*, A. Nasr[1], E. Nasr[1], I. Monir[1], M. Samier[1], M. El-Sherbiny[1], Z. Osama[1], P. Thierry[2], S. Gogar[2], C. Andreolli[2] [1]Brightskiesinc.; [2]Intel Corp.
19:05	**LT06 - Optimizing HPC Parameters for Reverse Time Migration -** R. Sampath[1]* [1]Exxonmobil Technical Computing Company
19:15	**Virtual Coffee & Open Discussion**
19:45	**End of Day 2**

Oral Presentations | Wednesday, 8 September

Session Chairs: S. Feki (KAUST) & P. Thierry (Intel Corporation)	
14:00	**Introduction to Day 3**
14:05	**Keynote: Energy Transition and the Exascale Era -** Sharda Krishna (Hewlett Packard Enterprise)
14:45	**HP10 - GPU accelerated FWI using the Open Concurrent Computing Abstraction (OCCA) -** A. St-Cyr[1]*, S. Reker[2], S. Frijters[3], S. Chawdhary[1], A. Panda[1], S. Banerjee[1], H. Knibbe[4], M. Muruganantham[5] [1]Shell India Markets Pvt Ltd; [2]Shell Global Solutions International B.V.; [3]VORtech B.V.; [4]Current Affiliation EZ Numeric; [5]Calligo Technologies Pvt Ltd
15:15	**HP11 - Opensource RTM using DPC++ programming model -** A. Ayyad[1], A. Nasr[1], E. Nasr[1]*, I. Mounir[1], O. El-Maihy[1], M. Samier[1], M. El-Sherbiny[1], Z. Osama[1], K. Elamrawi[1], S. Gogar[2], P. Thierry[2] [1]Brightskies Inc.; [2]Intel Corp.
15:45	**HP12 - GPUFORT: A source-to-source translator for Fortran accelerator dialects -** M. Sabony[1]* [1]Advanced Micro Devices (AMD)
16:15	**Break**
16:25	**Keynote: Extremely Heterogeneous HPC: Coming, Ready or Not -** Barbara Chapman (Stony Brook University)
17:05	**HP13 - Application of the vectorization library NSIMD to the EFISPEC3D kernel -** G. Quintin[1]*, S. Jubertie[2], F. De Martin[3], K. Péou[1] [1]Agenium Scale; [2]University of Orléans; [3]French geological survey
17:35	**HP14 - Performance Characterization of a Vector Architecture for Seismic Applications -** V. Etienne[1]*, A. Momin[1], L. Gatineau[2], S. Momose[2] [1]Saudi Aramco, EXPEC ARC; [2]NEC Deutschland GmbH
18:05	**Break**
18:15	**Panel Discussion on Cloud** Moderator: Suha Kayum (Saudi Aramco) Panelists: Amir Elsharony (Emerson) Diego Klahr (TotalEnergies) Marco Aldinucci (University of Torino) Karl Podesta (Microsoft)
19:15	**Virtual Coffee & Open Discussion**
19:45	**Closing Remarks & End of Event**

KEYNOTE SPEAKERS

Dr. Stuart Midgley
Chief Information Officer
DUG

Marc Hamilton
VP of Solutions Architecture and Engineering
NVIDIA

Marco Aldinucci
Professor and P.I. of the Parallel Computing
research group
University of Torino

Jean-Marc Denis
Chief of Staff, Innovation and Strategy
division Atos/Bull & Chair of the Board
European Processor Initiative (EPI)

Dr. Barbara Chapman
Professor of Applied Mathematics and
Statistics & Computer Science
Stony Brook University

Sharda Krishna
Senior Manager, HPC & AI
Supercomputing Products
Hewlett Packard Enterprise

HOW TO JOIN THE VIRTUAL WORKSHOP

The workshop will be held online, all registered and paid attendees will receive a link to join the workshop 24 hours prior to the start of the event. The time zone for the event is in CEST, and the starting time for each day is **14:00 CEST**. Please ensure you log on early to test your sound and camera to avoid any technical issues on the days of the event.

REGISTRATION

REGISTERED AND PAID	FROM 10 JUN TO 6 AUG 2021	FROM 7 AUG TO 5 SEP 2021
EAGE Green Member	€320	€370
EAGE Bronze/Silver/Gold Member	€300	€350
EAGE Platinum Member	€300	€300
EAGE Student Green Member	€160	€185
EAGE Bronze/Silver/Gold Student Member	€150	€175
Non-member*	€370	€420
Student Non-member*	€175	€200

All prices are subject to 5% VAT as per UAE regulations.

Members please note: To qualify for the member registration fee, your EAGE membership dues for 2021 must have been paid and confirmed. The processing time for membership applications or renewals is around 10 working days. To qualify for the reduced student registration fee:
- Students must be enrolled in a full-time study programme at a recognized university or institute.
- The registration must be accompanied by a copy of a student ID card and/or official proof of enrolment.

The non-member fee includes EAGE membership for the remainder of 2021. This membership will be activated shortly after the conclusion of the event. Student non-members cannot be older than 34 years of age (when registering).

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