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PROGRAMME HIGHLIGHTS

Energy is a vital substance required throughout the world to maintain our current civilisation and advance further. A significant portion of our energy needs come from oil and gas. Giant oil and gas reservoirs of the Middle East and other regions contribute to a major portion of the world's hydrocarbon supply. Mathematical models in fluid dynamics and flow through porous media play a critical role in developing and managing these reservoirs.

Today, oil companies and universities work on highly sophisticated mathematical and computational methods describing multi-phase, multi-component fluid flow in reservoirs, pipe line networks, and surface separators. Numerical solutions of these highly nonlinear coupled partial differential equations require moderate to sophisticated computing platforms.

As giant fields mature, being able to utilise the vast amount of measured data with higher accuracy in simulators paves the road to recover more hydrocarbons and thus respond to the world's energy needs. This conference will gather mathematicians and engineers to address challenges in mathematical modelling of compressible multi-phase flow in porous media with reactions, fractured media, flow in pipes and pipe networks, coupled numerical solution of porous and non-porous media, geomechanics, diffusion, dispersion problems, unstructured grid generation, linear and nonlinear solvers, multi-grid methods, new discretisation methods, parallel computing, hybrid computing involving multicore CPUs and GPUs, scientific visualisation of large data, real field studies for giant oil and gas reservoirs using simulators.

Session 1: Scalable Solvers for Linear and Nonlinear Systems

Session Chairs:

- **Arthur Moncorge**, Total
- **Kees Vuik**, Delft University of Technology
- **Klaus Stueben**, Fraunhofer Institute for Algorithms and Scientific Computing
- **Knut-Andreas Lie**, SINTEF

A primary challenge for reservoir simulation is the accurate description of multiphase flow in porous, highly heterogeneous and fractured media with very complex geometries. The lack of robust and efficient solvers for fully implicit formulations is still one of the main bottlenecks that most simulator developers face in the oil and gas industry. Generally, the underlying systems of partial differential equations are nonlinear, highly non-symmetric, and indefinite. The condition number and degree of coupling of these systems may be subject to dramatic changes due to abrupt flow variations induced by the high-heterogeneity and complex well operations during the simulation process.

In addition, reservoir models have been growing in complexity regarding geometry, discretisation and physical models including, for instance, thermal and chemical influences, geomechanics, heterogeneity, and size, causing these systems to get increasingly large and difficult to solve. In fact, the computational time required to solve these systems of equations is still a major bottleneck in the practicability of numerical simulation. Hence, advanced reservoir simulators need to combine the numerical scalability (optimality) of efficient solvers with the parallel scalability of modern hardware.

This session addresses all relevant numerical aspects such as the efficient and robust treatment of linear and nonlinear problems, the treatment of fully coupled systems (either the Jacobian directly or by CPR-type approaches), efficient preconditioning techniques, fast linear solvers (hierarchical solvers such as multi-grid or multi-level ILU as well as parallel performance aspects).

Session 2: Big Data Discovery and Its Impact on Decision Making

Session Chairs:

- **Ahmet Duran**, Istanbul Technical University
- **Hector Klie**, ConocoPhillips
- **Sylvain Desroziers**, IFP Energies Nouvelles

Data discovery or mining of large volumes of data is a challenging but, without a question, a revolutionising topic in several branches of science and engineering. Major challenges include acquisition, cleaning, storage, transformation, and visualisation of these data to be able to extract relevant knowledge that may lead to improved predictive models, reliable decisions, and ultimately, unlock new business opportunities. In the oil and gas