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INTERSECT Full-GPU Simulation

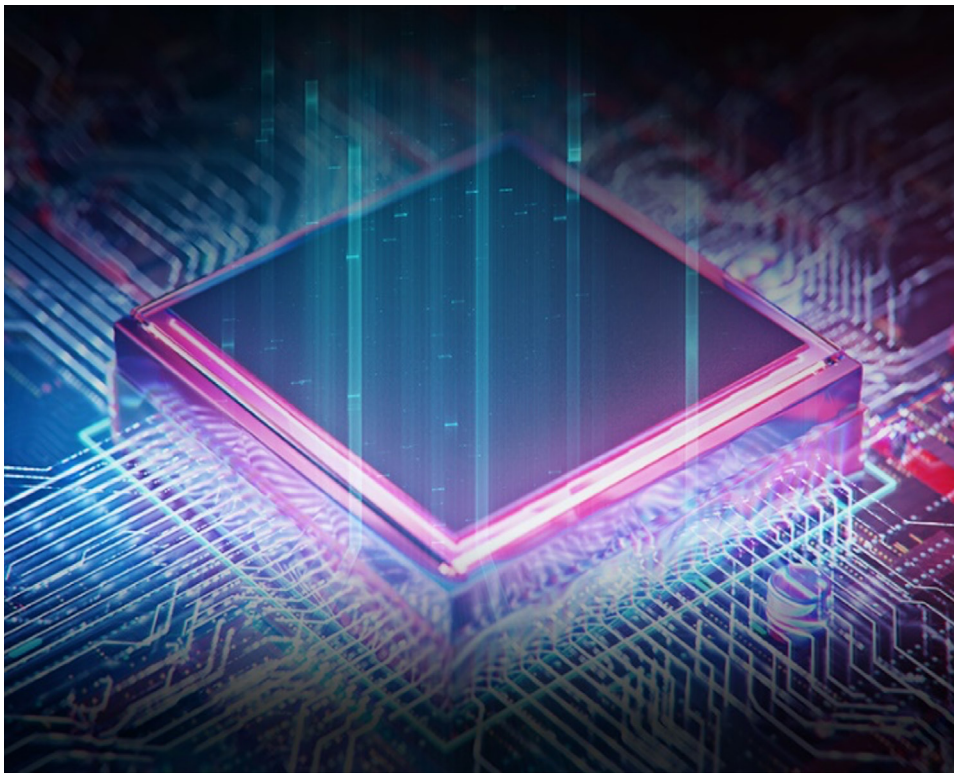
Harness the power of GPU

Overview

- Full-GPU black-oil reservoir simulation
- Available in INTERSECT 2021.3 on Linux platforms
- Single-GPU support for P100, V100, and A100 NVIDIA cards

Benefits and features

- Accelerates your simulation studies
- Provides a hardware-agnostic solution
- Delivers consistent user experience across implementations
- Includes a bespoke linear solver that scales with GPU parallel capabilities
- Produces dramatically faster property calculations and linearization of equations
- Contains an optimized reporting code for improved performance



The INTERSECT 2021.3 release now supports full-GPU simulation for black-oil models. Reservoir engineers can now explore the full potential of the INTERSECT* high-resolution reservoir simulator with the best hardware available, CPU or GPU—the solution is now fully hardware-agnostic, to optimize the price-performance of the simulation runs. The addition of the full-GPU simulation capability preserves the user experience, robustness, and accuracy of the INTERSECT simulator.

Faster simulations, same user experience

Key components have been re-written for GPU in INTERSECT 2021.3. The Linear Solver is a bespoke implementation that significantly outperforms the previous versions. The algorithm is tailored to take full advantage of the large-scale parallel capability of GPUs.

The calculation of grid properties and the linearization of the reservoir equations take place on the GPU, making them significantly faster than the CPU implementation. The reporting code has been redesigned to increase performance, especially when using GPU for the simulation.

We have developed a ‘full-GPU’ simulator that is both efficient and robust. An extra benefit is that the reservoir engineer does not have to carry out additional steps to achieve the same results and behavior as achieved in the CPU implementation.

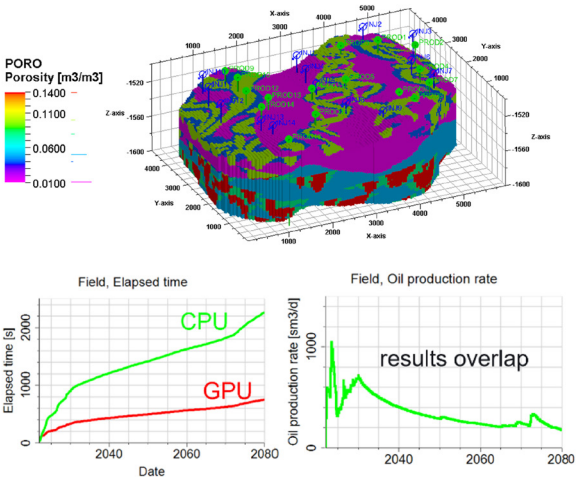
INTERSECT

A truly hardware-agnostic simulator

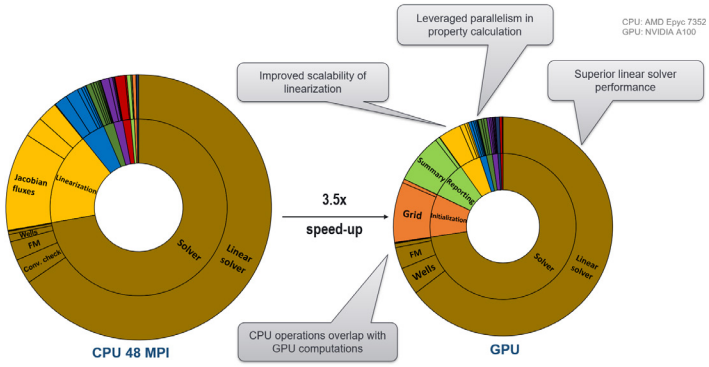
Reservoir simulation is composed of a series of complex processes each with distinct characteristics. Some of these processes are more compatible with CPU architecture, while others are better suited for GPU architecture. The balance between each architecture is extremely case-dependent and can be reversed with minor modifications to the dataset, such as numerical tuning.

Although GPUs have impressive raw computing power capability, they are more expensive in terms of both fixed and operating costs. It is therefore not straightforward to compare simulation on GPU and CPU. Absolute performance speed-up values are of relative importance. Another factor to consider is the price-to-performance ratio to determine what run throughput will be achieved in return for the investment. Given the wide variability of performance behavior, the user may question investing in a software that is locked to a specific hardware configuration.

The addition of full-GPU simulation included in INTERSECT 2021.3 makes it an optimum solution as a hardware-agnostic simulator. The user can choose the best hardware available.



A highly heterogeneous fluvial channel reservoir under waterflood, with a comparison of results between GPU and CPU runs.



An example of the balance shift in calculations between CPU and GPU simulations

Case study: fluvial channel waterflood

Consider a waterflood scenario in a reservoir with a fluvial channel. With 2.3 million active cells, the main challenge is a high petrophysical contrast between the main channel and the background facies, and a permeabilities range from 1 to 1,500 mD. A field management approach indicates a drilling pattern of 16 producers and 14 water injectors for sequential drilling as rigs become available. The simulation predicts a field life of 58 years.

The case study compares the use of a single computing node, where 48 CPU cores are available (2× AMD 7352) with an NVIDIA A100 GPU card. Running this model in the INTERSECT simulator in both CPU and GPU formulations provides identical results, with no changes needed to the data deck. GPU also outperforms the 48-way CPU run by a factor of three, which is significant for this model and hardware combination.

Get the best performance with INTERSECT high-resolution simulator, no matter the type of hardware. The GPU implementation is a result of the combined expertise in the partnership between Schlumberger, Chevron, and TotalEnergies.

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