CASE STUDY: Arm HPC tools helps Tullow Oil make waves in seismic processing

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Tullow Oil is a leading independent oil and gas exploration and production company with a focus on finding and monetizing oil in Africa and the Atlantic margins.

Software developed in-house to analyze seismic survey data is used to accurately identify oil and gas reserves in the subsurface.

Increasing the performance of that software directly translates to faster turnaround of important results, and ultimately, more confidence in well location decisions.

CHALLENGE
Software for seismic processing must be optimized to meet business needs at an industrial scale

Working with the Irish Centre for High End Computing (ICHEC), Tullow Oil used development tools from Arm HPC tools to provide valuable insight in the performance optimization process, reducing development time and costs.

Performance is Critical

Reverse Time Migration (RTM) is fast becoming one of the staples of the industry in seismic processing. It is a high-fidelity method for constructing images of the subsurface from the data gathered by arrays recording seismic pulses (shots) reflected from below the earth's surface.

Compared to earlier processing methods, it can generate higher quality images, particularly where the geology is complex. The cost of that uplift is of an order of magnitude increase in computational complexity.

Sean Delaney, Computational Geophysicist at Tullow Oil explains: "When developing TORTIA (Tullow Oil Reverse Time Imaging

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Dr. Sean Delaney, Tullow Oil

Application), one of our RTM codes, performance and time were major issues. We needed minimal turnaround times and computational cost. The scales are enormous, and there is a lot of processing to do."

Providing Insight

Tullow engaged ICHEC for their insight in the development of an industrially optimized code. Delaney was a Computational Scientist in the centre at the time and was engaged on the project.

The team used Arm Performance Reports and Arm Forge as the primary parallel debugging and profiling tools on the project.

Arm Performance Reports summarizes the performance of any application and shows the time and characteristics of the compute, memory, I/O and communication - and enabled the group to target their efforts.

Saving Time

"Performance Reports can save many hours gathering performance statistics. It was one of those few times in high performance computing where you press go and it works."

"Its ease of use and the comprehensibility of the report made it very convenient for us, especially when tracking progress."

"From the programmer's perspective, it confirms where your performance is going and tells you where the application is spending time - and it was both clear and succinct when presenting our work to senior management," adds Delaney.

Easier Debugging - at Scale

The Arm Forge development tool suite, which includes the debugger DDT and performance profiler MAP, was regularly used on the project.

"I had been a big fan of "printf" based methods of debugging, having not used many parallel debugging tools in my early career."

"However, once I started using DDT on parallel code, debugging became a much less arduous experience. Its ability to run at scale was critical - and saved us time, potentially saving days of fault finding in many cases."

Unleashing Performance

Using Arm MAP for profiling enabled early challenges of scalability in I/O and MPI communication to be identified.

"MAP really delivers when running it at scale - it highlights if you have one process behaving differently to another which can be really hard to track down by other methods."

Optimization Success

Michael Browne, Technical Manager at ICHEC, sees the results of the engagement as a model for how their work benefits industry:
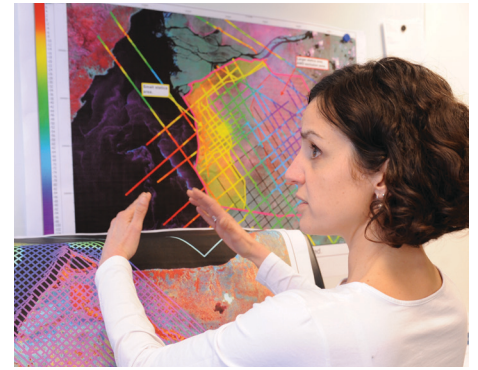
"ICHEC's ongoing partnership with Tullow complements their capabilities in seismic processing and provides a competitive benefit to one of Ireland's most innovative companies. Productivity matters to both ICHEC and Tullow: using Arm HPC development and performance tools enables us to use our expertise more efficiently."

As for Delaney, he is now employed by Tullow Oil as a Computational Geophysicist and is excited about the ongoing development and strategy of the business.

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Looking to the future he adds, "I don't think there will ever be a time when the oil industry isn't crying out for more compute power. Leveraging new technologies in terms of the physics and the types of codes we run are part of our core strategy as a company, so it's a really exciting time."

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