Ansys

Ansys + Lumotive

"We designed every nanometer of this metasurface using Ansys Lumerical FDTD, Amazon Web Services (AWS), and Python API while making it compatible with CMOS fabrication tolerances. Lumerical's AWS solution allowed Lumotive to scale its design cycle by two to three orders of magnitude without additional cost or accuracy compromises."

Prasad Iyer
Senior Lidar Engineer / Lumotive

Business Need

Lumotive is an innovative startup developing solid-state lidar for the automotive industry based on revolutionary beam-steering technology that leverages semiconductor chips designed using metamaterials and enables lidar systems to achieve compact size at low cost. Lumotive's goal is to revolutionize perception systems in the emerging self-driving car industry.

Lumotive's lidar products are based on their advanced beam steering technology using liquid crystal metasurfaces (LCMs). Their LCM technology was designed and optimized with Ansys Lumerical FDTD on AWS. Lumotive's innovation provides a clear step forward from the relatively immature state of beam-steering technology based on LCMs. To achieve success in developing their lidar systems, they needed the ability to quickly and accurately model and validate the beam-steering performance of their LCM design. The most important requirement was an efficient method for predicting anisotropic permittivity and the response of the liquid crystal at the nanometer scale.

Lumotive's primary challenge when simulating LCM performance was the requirement to model large-area optics while including the nanoscale features representing CMOS process variations. Specifically, they needed to capture optical properties at a macro-scale length (> 100 µm) with nanoscale (< 5 nm) precision. This requirement created significant computational complexity for Lumotive. Their on-premise computing resource proved insufficient, so they set out for a new solution for their simulation needs.

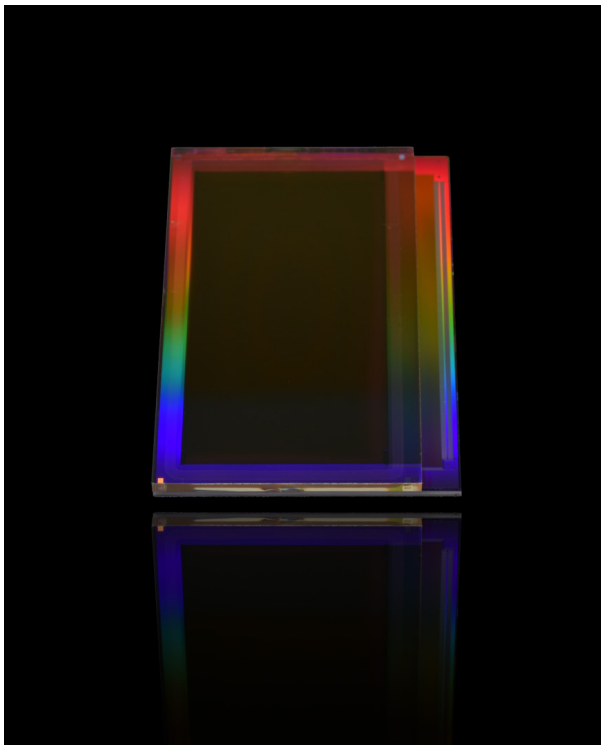

Figure 1. A liquid crystal metasurface developed by Lumotive with Ansys Lumerical FDTD on AWS.

Lumerical's HPC Solution on AWS EC2

Lumotive considered several HPC solutions to accelerate large-scale simulations, but in the end, they decided to go with a cloud solution on Amazon Web Services (AWS) powered by Ansys Lumerical FDTD. This decision was driven by the accuracy and run-time performance of Lumerical FDTD coupled with its amenability to HPC and the cost-effective flexibility of Amazon's cloud solution.

Lumotive was able to achieve their aggressive design goals with a custom workflow developed with the support of Lumerical. Lumerical's Python API was an essential part of this custom flow to achieve runtime scalability and the interoperability needed for Lumotive to exploit the open-source tools necessary for optimization and post-processing. Prasad Iyer from Lumotive says, "We designed every nanometer of this metasurface using Ansys Lumerical FDTD, AWS, and Python API while making it compatible with CMOS fabrication tolerances."

AWS provides a secure, resizable computing capacity with an easy-to-use web interface. It offers a convenient way to buy compute time on demand and makes it possible to access multiple large servers, paying only for the actual time used. Such flexibility is attractive to Lumotive as they require massive computing resources for only a short duration during the development cycle. Further, due to the flexibility of Lumerical FDTD, jobs can be greatly sped up by running large simulations using several servers concurrently. The cost is similar to running on one server for a longer period.

High-performing Ansys Lumerical FDTD works seamlessly with EC2 and can be launched in minutes. Only a few steps are needed to launch a typical FDTD simulation, including the creation of a virtual private cloud, the activation of security and license management, and the definition of a launch template. A cost-effective solution runs an Ansys Lumerical FDTD engine on Amazon Linux without a graphical interface. Simulation files are stored in S3 to remove the need for costly transfers to and from the cloud.

/ Results

With the help of Lumerical's HPC solution, Lumotive rapidly scaled their simulations to AWS. The ability for individual simulations of Lumerical FDTD to be distributed across many computing cores provided extremely high levels of parallelism. This rapid scaling allowed Lumotive to reduce their design time by two orders of magnitude without compromising on accuracy. Previous simulations running on their workstations that would take hours now finished in minutes.

In addition to improving the performance of their simulations, workflow improvements made possible by Lumerical's Python API were critical for Lumotive to optimize designs that were dependent on many independent process parameters and constraints. The Python API further enabled Lumotive to make use of state-of-the-art open-source optimization algorithms to maximize the performance of the LCM while maintaining highly accurate simulations.

Lumerical's HPC using AWS provided Lumotive with a solution that is scalable, cost effective, and flexible. Lumotive was able to confirm the correct functionality of its LCM, allowing them to deliver their product on time. Without Lumerical's solution, this level of validation would not have been possible, as the runtime on conventional hardware would be unreasonably long. Further, the cost of procuring dedicated hardware would not be justifiable for a task needed only intermittently for a small portion of the design cycle.

Lumotive's Iyer says, "Lumerical's AWS solution allowed Lumotive to scale its design cycle by two to three orders of magnitude without additional cost or accuracy compromises."

ANSYS, Inc.
Southpointe
2600 Ansys Drive
Canonsburg, PA 15317
U.S.A.
724-746-3304
ansysinfo@ansys.com

When visionary companies need to know how their world-changing ideas will perform, they close the gap between design and reality with Ansys simulation. For more than 50 years, Ansys software has enabled innovators across industries to push boundaries by using the predictive power of simulation. From sustainable transportation to advanced semiconductors, from satellite systems to life-saving medical devices, the next great leaps in human advancement will be powered by Ansys.

Visit www.ansys.com for more information.