a.i. solutions

Space exploration engineering company leverages the cloud for trajectory analysis and design

a.i. solutions

a.i. solutions' staff of 450 people, in six sites throughout the U.S., provides engineering services to government agencies and private industry focused on space missions.

a.i. solutions' Deep Space Trajectory Explorer provides the computational software and graphical front-end for astrophysicists to analyze, explore, and select trajectories for orbital insertions, and other similar problems during the design phase of projects such as NASA's Deep Space Gateway missions, planned for the 2020's.

Finding cost-effective compute power for parallelizable problems

Engineering problems like trajectories and orbits involve complex, multi-dimensional calculations. Calculating one low orbit is not difficult for a modern computer, and university students calculate the impact of small changes to such orbits every day. However, once multiple nearby sources of gravity, such as the moon and earth, are involved, the effect of very small changes, such as the amount or direction of acceleration, result in dramatically different outcomes – from landing gently, to orbiting safely, to flying off into space.

During mission design, engineers need to explore a large problem space, and consider many different potential solutions carefully.

"You can't just start with a single orbit and intuitively know the impact small changes will have. You have to iteratively compute the impact of changes over time for each change you're considering to see the actual result. This gives you an enormous set of potential solutions. Selecting the best solution is then something humans and computers do well together," said Dr. Diane Davis, Principal Systems Engineer.

High Performance Computing (HPC) – up and running quickly – only when you need it

While developing the Deep Space Trajectory Explorer, the team discovered that ordinary workstations didn't have the computational power they needed. Artificially restricting the problem, or the space of potential solutions wasn't an option for producing the best results, so the team was stuck waiting a long time for computations to complete.

"Even though each computation might take 10 milliseconds or less, when you need to perform millions of those computations, you're going to be waiting – a full day in some cases. Constraining your problem by throwing away potential solutions results in losing important

"We don't need that much hardware all the time, so it would never have been cost-effective to purchase it all. When we started exploring Oracle's cloud, everything just worked – it was easy to get our JAVA 8 streaming API and Ubuntu environment up and running in minutes. We started in March, and by June we demonstrated the live solution running in real-time, displaying spacecraft trajectories to the audience, selecting and modifying them from a tablet"
- Sean M Phillips,
Principal Software Engineer

WHY ORACLE?

- Dependable, burstable performance, suitable for their High Performance Computing (HPC) application
- 52x increase of capacity compared to local resources

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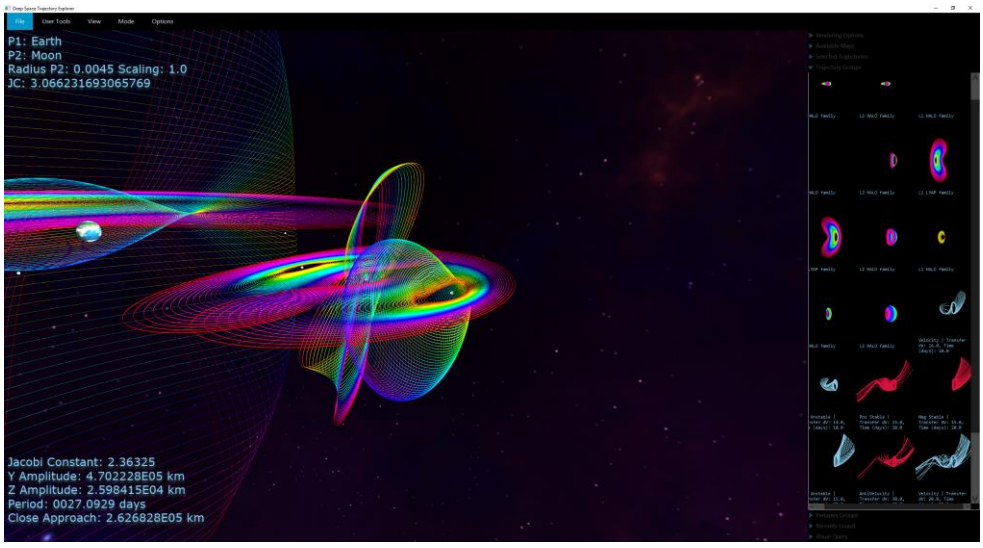
insights. But throwing cores and RAM at the problem means we don't have to do that, and speeds our time to solution dramatically. With Oracle, we can spin up several bare metal compute instances, running our software, in minutes. The software then returns filtered and ranked results, which our engineers can then explore visually with our toolset," said Sean M. Phillips, Principal Software Engineer at a.i. solutions.

"We don't need that much hardware all the time, so it would never have been cost-effective to purchase it all. When we started exploring Oracle's cloud, everything just worked – it was easy to get our JAVA 8 streaming API and Ubuntu environment up and running in minutes. Oracle Cloud Infrastructure, combined with third-party data streaming tools like Gluon's CloudLink provided a strong technical implementation pattern to build on. We started in March, and by June we demonstrated the live solution running in real-time, displaying spacecraft trajectories to the audience, selecting and modifying them from a tablet."

Prior to using Oracle Cloud Infrastructure, the team was limited to computing about 25,000 independent trajectories per run – less than 2% of the typical design space. This forced analysts to spend a lot of time and energy attempting to organize the order of computations and estimate which areas of the design space were of highest priority, which risks missing potential solutions. Running the same task on Oracle Cloud Infrastructure Compute bare metal instances relieved these limitations. The numerical engine can now process, filter and return approximately 1.3 million independent trajectory maneuvers, a 52-fold improvement.

"Someday, solutions like this have the potential to move beyond the design phase to the operational phase of missions," Sean continued, "Imagine being able to instantly deploy a large cluster of servers to securely analyze every conceivable solution to a Mars mission trajectory problem, and select the best within minutes."



About a.i. solutions

a.i. solutions' work is rooted in finding solutions that further space exploration. For more than 20 years, they have designed, analyzed, and operated space missions of all sizes. Their flight dynamics engineers and software developers have created robust solutions to address a myriad of mission-based challenges, including space situational awareness, flight dynamics systems, and orbit and trajectory design.

SOLUTION

- Oracle Cloud Infrastructure Compute
- Oracle Cloud Infrastructure Block Volumes
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