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What's Up MAK

Beyond Training

MAK's VR-Forces software expands the limits of learning through simulation

Tech Tip: Scene Graph Debugging Tools in VR-Vantage and VR-Forces

Built-in debugging tools help you with your terrain development process.

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Learning Without Limits

It's not just for training: MAK's VR-Forces software expands the limits of learning through simulation with its ability to be extended and customized. From wargaming to experimentation to prototyping, we take a look at how people are learning new things everyday with VR-Forces. *By Rob Hamilton*

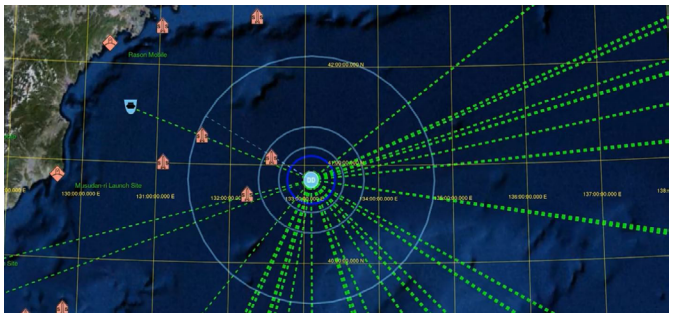
At MAK, we believe that modeling and simulation exist for one true cumulative purpose – learning. Sure, our products are diverse and flexible in order to support all aspects of a simulation system, but ultimately, anyone using our components is trying to learn something they didn't know yesterday. Typically, one might associate learning strictly with training, but in this article, we take a look at the kinds of learning that happens in many non-training disciplines — experimentation, operational analysis, research and development, wargaming, mission rehearsal, and virtual prototyping.

Wargaming

When developing strategies to defend against intercontinental ballistic missile attacks, analysts can use Wargaming techniques to model and test alternatives. The positioning of defensive and offensive assets can be studied with respect to the timelines of potential scenarios to best prepare for a range of possible threats.

The modeling of a particular attack, for example, might begin with the launch of many ballistic missiles, which would be detected by sensor systems aboard Navy vessels at sea. Detection of the launch is passed along to destroyers and submarines as well as to anti-missile batteries stationed at strategic locations on land. The submarines might be the first to act, responding with an array of cruise missiles that attempt to destroy and incapacitate the threatening launch sites. Simultaneously anti-missile batteries would use their radars to search the sky for incoming missiles. After detection, interceptor missiles would be launched in an attempt to eliminate the threat.

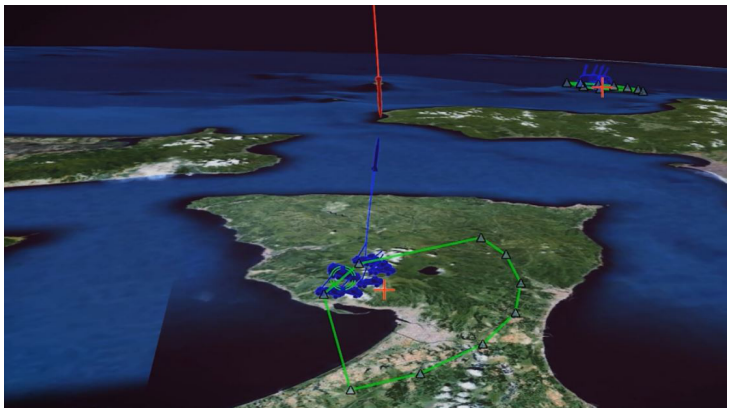
Click on the play button above to watch a video of the full missile wargaming scenario!



The Destroyers detect the launch and immediately notify the submarines and ant-missile batteries.

VR-Forces helps analysts create and run scenarios like this to study the interactions and likely effectiveness of their choices. VR-Forces batch mode allows them to run many iterations of a scenario to better understand the probability of the outcomes.

VR-Forces makes this type if simulation possible by enabling users to supply Missile Hit Tables into the VR-Forces simulation that define the probability of missile on missile interception. Using the VR-Forces API, users can accurately model missile behavior, both in terms of flight trajectory and interception probabilities. As new research is conducted and new air defense system prototypes are developed, these tables



The anti-missile batteries lock onto the incoming missile and intercept it before it can strike.

can be easily modified to recalibrate for the changing capabilities. VR-Forces also offers a variety of modes to help visualize the size and position of the threat and effective ranges of the anti-missile systems, making it easier to understand defense strategies.

Reactive Armor Prototyping

Certain customers of MAK conduct R&D/Virtual Prototyping in simulation to learn how the mechanics and engineering of a defensive system work. By better understanding the functionality and limits of a system, they can achieve a very high performance capability.

For example, reactive armor is a technology designed to intercept incoming threats approaching from relatively close proximity to the vehicle. Engineers need to determine how quickly a tank can detect an incoming grenade, how quickly a targeting system can lock onto it, and how effectively different launcher prototypes can aim and fire to successfully conduct the interception in time. Inside a simulation, engineers can model a vehicle with this system and put it through a variety of tactical situations.

VR-Forces is designed with extensibility in mind, so that engineers can add or customize features that they need for their project. In this case, the engineers used the API to develop an HLA Time Management capability, perfect for calculating complex interceptions in very accurate ways. Because the calculations for interception are extraordinarily complex and time is very limited, oftentimes the computer running the simulation cannot complete all the calculations in real time. In this case, the engineers modified VR-Forces to manage time by slowing down the simulation to increments of 1/1000th of a second, allowing time to run all the calculations in order to accurately model super fast weapon systems and their mechanisms needed to shoot down incoming rockets. When the engineers need to maximize the speed and accuracy of every aspect of an interception system, VR-Forces is flexible enough to give them clarity into the tiniest windows of time.

Ground-Based Air Defense Experimentation

In a case of experimentation and R&D, analysts are looking to develop a modern, state-of-the-art ground-based air defense system that uses logic to prioritize targets. By experimenting with prioritization algorithms, shot patterns, and ammunition types, an analyst can determine which threats pose the greatest risk to sensitive areas.

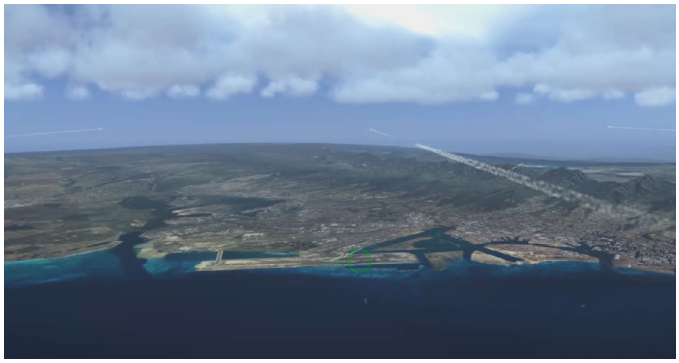
Click on the play button above to watch a video of the full GBAD Experimentation scenario!

Missiles launched by the surface vessels approach the priority zones.

2-D and 3-D views give this analyst a synthetic sandbox to test out this system against a variety of threats (and non-threats) and determine the algorithm that will maximize its effectiveness. In one particular case, the analyst's air defense system is protecting three target areas with different levels of priority — low, medium and high. Six threats are established, three aircraft and three ships. The surface vessels fire three missiles, one at each of the target zones. The air defense system calculates position, direction vector, and speed to determine which priority areas each missile is attacking. In this case, the system's algorithm determines that it should eliminate the missiles in order of the vulnerability of the zones they are threatening. As such, the system adjusts its order and shot pattern to reflect that priority, firing multiple interceptors at the missile threatening priority number one, then one interceptor at number two, and finally, one at number three. After those threats have been vanquished, the air defense system turns on the aircraft themselves, destroying them with its missile system.

As the jets above try to distract the air defense system, surface vessels launch a missile attack.

VR-Forces provides unique, informative displays for this simulation, with 2-D and 3-D displays that illustrate important information, including radar domes, effective firing range, and entity identifiers.



Te air defense system unleashes a group of missiles to intercept the incoming attack.

An important aspect of the VR-Forces API that allowed this analyst to model his targeting priority, is the ability to customize the Target Selection Controller within the VR-Forces framework. This controller dictates the priority of incoming threats, as well as details like ammunition type and shot pattern to use against those priorities. The VR-Forces API can be used to rewrite that code and modify behaviors, testing the default setup of the system and prototyping new behaviors that improve results.

Ultimately, the customer was able to build and model a high-fidelity air defense system into VR-Forces using the VR-Forces API. They were then able to modify that model to develop the best air defense system possible because of VR-Forces.

The interception is successful, and the priority zones are safe.

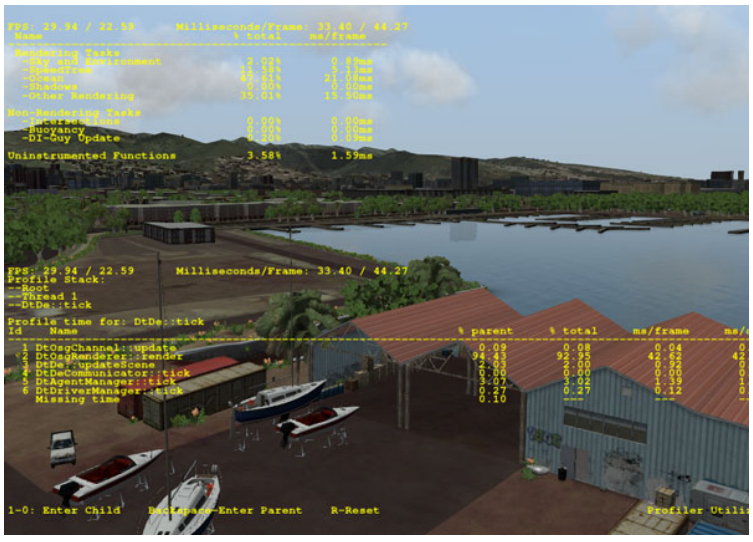
When you look around, everyone using MAK products seems to be learning something, even when they aren't training. Simulation is a fantastic tool for getting an advantage on the opponent, and we're happy to bring flexibility and extensibility to maximize the capabilities of our customers' simulation sandboxes.

Tech Tip: Scene Graph Debugging Tools in VR-Vantage and VR-Forces By Fred Wersan

Many factors affect the visual quality and performance of terrain databases and terrain developers must be able to assess the effect of their decisions when building terrains. VR-Vantage and VR-Forces have some built-in debugging tools that can help you with your terrain development process. This tech tip is a brief survey of some of these tools.

OSG Statistics Display. Includes frame rate, cull time, draw time, GPU usage, and the number of drawables and other terrain data.

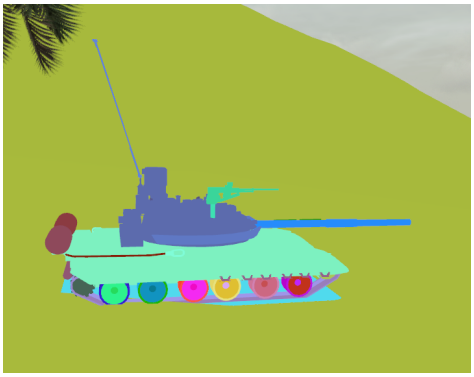
VR-Vantage Statistics Display. Displays time spent on rendering tasks, such as sky, SpeedTree, ocean, and shadows. Also, intersection, buoyancy, and DI-Guy updates.



Function Profiler. A profiling system that you can use to profile a function or portion of a function and provide on-screen results.

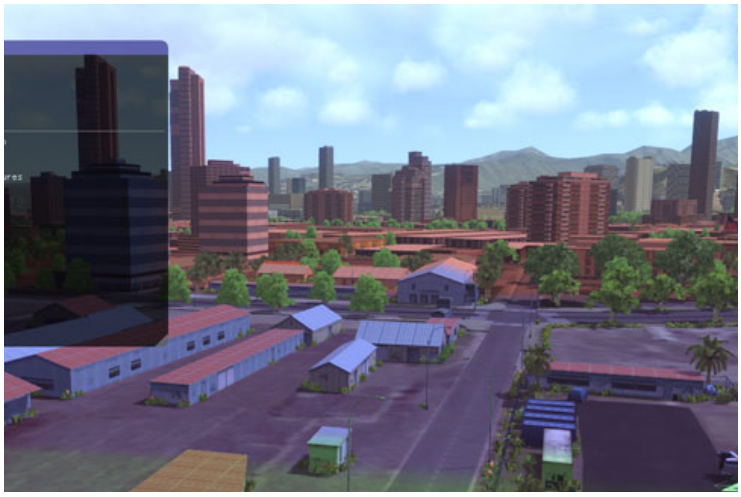
osgEarth Debugging. The osgEarth Profile dialog box lets you turn osgEarth layers on and off to see how they affect performance. You can change the opacity of a layer and view the effect **of lighting on it.**

Colorizing Drawables. You can colorize the draw calls in a scene so that you can see which objects have large number of drawables that might affect performance.



Wireframe view. Displays the polygons in the terrain.

Developer Debug Overlay. The developer debug overlay (built using the Dear ImGui API) lets you test changes to visual features, including ocean setting, lighting, and shadow settings. Developers can use the API to add additional test features.



Shader Component Visualization. You can change the display to show different shader components, such as bumpmaps, specular poser, ambient light, and albedo.

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We attended ITEC last month in Stuttgart, and we were featured in several magazines around the show. Ben Lubetsky was interviewed about how MAK's suite and how it works with the cloud, he gave his take on the state of the industry and the importance of innovation, and MAK's updated software suite made the news!

Follow us on Facebook, Twitter, and LinkedIn! We bring frequent updates, show news, videos, and sneak peeks of MAK products.

We want to make sure you can always see the latest news from MAK, not just at the beginning of the month - so we created a new version of our news page on our website! Take a look there to find the latest press releases, product releases, timely blogs, and newsletters from the world of MAK.