

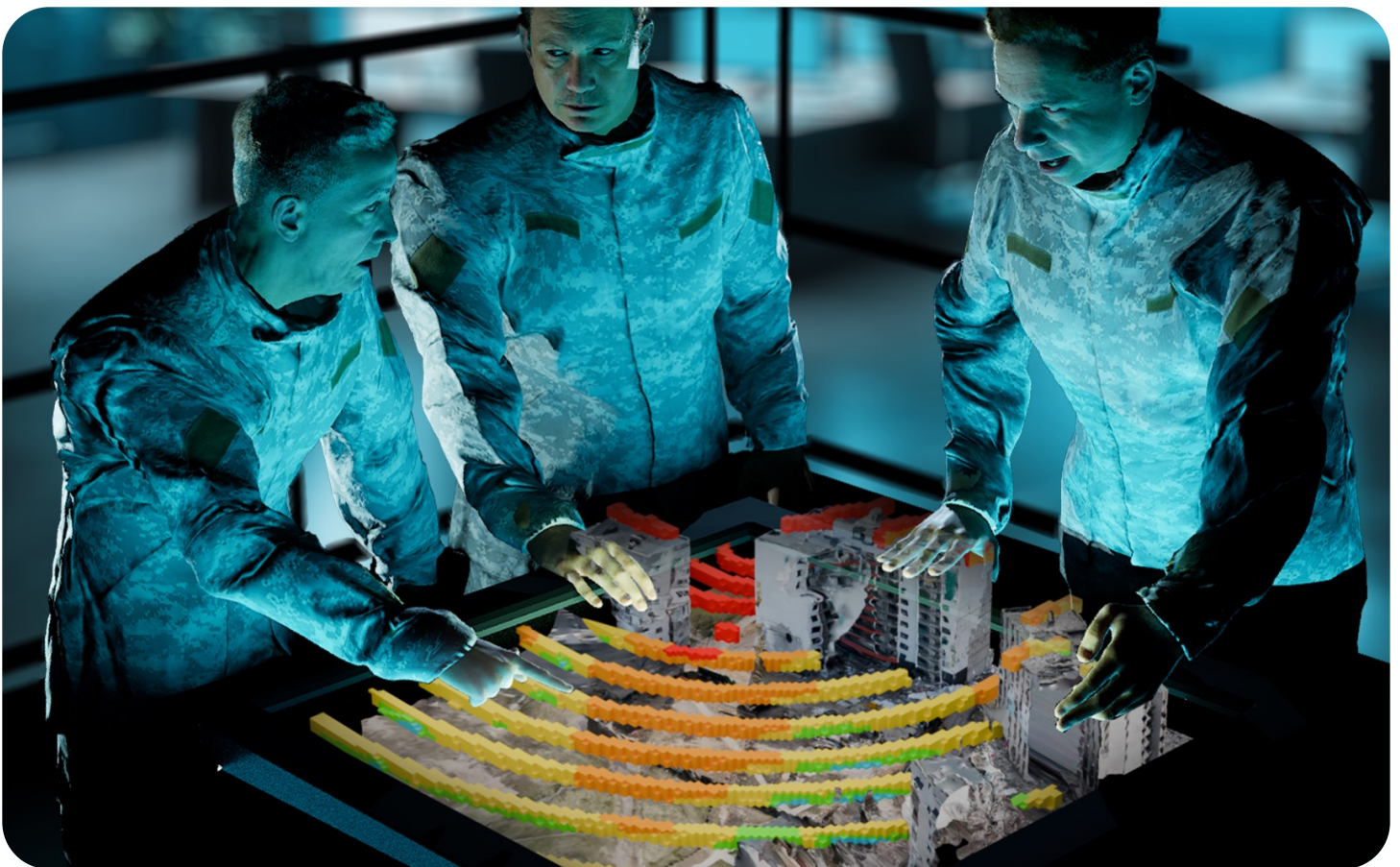


Holographic Display for Complex RF Visualization

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Executive Summary

Avalon's NOVAC is a cutting-edge holographic display system poised to redefine complex visualizations. Tailored to address the evolving challenges of modern defense landscapes, NOVAC enhances situational awareness and facilitates collaborative planning by providing a true 3D visualization experience. Designed for seamless interoperability with established systems like TAK and radio planning tools like CloudRF, NOVAC integrates diverse battlespace data into a unified 3D display, enabling defense agencies to navigate complex scenarios with unprecedented precision and efficiency. With a 40" diagonal screen, 74-degree viewing angle, and over 5 billion rays, NOVAC offers an immersive visual interface that transcends current display capabilities, empowering users to make informed decisions and optimize resource allocation.

NOVAC's versatility extends beyond its technical specifications, offering tangible benefits across a spectrum of defense applications. Whether enhancing mission planning through dynamic 3D visualizations of flight paths and terrain features, optimizing radio planning by visualizing RF propagation in varying scenarios, or facilitating virtual training by enabling adaptive learning experiences, NOVAC serves as a pivotal asset in modern defense operations. Its ability to ingest and integrate real-time data—ranging from sensor inputs and topographical data to dynamic threat assessments—enables defense personnel to make informed decisions and adapt strategies in real-time, enhancing operational effectiveness across diverse defense sectors. Supported by robust endorsements from defense communities and successful engagements with major contractors, NOVAC stands as a testament to Avalon's dedication to advancing defense capabilities through cutting-edge technology.



Avalon NOVAC™ Display

Holographic Display Technical Specifications and Capabilities:

NOVAC solves these long-standing data visualization problems with powerfully detailed holograms that provide a natural 3D Common Operating Picture and Battlespace Situational Awareness. Designed to be interoperable with existing systems like TAK and cloudRF, NOVAC delivers a 3D view without the need for any headsets or awkward accessories. By reducing cognitive load and improving operational tempo, NOVAC empowers users to make better decisions, faster.

NOVAC stands as a pioneering platform that adeptly ingests critical battlespace data, encompassing intricate details like terrain and bathymetry, through universally recognized OGC formats such as 3D Tiles, as well as ingesting common data sources like Google Maps and Esri. Future data sources like One World Terrain (OWT) can be easily integrated.

Going beyond mere topography, NOVAC seamlessly integrates platform and entity information into the dynamic 3D environment either via predefined scenarios or a robust API framework. Furthermore, the platform can ingest a diverse array of inherently 3D sensor data types – including but not limited to SONAR, radar, and RF – into the unified 3D scene. The culmination of these capabilities manifests in a truly immersive holographic viewing experience, enabling stakeholders to engage with complex data sets in a natural, intuitive manner, thereby fostering enhanced situational awareness and informed decision-making within defense, intelligence, and public safety sectors.

NOVAC is 40" diagonal screen, has almost a foot of depth, more than 5 billion rays, and can be seen by multiple viewers.



Technical Requirements

Display	
Screen Size	40"
Resolution	63,888 x69,696 5 Billion Rays of Light. Equivalent to 2,500 HD TVs
Active Pixels	4.5 Billion
Aspect Ratio	1:1 (Square)
Light Field	
Number of Viewers	6-8
Viewing Angle	74 degrees x 74 degree viewing angle (other optical configurations available)
Dimensions	
Size Dimensions (L x W x H)	3.5' L x 3.2' W x 2' H
Weight	929.5lbs, 422.5kg
Power Consumption	6700 watts
Software Details	
Battle Management System Integration	SIMDIS, TAK, AFSIM, Google Maps, One World Terrain, ESRI/ArcGIS, etc

Operational Problems

Understanding Interference in MIMO Configurations:

Current network configurations such as 5G Cellular, Wi-Fi, Satellite, and others take advantage of Multiple Input Multiple Output (MIMO) which involve multiple transmitters and multiple receivers that enhance performance, capacity, and reliability. However, the complexities of MIMO configurations result in difficulty understanding interdependencies between multiple parameters such as multiple channels, interference, phases, and power. Fresnel zones impact signal quality through constructive and destructive pathing, and the complexity of multi-path makes configuration and maintaining networks with multiple moving users and potentially moving base stations incredibly difficult to maintain.

Dynamic Directional Antennas

In a near peer conflict, reducing comms signature on the battlefield is a critical component. A well-known tactic is using directional or "line-of-sight" antennas. However, these antennas have complex antenna patterns and not only do the main, side, and back lobes need to be considered but the gratings, scattering, and nulls as well. In a dynamic environment, being able to maintain comms using directional antennas can be cognitively overwhelming.

UAS and c-UAS

Drones are now ubiquitous on the battlefield. There is a constant battle for C5ISR data in drone warfare, both in acquiring it and denying it to the enemy. Understanding the tens, hundreds, and soon thousands of nodes, how they can communicate and reducing their signature and EW vulnerability, all while still maintaining dominance over the enemy, creates a high cognitive load, even when managing mostly autonomous systems.

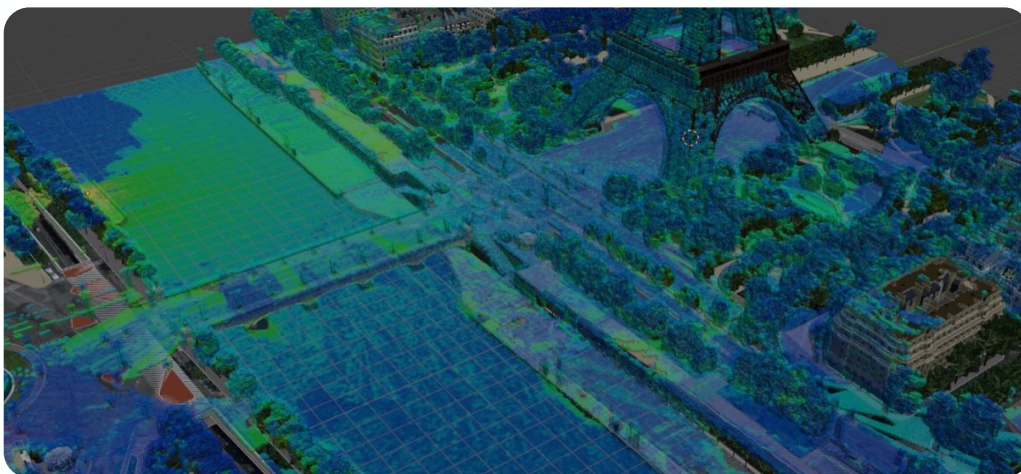
Understanding Phased Array Beam Patterns in Dynamic Environments

Phased Array radars have been used for decades on a multitude of platforms. However, the capabilities of Phased Array radars including beam forming, agile frequency and waveform adaption are difficult to understand, especially when presented with possible Electronic Counter Measures (ECM) such as jamming, spoofing, and decoys. The cognitive load of remembering the different courses of action in the complex environment can be overwhelming.

Expected Use Cases

Deconflicting MIMO Communications Networks in Dynamic Environments

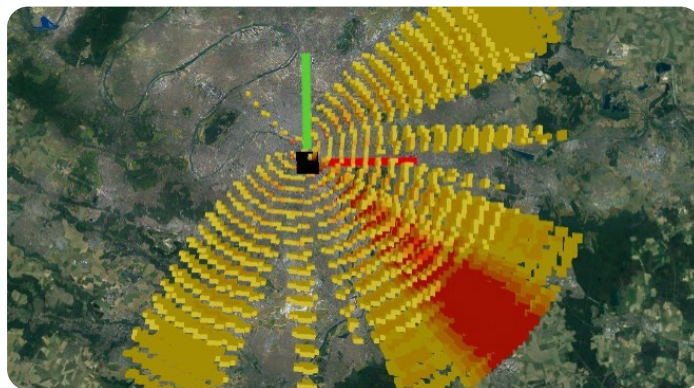
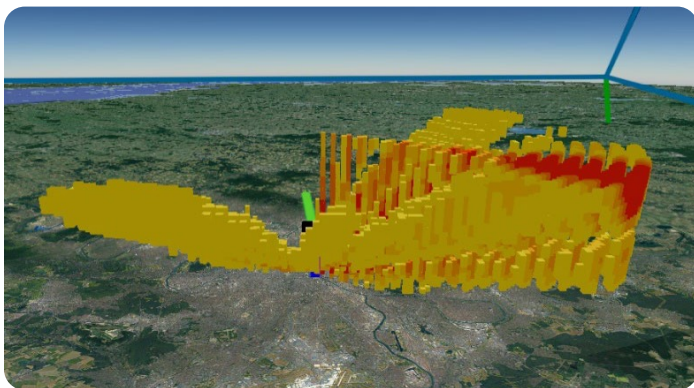
Using a holographic display can significantly aid in understanding, deconflicting, and optimizing complex communications networks. The nodes and topology are inherently 3D, and therefore in addition to being able to visualize the dynamic network topology, being able to visualize beam forming, interference mapping, and resource allocation would reduce the cognitive load on a signals operator in configuring and maintaining the network in real-time.



*image courtesy of CloudRF

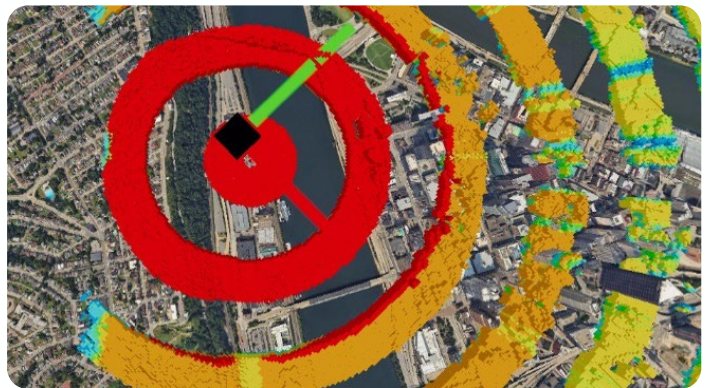
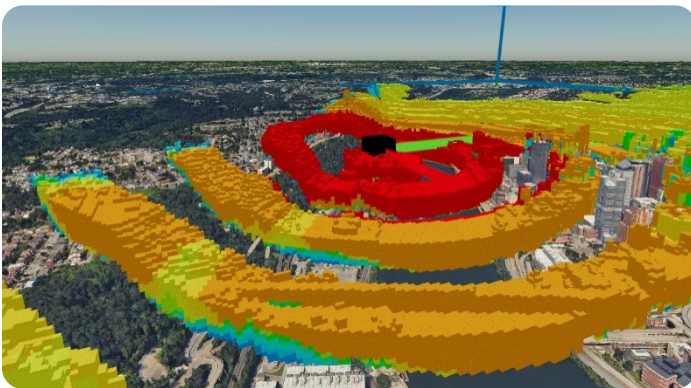
Realtime Adjustment of Directional Communications in Contested Environments

Visualization of a directional antenna's pattern is crucial on the battlefield as it enhances strategic deployment to minimize electromagnetic signature. By understanding the precise beam shape and direction, operators can aim signals narrowly towards intended receivers, reducing the risk of interception by adversaries. This focused transmission not only strengthens communication security but also diminishes the chance of detection and targeting by enemy electronic warfare systems. Effective holographic visualization aids in optimizing antenna orientation and positioning, ensuring robust, covert communication while maintaining tactical advantage. By using a holographic display at an Operations Centre, Command can significantly aid the forward operator with secure and reliable communications.



Planning and Operational Execution of Uncrewed Systems and c-UAS

A 3D holographic display could significantly improve both UAS and counter-UAS operations by offering enhanced situational awareness, spatial understanding, and real-time data visualization. For UAS operations, this technology could empower operators with a more immersive view of the battlefield, reduce cognitive load, and facilitate collaborative decision-making. In counter-UAS efforts, holographic displays could enhance detection, tracking, and precise targeting of hostile drones, while also providing defenders with better situational awareness and enabling realistic training simulations. Integration with countermeasures could optimize their deployment and effectiveness.



Operational Awareness for Air Surveillance and Electronics Combat

Integrating a 3D holographic display into platforms such as AWACS aircraft provides unparalleled advantages for Air Surveillance Officers (ASOs) and Electronic Combat Officers (ECOs). This technology offers enhanced situational awareness by providing a comprehensive three-dimensional visualization of the battlespace, facilitating more accurate target identification and threat assessment. The interactive nature of holographic displays enables intuitive manipulation of data, reducing cognitive load and enhancing decision-making speed. By seamlessly integrating data from multiple sensors and sources into a cohesive visualization, ASOs and ECOs can effectively correlate information and coordinate responses to evolving threats. Ultimately, the adoption of 3D holographic displays could revolutionize the way AWACS crews operate, leading to increased mission effectiveness and safety in monitoring airspace and conducting electronic warfare operations.

Traction/Testimonials

Avalon has been engaged with the defense community for over 7 of our 9 years. Battlespace visualization is the most consistently identified early application for holographic displays. We've closed greater than \$14M in contracts, primarily with major defense contractors and the Canadian government. Support from both Canada's Department of National Defence (DND) and the US Department of Defense (DoD) has been strong and steady. A select set of testimonials appears below (where appropriate, Chatham House Rules apply):

End Users:

"This would be especially useful tracking targets in difficult environments like urban settings. If I could deploy this tomorrow, I would."

– Active Operator (CANSOFCOM)

"We lost people in an operation, and during AAR we realized we missed key sightline info during mission planning. I think this technology could have made the difference in saving them."

– Active Operator (SOCOM)

"I feel like I'm looking at the very first steps of a technology that will one day be as commonplace as LCD monitors or seatbelts."

– Lead assessing advanced battlespace visualization and interaction technologies (Army Research Lab, DoD)

"We've tried every 3D technology out there, and they all disappoint. This is the real deal; I've been waiting my whole career for this."

– Ed Chaulk, Naval Combat Systems Officer, Maritime Warfare Center (Canadian Navy)

"Avalon will sell a lot of tabletop light field displays; even with a multi-million dollar price."

– Operator, Joint Innovation & Technology Battlespace (JITB) (Canadian Navy)

Prime Contractors:

"I was skeptical, but after seeing the demo, I've had our CTO add this to [our] Technology Roadmap."

"Avalon's holographic display technology will revolutionize how underwater data is visualized."

"Avalon represents a new generation of pioneers, opening frontiers for the future use of effective, yet unobtrusive methods of visualization."

Government Contracts

Avalon has been awarded several contracts under Canada's Innovation for Defence Excellence and Security (IDEaS) and Innovative Solutions Canada (ISC) programs. These are structurally similar to the US SBIR program, with similar goals. Specifically:

1. Holographic Battlespace Visualization: Modified SIMDIS – Littoral sight lines & RF coverage
 - Completed Phase 1a & 1b (equiv. to SBIR 1 & 2), discussing Phase 2 (SBIR 3)
2. 3D Visualization for Complex Info. Systems (w. MDA) – Completed Phase 1a
3. Holographic Space Situational Awareness: Conjunction Assessment & Collision Avoidance, Suspicious (RSO) – -- - Completed Phase 1a
4. It's Not Just Noise: Acoustic Tools (w. Kongsberg Geospatial): Visualization of sonar data – Completed Phase 1a
5. Making Data Make Sense: RT Rapid Decision Making (w. 3D Planeta/Terris): Visualization and analysis of GIS data
 - Completed Phase 1a & 1b, discussing Phase 2
6. ISC-Testing Stream 1, 2 & 3: 1st Sales
 - Sold preNOVAC to DRDC Halifax; testing completed recently
 - Sold kidNOVAC to Navy Innovation (Canada)
 - Pre-Qualified to sell HighGround software to Navy Innovation (Canada)

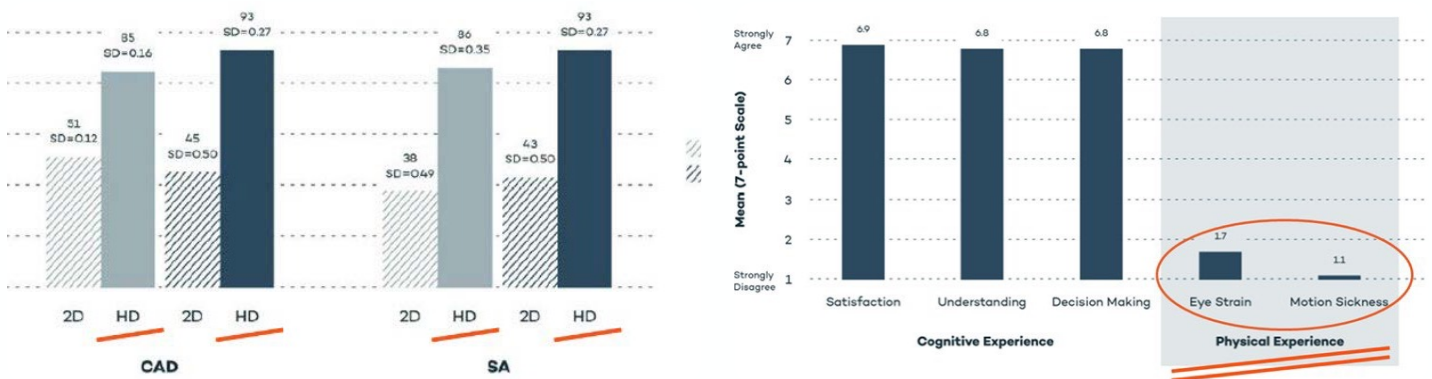


Holographic Benefits

Holographic prints are already used in several defense applications, and interest in displays has been prevalent for over 20 years. The constant drive for 3D graphics, taking off in the 1990s and evolving into today's VR and AR technologies, and the repeated issues and limitations encountered by these technologies, only reinforces this. The interest derives first from an intuitive sense that viewing information in natural 3D, the same way we observe the real world, must inherently be more efficient and effective. Human beings and our visual systems have evolved to react and respond to the natural light field very quickly, as a survival mechanism. Therefore, when we need Situational Awareness in a three-dimensional context, an obvious conclusion is that the best way to view this 3D information is as we view the real world. The use of constructed physical models (including 3D printing) in recent times, such as in the buildup to the Bin Laden raid, is a constant reminder of this desire. And as noted previously, space is always dealt with in a three-dimensional context.

Studies show that holographic visuals significantly reduce cognitive load by 20% to over 50%, allowing operators to make faster, more accurate decisions, and enabling faster learning and better retention in training. Most studies were limited to printed laser holograms, but full motion digital holograms are expected to offer better results. Avalon has also conducted early prototype studies that show significant cognitive advantage: decision making accuracy improvements of 67%-126% and no viewer discomfort.

Qualitative Study Results (Avalon Holographics)



Rough Order of Magnitude (ROM) Cost Estimate

The Rough Order of Magnitude cost for the NOVAC system is five million dollars. While very expensive now, this technology represents a multi-generational leap in information consumption and can be an integral part of force protection. The long-term benefits in terms of enhanced situational awareness, improved decision-making, and operational effectiveness position make NOVAC as a vital asset for defense organizations committed to safeguarding national security interests.