C3.ai

Enterprise AI for Missile Defense Modeling and Simulation

1000x

increase in the available threat data for a given scenario

99%

reduction in the time to generate threat data, from weeks to minutes

26 Billion

data points used to train and generate threat kinematic ML model

The Missile Defense Agency (MDA) is a large research, development, and acquisition agency in the U.S. Department of Defense. Their mission is to develop, rigorously test, and field reliable, state-of-the-art defenses against current and projected missile threats. These defenses include ground, sea, and space-based sensors, interceptor missiles, and command and control systems.

Live testing and exercises of missile defense systems are costly and complex, and MDA relies on modeling and simulation to support many facets of its mission. Modeling and simulation are critical components of activities such as designing missile defense systems, defining optimal architectures and laydowns of system components, and establishing the concept of operations (CONOPS) for how those systems are used. Nearly all these simulations require accurate models and representations of threat missiles to ensure that the Missile Defense System (MDS) can succeed in its mission.

Today, MDA creates limited threat missile data using highfidelity physics-based models and simulations to satisfy minimum test coverage needs. This results in inadequate stress testing of components and architectures, sparsely defined envelopes on which to design systems or run analyses, and the inability to meet demand for the quantity or scale of threat data needed as testing requirements evolve.

To address these challenges, C3 AI has collaborated with MDA to develop a method to deploy the C3 Agentic AI Platform and the C3 AI Parametric Threat Generative Modeling application within its secure, classified environment. They demonstrated the proof of concept with a representative threat object and are completing a full threat definition that will be available at the end of this fiscal year. With this capability, agency personnel will be able to rapidly generate large threat data packages in data-starved environments for a broad spectrum of missile defense technology initiatives. Additionally, the agency will be able to significantly accelerate developing and deploying state-of-the-art artificial intelligence techniques by leveraging the C3 Agentic AI Platform as a shared Enterprise AI toolset across development teams.

The C3 AI team deployed the C3 Agentic AI Platform into MDA's secure environment and achieved Authority to Operate (ATO) accreditation for its V8 platform. The C3 Agentic AI Platform is accredited for operational missile defense data and is globally accessible across all MDA sites with the proper connection. MDA plans to start populating the threat library in FY26 with new threat definitions for use by stakeholders in that year.

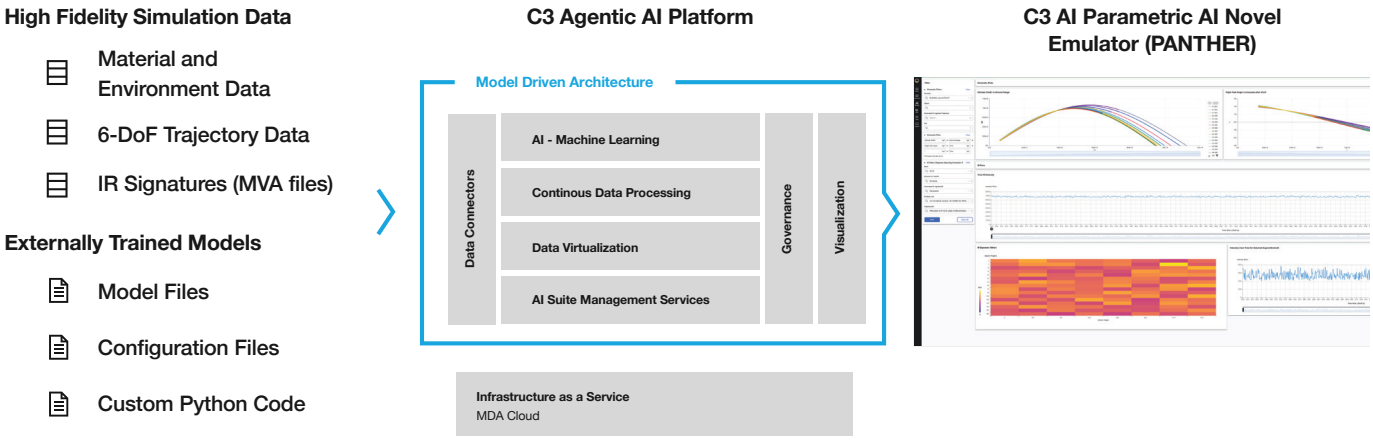
Solution Architecture

MDA data scientists used the C3 Agentic AI Platform to train or deploy ML models used for trajectory and infrared (IR) signature generation for specific missile threats. The C3 AI team, in close collaboration with the MDA Threat Systems Engineering group, developed and demonstrated the following AI generative modeling capabilities through a rigorous process of training and validation by MDA subject matter experts:

Kinematic models
that generate missile trajectories with three degrees-of-freedom in 3D space at a frequency of 1 Hz. Over 250,000 missile trajectories encompassing over 26 billion data points were used to train and build kinematic models.

Infrared signature models
that generate missile IR emissive and reflected signatures at a frequency of 1 Hz across 128 pairs of aspect and azimuth angles. Over 390 million IR signature data points are used to train and build corresponding IR models.

Threat data packages
that encompass a diverse set of threat data including trajectories and signatures over a specified region of the parametric threat space. They are available in various MDA standard outputs, including the Ballistic Missile Reporting Data (BMRD) format.



The C3 AI Parametric AI Novel Threat Emulator (PANTHER) application supports easy integration of third-party ML models. The C3 Agentic AI Platform's modular open-source architecture (MOSA) enables any MDA data scientist to code, train, and develop models in their preferred environments and coding languages and seamlessly import them into the platform. The C3 AI PANTHER application also serves as a threat model repository hub for data science teams to share and collaborate. Threat engineers can log into the application to view the inventory of threat models, review the model description and validation artifacts, generate novel scenario threat data packages, and verify scenario outputs via analytic plotting functions.

By using the C3 AI Parametric AI Novel Threat Emulator application, MDA can:

- Generate accurate threat data for new scenarios within minutes or hours instead of weeks or months.
- Provide a dynamic generative machine learning framework capable of generating advanced missile trajectories to satisfy the entire envelope for design and test optimization.
- Accelerate systems development by providing a certified set of threat data in time to meet the demand of MDA integrators and partners.
- Build, train, manage, and deploy AI solutions and models in a centralized hub accessible to all MDA users with a classified network connection to support a broad spectrum of technology initiatives.

Proven Results in Initial Production Deployment

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