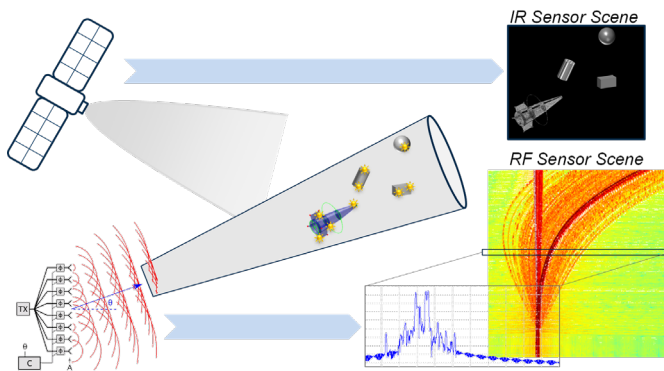


# Axient Capability Highlight: Integrated Sensor-Scene Modeling & Simulation: Physics-Based Unlimited-Scalability Simulation Environment (PULSE)

## PULSE Motivation

Single Source of Truth Data: PULSE supports activities across the system engineering “V” by providing a common source of truth data representing the entire fully integrated threat scene. This shared technical framework ensures consistent representation from requirements to design, through HWIL testing, operational testing, and warfighter training and mission planning.



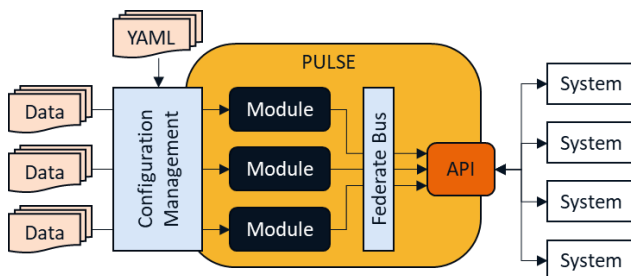
Software Integration Simplification: The IAMD scene is described by a wide range of models that must be integrated into many weapon/missile system simulations which is costly and error prone.

Data Configuration Management: TBs of data comprising hundreds of thousands of files. Decades of data products with dozens of file naming conventions and formats

## PULSE Architecture

PULSE employs a federated architecture which offers “best of both worlds” features:

- Integrated threat scene modeling
- Standard interface
- Ease of integration of new capability
- Ability to breakout/deliver individual or subsets of modules as standalone simulations



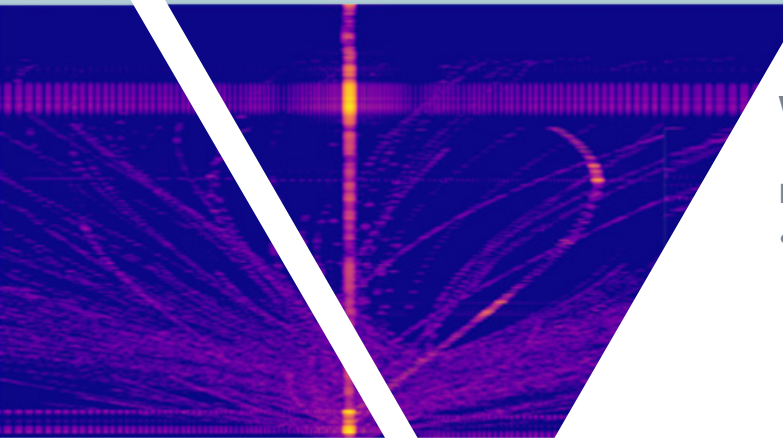
## What is PULSE

PULSE is an integrated sensor-scene generation simulation framework providing frame registered sensor truth data for complex scenes. It includes modules that simulate debris, corporate clutter, and other phenomena for a wide variety of integrated air and missile defense applications and hosts a user-defined vehicle model library. Currently hosted vehicle models include the MDA common threat library, Navy Intelligence ATEP models and MSIC OMEGA models. PULSE supports individual RF scatterer, per object RCS, and convolved RF scene output as well as IR signatures and scenes comprising point-sources and resolved images. PULSE provides a framework for SME analysis of threat systems and weapon system performance impacts in an adaptable M&S framework with a federated architecture to allow for fast integration of a wide range of tools for various applications.

## PULSE Legacy

PULSE is the culmination of Axient’s threat scene over 25 years of threat engineering experience serving the Navy and Missile Defense Warfighter and Intelligence Community by providing high-fidelity, physics-based threat engineering models representing the integrated air and missile defense threat scene. Axient provides advanced engineering solutions in the form of intelligence analysis, threat system engineering and physics modeling, expert systems of systems engineering, sensor prototypes, software, algorithms & models, missile M&S from component to All-Up Round (AUR), US and foreign system experience, and highly specialized scene generation and M&S products for R&D labs, DoD, industry and warfighters. All of these models and simulations are available through PULSE.





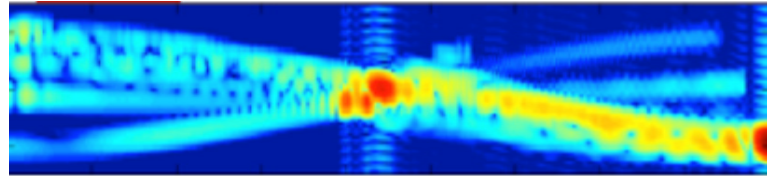
## What is in PULSE?

Physics Modules Currently in Software Federation:

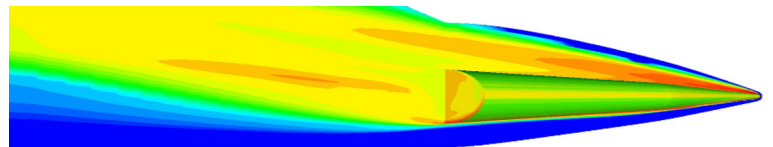
- Principal Object Trajectory: High-fidelity physics-based modeling of principal object kinematics including propulsion, 6DOF Aerodynamics, CAD-based mass properties, and GNC. Supports pre-generated data read from files, trajectory optimization, and fully integrated on-the-fly modeling.



- RF Scatterer/Signature: Modeling of Radar returns of objects in the scene based on a variety of selectable fidelity tools and techniques including method of moments based on detailed CAD models, physical optics approximations, and mathematical models



- IR Signatures: Modeling of IR emissions of objects in the scene as either point-sources or fully resolved images
- Hypersonic Atmospheric Waking: High-fidelity physics-based modeling of RF properties of endo-atmospheric wake characteristics of a hypersonic vehicle. Includes RF signature of the wake itself as well as attenuation of the PO's hard-body signature



- Debris and Clutter Phenomenology: Physics-based modeling of various debris phenomena represented in threat scenes including post-intercept debris, solid fuel, separation hardware, break-up debris, and other sources. Debris is initialized either statistically or using higher fidelity methods and is propagated using selectable fidelity propagators (3DOF, 3+3DOF, 6DOF) and can be down-sampled to improve performance. RF and IR Signatures are calculated using selectable fidelity representations including up-sampling, shadowing, and multi-bounce where appropriate.
- Scene Construction: the RF and IR signatures of objects in the scene can be convolved and returned to sensor simulations through the API.

## Where is PULSE?

PULSE and Component Sponsors:

- |                   |                    |
|-------------------|--------------------|
| • MDA/AB          | • DoN M&S          |
| • NSMWDC          | • IWS 1 (CSTB)     |
| • NSWC DD         | • MDA/DE           |
| • NSWC CDR        | • MDA/AB           |
| • MIT/LL          | • IWS10 (ETB)      |
| • JHU/APL         | • Kratos           |
| • Raytheon M&D    | Technologies       |
| • Lockheed Martin | • Mitsubishi Heavy |
| • IWS 1 (CSTB)    | Industries         |

Other Axient-SEG GFI Threat Data Users:

- |              |               |
|--------------|---------------|
| • MDA/AB     | • OASIS/ACSIS |
| • MDA/DE     | • RTSS        |
| • LM ATL RSG | • OSF         |
| • NGS        | • ONI         |

## About Axient

Axient is headquartered in Huntsville, Alabama and is a proven leader in providing nationally significant services and solutions in defense, space, and commercial programs to the Federal Government, with deep domain expertise and capabilities in space & missile engineering solutions; systems engineering & integration; modeling, simulation & decision analysis; and test, evaluation, and logistics.