

Modeling & Simulation



TriVector's M&S experts are widely known for their diverse M&S capabilities and *experience*; and for developing innovative M&S solutions to our customers' critical requirements. At TriVector, we provide our customers with superior M&S *performance* and exceptional *value*!

Our People

- ▶ 65% 25+ Years Experience
- ▶ 49% Engineers
- ▶ 42% Advanced Degrees
- ▶ 25% Subject Matter Experts

Our Customers

- ▶ U.S Army: AMRDEC (ED, S3I)
- ▶ MDA: GMD (RKV)
- ▶ NASA: MSFC (SLS)
- ▶ Commercial Industry

Modeling & Simulation Processes & Procedures

- ▶ Model Based Systems Engineering
- ▶ Vehicle Architecture Concept Model Development
- ▶ Command and Data Handling/Software Timing
- ▶ Software Verification, Validation & Accreditation
- ▶ Building Damper Modeling

Our Modeling & Simulation Tools

- ▶ MATLAB – SIMULINK, MAVERIC, SPENVIS
- ▶ RKVSim, GMDSIM, Piranha, STRIDE
- ▶ IBM Rhapsody, Magic Draw, JAVA, Others

Exploring and Validating System Solutions... Delivering System Confidence



Ground Based Mid-Course Defense Piranha M&S Validation

GMD's Piranha software suite is a medium fidelity tool for simulating and analyzing the entire midcourse timeline. Piranha's models and algorithms are real world system approximations and require validation. TriVector's task is to validate Piranha against GMDSIM, a hi-fidelity simulation previously validated against flight testing. We gathered GMDSIM performance parameters and acceptance criteria from its validation documentation and mapped these to their Piranha counterparts. We created a JAVA-based validation package, within Piranha, to perform the collection, analysis, and validation of Piranha parameters and algorithms. TriVector's validation package will provide confidence in Piranha's simulation and analysis results.

U.S. Army AMRDEC STRIDE Tool Development

For the AMRDEC's rapid prototyping missile simulation model development, TriVector's engineers created and implemented a set of algorithms to predict solid rocket motor thrust profiles based on motor case properties and propellant grain geometry. Additionally, our algorithms predicted mass properties of the solid rocket throughout the flight profile, enabling more accurate trajectory analysis and simulation. TriVector directly leveraged experience gained from work we performed for the Stratolaunch launch vehicle development effort to provide this tool set. As a result, the AMRDEC STRIDE simulation model was successfully tested against commercially available data regarding medium and large-sized solid rocket thrust profiles.



NASA Space Launch System (SLS) Control System and Flight Analysis

TriVector supports the NASA Guidance, Navigation, and Controls organization in analyzing the unique SLS control system. Our experts verify the flex models, select the models' appropriate modal content, and analyze time and frequency domain data from multiple sources. Our analysis results are input directly into NASA's high fidelity, 6-DOF, flight control simulation software, MAVERIC, to evaluate performance. TriVector also derived a model to fully visualize the bending modes of rocket-type vehicle bodies during flight. NASA uses this visualization program to better understand and demonstrate the SLS flex behavior. TriVector's analyses continue to advance SLS program success.

U.S. Army AMRDEC RKVSIm Objective Evaluation

The AMRDEC System Simulation & Development Directorate (SSDD) Modeling and Simulation Division required a continuous evaluation of the software being developed to simulate the Redesigned Kill Vehicle (RKV) interceptor data. The software, RKVSIm developed by Raytheon, is used to simulate the interceptor timeline. TriVector was tasked with evaluating Raytheon's RKVSIm incremental source code drops. Our team received the drops, inspected the source code, compiled the code, ran the program, and delivered reports documenting our findings and issues we encountered. We not only found code errors, but also errors in logic and behavior. However, our continuous evaluation allowed for early detection and quick and efficient correction early in the software process.



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