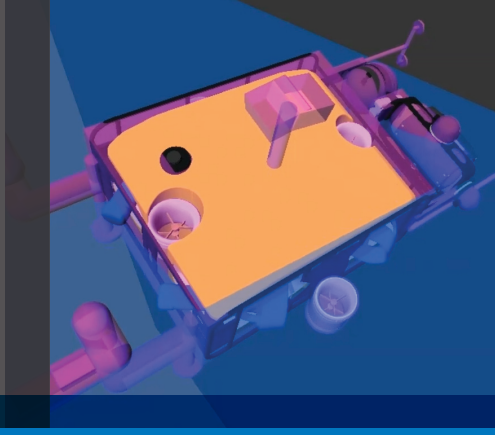
Battelle Autonomy Solutions

ADVANCED MODELING AND SIMULATION



FULL PRODUCT LIFE-CYCLE MODELING AND SIMULATION SOLUTIONS

Battelle is a leader in modeling and simulation for progressive engineering systems, providing custom virtual environments to facilitate state-of-the-art engineering processes for the full product life-cycle – from visualization of a new product concept, to virtual prototype analysis, to product testing and verification, and continuing on through post-deployment optimization and operator training across domains and platforms.

CAPABILITIES:

- Design concept animations
- Rapid virtual prototyping
- Data analysis and visualization
- Product testing and verification
- Automated product optimization
- Operator training systems
- Custom land or sea virtual environments

BENEFITS:

- Reduced cost, risk and time
- Makes concept systems and data easier to understand
- Design validation prior to prototyping
- Optimized product performance and quality
- Increased product success

FEATURES:

- Virtual modeling allows for extensive analytical testing processes with iterative software algorithms that are not possible with traditional hardware-based testing

- Experiments can be run continuously with millions of permutations of design variables to achieve desired outcomes by minimizing or maximizing on key performance metrics

MTRS MK1/PackBot simulation in Battelle's EOD Robot Training Simulator (ERTS).

PRODUCT LIFE-CYCLE PHASES

1. VISUALIZE

Accelerate product development by creating rapid prototypes of products and processes in a physics-based 3D simulation environment. Visualizations can be used to communicate advanced concepts to project/program stakeholders.

2. ANALYZE

Conduct analysis without the cost of early hardware experimentation by developing a testing environment for virtual prototypes in a physics-based 3D simulation environment.

3. VERIFY

Ensure product candidate integrates properly into open architecture systems with virtual compliance and verification testing.

4. OPTIMIZE

Optimize product performance through automated testing processes and statistical analysis of captured metrics.

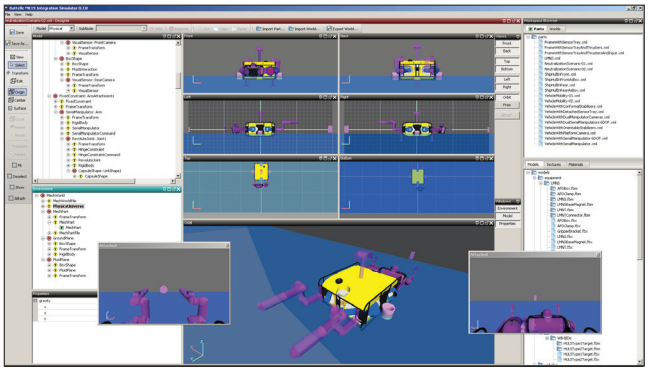
5. OPERATE

Provide low-cost training systems for operators by reusing same suite of simulation tools and virtual environments as used in product development, verification, and optimization phases.

BATTELLE

OFFERINGS:

- Simulation Architecture for Mobile Systems (SAMS) – a toolkit to support formal engineering analysis, test and evaluation for autonomous systems
- Custom virtual environments for state of the art design, development and engineering processes
- Accurate geo/environmental simulations – for mission-specific operations in real world locations
- Real-time physics simulation for maritime and ground robotics – demonstrating complex and dynamic environment interaction
- Robust, accurate network emulation for compliance and verification of open architecture systems



Conceptual maritime vehicle designed within Battelle's suite of modeling and simulation tools.

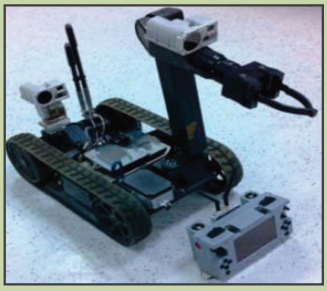
CASE STUDY:

Advanced Explosive Ordnance Disposal Robotic System (AEODRS)

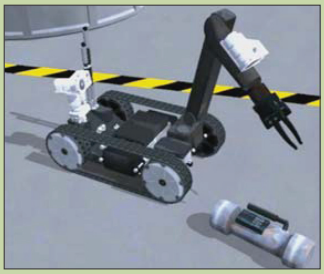
Battelle is the provider of the physics-based simulator for the AEODRS program of record, a Joint Service EOD program for developing the next generation of military ground robots. Each of the three robot platforms is simulated with the Simulation Architecture for Mobile Systems (SAMS) and can be connected to prototype hardware modules using the program-selected open architecture network protocol called Joint Architecture for Unmanned Systems (JAUS).

Project Benefits:

- SAMS verifies newly defined interfaces by exercising the logical and communications architecture of the system completely in software simulation before any physical parts are even ordered.
- SAMS accelerates the design cycle and drastically reduces costs over the lifetime of the product development timeline, as compared to the traditional approach of building costly hardware prototypes that may only show only incremental improvements between versions.
- SAMS is used extensively in pre-production prototype testing and evaluation, where models are more accurately simulated to resemble an as-built hardware prototype robot; evaluations are performed to assess effectiveness of designs through comprehensive virtual testing scenarios that would otherwise be too risky or costly to run in the real world.



AEODRS Increment 1 Robot As-Built Hardware Prototype



AEODRS Increment 1 Robot Simulated Virtual Prototype

Every day, the people of Battelle apply science and technology to solving what matters most. At major technology centers and national laboratories around the world, Battelle conducts research and development, designs and manufactures products, and delivers critical services for government and commercial customers. Headquartered in Columbus, Ohio since its founding in 1929, Battelle serves the national security, health and life sciences, and energy and environmental industries. For more information, visit www.battelle.org.

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