



Battelle PathPlan™ Software

AUTONOMOUS MOTION PLANNING SOFTWARE

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Real-time, predictive collision free-path planning

From robotic manufacturing and maintenance operations to manual process automation, Battelle's PathPlan™ autonomous motion planning software reduces risk and increases quality and efficiency for industrial robots operating in complex or high-stakes environments.

Utilizing scan-to-path and CAD-to-path motion planning and real-time, predictive collision avoidance technology, Battelle PathPlan software provides intelligence to minimize robotic programming time and optimize your systems to perform previously impossible tasks while also maintaining enough flexibility to enable quick transitions from automated to manual operations.

REDUCED PROGRAMMING

The software features an easy-to-use “point-and-click” interface which gives the operator a clear picture of the robot and its surrounding environment. Instead of relying on a skilled programmer to script each motion, PathPlan utilizes scan-to-path, CAD-to-path or hybrid data to autonomously determine the optimal, collision-free path to execute the task –resulting in less reliance on skilled programmers and up to 80% reductions in overall programming time and cost.

The result: Making previously impossible operations possible.

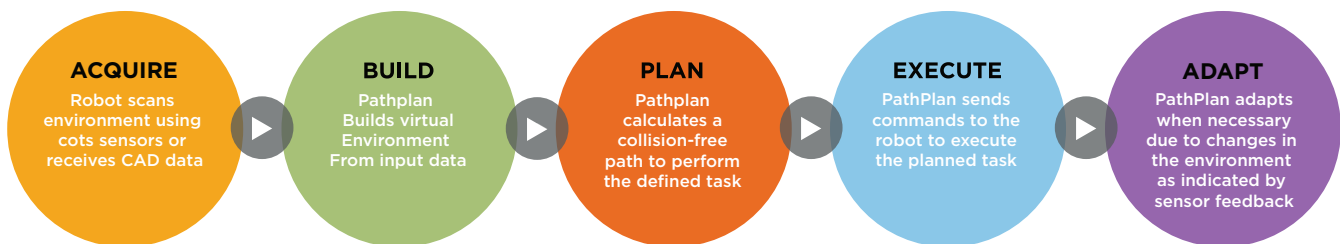
NEW AUTOMATION OR SYSTEM ENHANCEMENT

Battelle's software quickly converts operations from manual to automated by combining cutting- edge sensors and advanced algorithms to optimize integration of new automation and enhance current robotics capabilities.

The PathPlan software is robot platform agnostic enabling flexibility for new projects and the ability to rapidly repurpose existing equipment.

EASILY CONFIGURE TASK EXECUTION

By using COTS sensors, CAD data, or a combination of both, the PathPlan software determines its workspace and uses its control algorithms to independently compute collision-free paths from the current robot position to the work surface or feature, using this easy five step process:



COLLISION-FREE TEACH MODE MODULE

The Teach Mode Module of the PathPlan™ software provides collision avoidance during manual or teach mode operations to protect the robot cell and work piece during the most likely times of a collision. In addition to the greatly reduced programming time for run time operations, the Teach Mode Module mitigates vulnerabilities during operations that are not pre-scripted or when stepping through already scripted paths

Benefits

- Real-time, predictive collision avoidance protects valuable work pieces and robots
- Ability to upgrade current equipment to eliminate the most complex, still manual processes
- Reduced set-up time
- Robotic platform agnostic
- Confined and hazardous space operation
- Complex work surface adaptation
- Work piece/surface anomaly detection and collision avoidance
- Increased safety, efficiency and effectiveness
- Reduced reliance on skilled programming labor
- Reduced manual operation errors and damage
- Up to 80% reduction in programming costs

AUTOMATING THE MOST COMPLEX INDUSTRIAL TASKS

Battelle's PathPlan software can easily automate grinding, welding, polishing, paint removal, paint application, composite work, non-destructive inspection and other tasks, but is particularly unique in its ability to execute these tasks in challenging environments, such as:

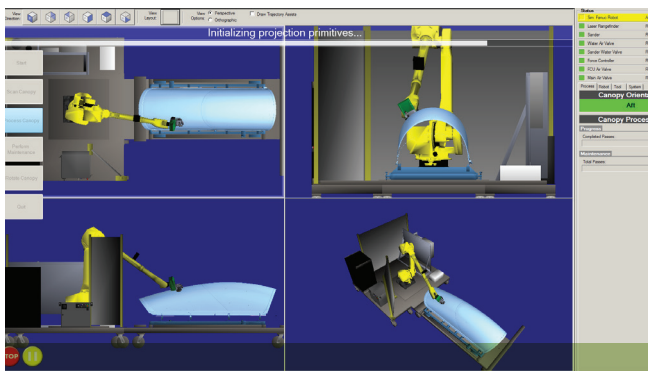
- Complex or variable surfaces or work pieces
- Confined or hazardous spaces
- High-cost or difficult to replace work pieces

CASE STUDY: AUTOMATED CANOPY RESTORATION SYSTEM

Battelle demonstrated PathPlan software's ability to process complex surfaces and reduce labor through development of the Automated Canopy Restoration System (ACRS).

Key Points

- In 2013, Battelle delivered the autonomous robotic-based ACRS to the US Navy to restore T-45 canopies
- Labor reduction of 50% or greater
- ACRS incorporates:
 - Path planning, intelligence and flexibility to adapt to other transparencies



Interface provides the operator a clear picture of the robot and its surrounding environment.

- Force control for consistent, repeatable processing
- Pattern staggering, randomness during run-time to prevent visual artifacts
- Click-and-drag selection for defect repair

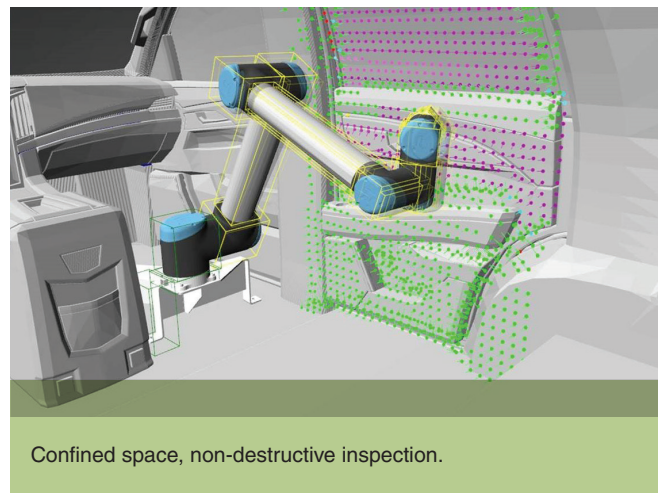
EXAMPLE APPLICATIONS

Confined Spaces: Battelle PathPlan software enables robots to operate in confined spaces that often present a variety of hazards to maintenance personnel, including being labor intensive.

- **Project application** – Industrial tank inspection and refurbishment.

Non-Destructive Inspection: Battelle's Automated Robotic Control enable consistent execution of precise, repetitive testing in a complex environment – difficult for personnel to accomplish with required quality standards.

- **Project application** – In-vehicle multi-point non-destructive testing for major automotive manufacturer.



Confined space, non-destructive inspection.

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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