Robotic Cross-Cutting Technologies For Naval Maintenance

Premise

The preservation of tanks and voids on U.S. Navy ships expends more than 25% of their maintenance funds annually. NAVSEA has spearheaded the development of new tank monitoring technologies to inspect corrosion, e.g., the Insertable Stalk Inspection System (ISIS) and new coating removal technologies e.g., induction coatings removal system. It is now time to roadmap the automation of new maintenance processes in order to fully maximize productivity and savings on total annual maintenance costs. PaR Systems has a diverse portfolio of specialized robotics that has been used to solve many difficult automation problems across several industries. The cross cutting of these technologies could significantly accelerate the development of production worthy systems to automate naval maintenance operations with low NRE costs. In order for PaR to fully develop a white paper outlining concepts worth considering, PaR seeks the cooperation of NAVSEA to survey these needs, identify basic requirements, and understand the cost drivers of current methodologies.

PaR / Jered Capabilities

PaR Systems' experience began in 1961 with the development of manipulator systems to meet the demand for remote handling equipment created by the growth of the nuclear industry. During the 1980's PaR continued to develop its robotic technology for drilling, milling, routing, waterjet cutting, and material handling applications. Since then, PaR has increased its expertise to provide equipment for a variety of specialized applications, building on its automation capability across a wide range of demanding commercial, government and defense segments. PaR's customers seek solutions to challenging automation needs and recognize that designing, building, and delivering these systems requires an intense commitment to manage the technical, schedule, and process components of the project in order to satisfy the throughput, quality, and safety specifications.

In May 2004, PaR Systems spun-off its commercial nuclear business to Westinghouse, allowing the company to increase its focus on defense and continue to deepen its expertise in material handling and automation in other key segments. Through several acquisitions, PaR has been able to provide specialized automation equipment to a number of critical industries. These businesses include equipment on-board Navy ships (Jered LLC and Unidynamics), high integrity custom crane and heavy material handling equipment (Ederer, LLC), lab automation and medical device manufacturing equipment (SSi Robotics), semiconductor automation systems (MöZAK), a specialized non-destructive composites inspection product line from Lockheed Martin (LaserUT®), and a company providing engineering, technical, and field service support for navy and commercial ships (American Heavy Industries, now known as PaR® Marine Services, LLC).

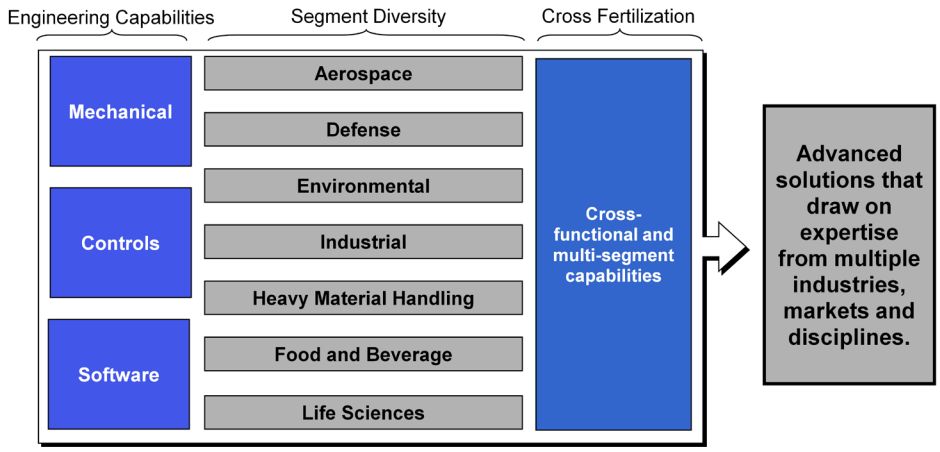
PaR's Robotics business provides systems that are performing critical manufacturing or inspection processes on the latest aircraft, including Airbus A380, Boeing 787, JSF, and F-18. Our X-ray systems are inspecting intact aircraft and space shuttle components. PaR's 5-axis industrial material removal systems are used to make a wide variety of critical parts. Our robotic material handling systems automatically carton, load, stack and palletize a wide range of products. Remote handling systems are

used throughout the DOE complex and many nuclear sites worldwide to reliably and safely handle and process hazardous materials. PaR-Capper and PaR-Labeler machines automate high volume and redundant processes in life science labs. Ederer cranes move the heaviest loads like the 5,100 ton crane for the Olmsted Dam project, and provide new designs for Jered's Navy applications.

As part of the PaR® Defense division, Jered focuses on designing and manufacturing specialty equipment such as cargo, weapons and boat handling systems, elevators, steering systems, equipment handling cranes, boat launch and recovery systems, and deck machinery. Jered combines its strong engineering heritage with very competitive and comprehensive heavy fabrication capabilities. Utilizing PaR's automation and material handling expertise, Jered can now provide an even broader range of equipment/cargo handling systems for military and commercial applications.

With the acquisition of Unidynamics, additional products were integrated, including helicopter hangar doors, vertical package conveyors, access doors, aviation maintenance cranes, well deck cranes, and launch handling and recovery cranes. Additionally, with the acquisition of an existing service business in Norfolk, Virginia adjacent to the largest naval base in the world, Jered now has increased access and capacity to provide waterfront support. The new business, PaR® Marine Services, will support all product lines including Jered, Unidynamics, NETEC, PaR Systems, and American Heavy Industries.

In each market segment, PaR Systems has a core of engineers that have developed deep market-specific application and process knowledge. However, we purposely cultivate cross-functionality and multi-segment capability by thoughtfully allocating engineering resources to cross fertilize between market segments in order to generate fresh solutions that are both innovative and cost effective. This has resulted in providing our customers with the highest level of automation integration experience by finding the best solutions taken from seemingly dissimilar industries of semi-conductor, medical, aerospace, food and beverage, and hazardous material handling environments. The common thread in all these application is PaR's deep knowledge in precision motion control that can be customized and adapted to a wide array of automated material handling applications by successfully applying the best practices found across many industries.



Relevant Examples

PaR Systems has successfully fielded many specialized robotic systems that are based on a modular technology building block approach. Some of these systems operate in very confined spaces such as inside glove boxes, annular spaces in nuclear reactor vessels, or in hazardous environments requiring explosive proof classifications, which are similar to the challenges found in many naval maintenance activities. Relevant examples to illustrate the depth of this experience are detailed below.

Inspections Systems

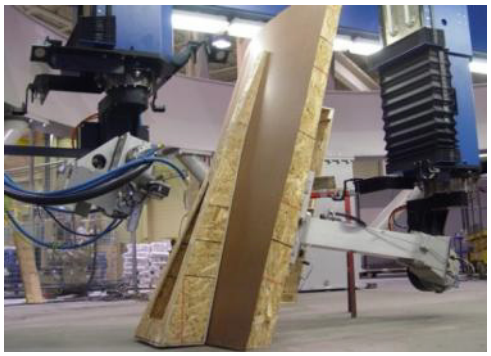
Non-Destructive Inspection – Boeing 787

Full NDI System

NDI with Barrel

Aft Skirt X-Ray Inspection of Space Shuttle– United Space Alliance (USA)

Robot System in Enclosure

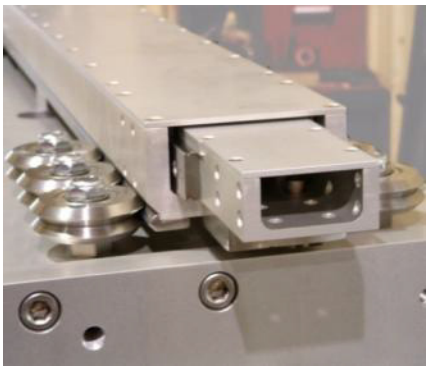


Scanning Test Structure

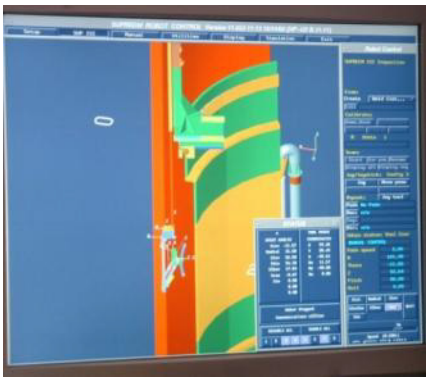
X-Ray and Radiation Spectrographic Examination – Savannah River Site

PaR XR® 100 Gantry Robot with LaserUT®

Reactor Vessel Inspection Tool – Westinghouse – Brunswick Nuclear Plant (BNP), North Carolina



Mast Full Retracted

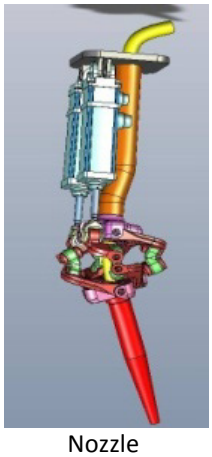


Simulation Package (created by WesDyne International

Westinghouse sets industry standard for BWR core shroud inspections. The successful deployment of the new tooling culminated an eight month development program partnered with PaR Systems. The new tooling utilizes a low profile 25' travel telescoping mast technology from PaR.

Omni Wrist Technology

Singularity-free wrist head – best suited in applications that require a compact, dexterous, and flexible head for positioning tools in any orientation. PaR is proposing this technology for many cleaning and inspection applications for the DOE high level waste tanks.



Nozzle

True 180° hemispherical motion

With antenna for tracking applications

Omni-Wrist IV – for applications in 5-axis robotic milling, drilling, and waterjet

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Coating Removal

FLASHJET® System – Boeing Military Aircraft & Missile Systems – St. Louis, Missouri

Full FLASHJET® system with omni-directional vehicle deployed on forward rudder.

FLASHJET®deployed using commerical rough terrain fork lift with servo pivot and boom.

NASA Cape Canaveral Stainless Steel Robot Automatically Cleans Space Shuttle Parts

Material Removal Systems

Defastening Wing Skins – Hill Air Force Base, Utah

Dual-Bridge Gantry System

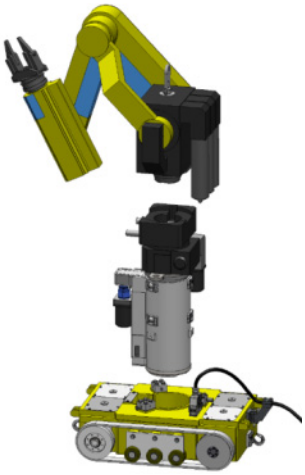
End Effector with Vision System

Mold Milling for Defense Application – Waukesha Foundry, Wisconsin

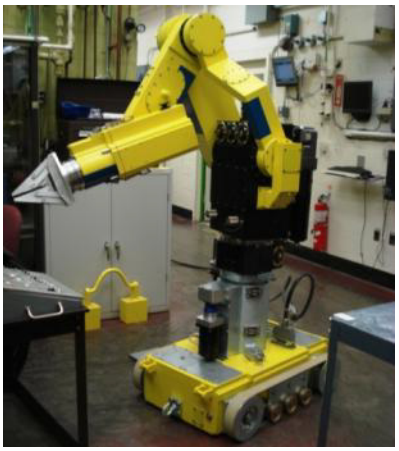
Remote Manipulator Vehicles

Tracked Mobile Manipulator – Argonne National Laboratory, Illinois

Robot range of reach is 3.5 m (11 ft. 5 in.) to floor level.

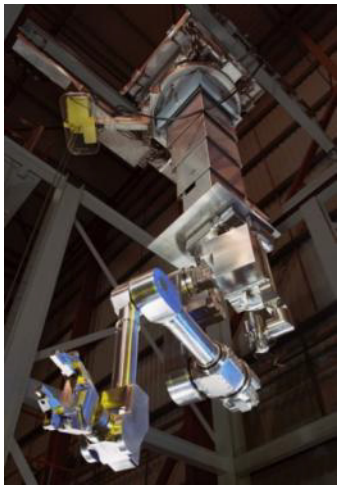


Remotely detachable subassemblies of 227 kg (500 lbs) max. Connections include mechanical and electrical interfaces.

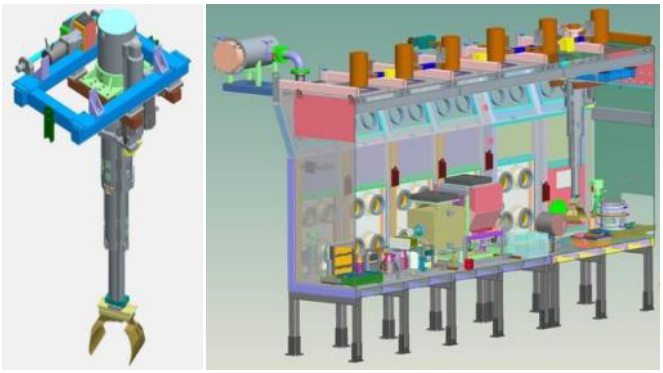


Used for hot cell maintenance, material handling, and decommissioning operations. Drive tracks allow robot to free-wheel for recovery purposes.

Manipulator Systems



Many Overhead Telescopic Manipulator Systems are in service at all the DOE nuclear facilities doing a wide variety of remote operations, e.g., decontamination, maintenance, and size reduction activities in very tight closed spaces found in hot cells and glove boxes.



PaR is working on the PDCF Pit Disassembly and Conversion Facility (PDCF) at Savannah River Site. This system requires multiple telescoping tubes to create a profile that is very compact to work inside a glove box with Argon and Helium atmosphere. The robot is designed for installation and removal through small “bag out” ports with circular openings.

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