Advanced Manufacturing

Larry R. Shipers, Ph.D.

Manager

System Technologies

For more information: www.sandia.gov/isrc

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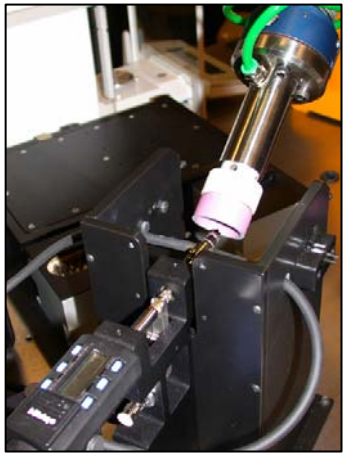
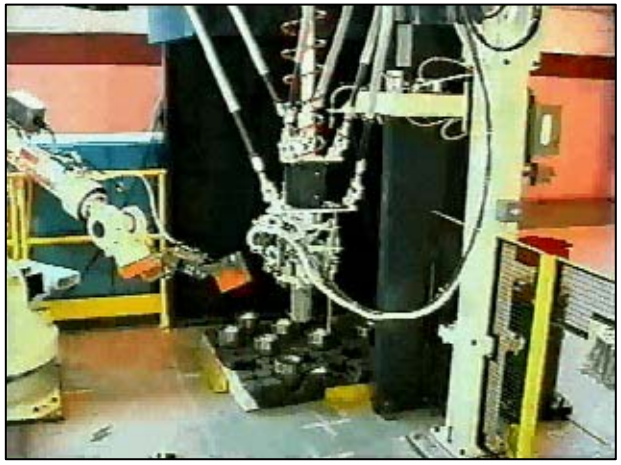
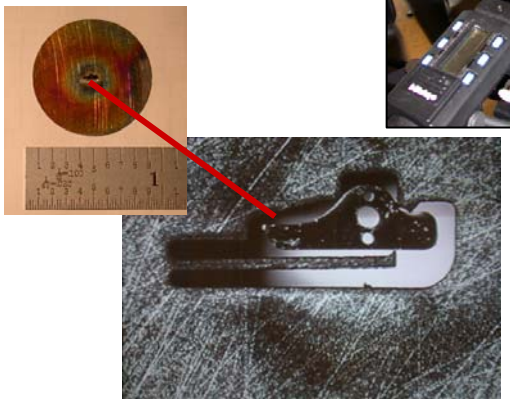
Enabling Capabilities

- Mirco/Nano Manipulation
- Precision Engineering
- Automated Planning and Programming
- Sensor and Model-Based Control
- Grasping and Fixturing
- Mobility
- Auto-Navigation
- Rapid World Data Acquisition and Model Building
- Geometric Reasoning







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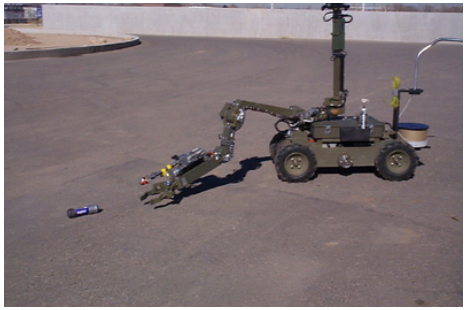
High Consequence Manipulation

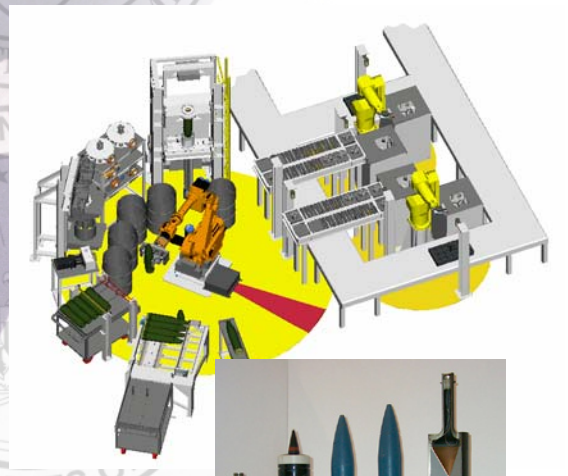
Nuclear Weapons

Stealth Fighters



Emergency Response

Remote Response



Legacy Munitions

- Process as lot size of one
- Strict process constraints: quality, safety
- Human Assisted Expertise
- Cost Effective Intelligent Technology

Surgery

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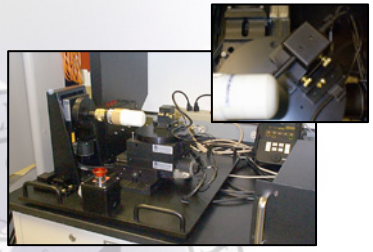
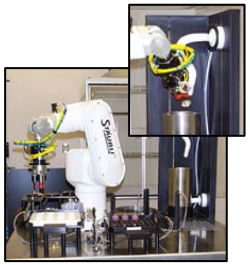
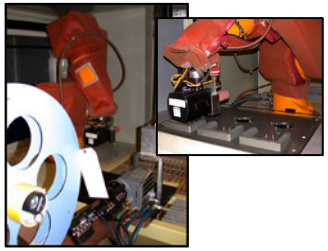
DOE Defense Programs



Thermal Spray Inspection Station, areal desisty measurements of applied materials, 2 operational in NGPF



Automated Particulate Removal System, reduces operator exposure during cleaning, operational at NGPF 2/01.



Automated Thermal Spray Station, increase process quality and coating uniformity, operational @ NGPF in 7/01

Automated Robotic Metallize System, applies uniform coatings to NG components, operational @ NGPF 6/02

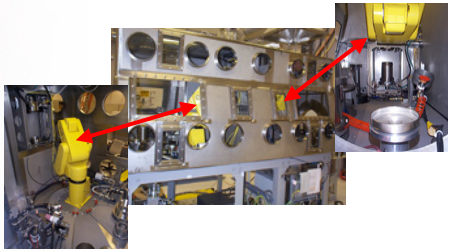
Stage Right, storage and monitoring of retired pits, hot operation in 1996

Automated disassembly of explosive gas generators, hot operation in 1997

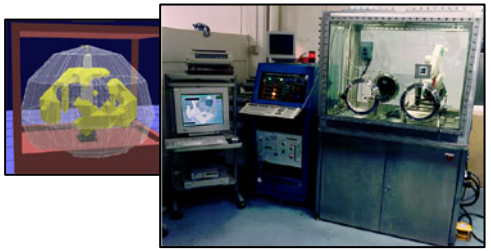
Pit Weigh and Leak Check System, Hot Operational 2/01

Strategic Reserve Stage Right, storage and monitoring of stockpile pits, deployment @ Pantex in 8/02

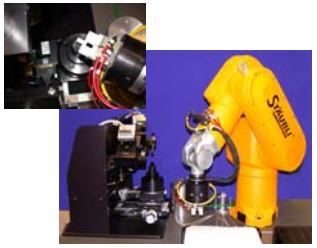
Robocal, Automated NDA, Readiness Review @ LANL complete



Canout, Automated SNM packing and processing for removal from glovebox, cold operation at LANL



Automated Component Cleaning, installed in AS-KCD in 1995, second generation with reachability developed



Automated Visual Inspection System, Inspects NG components for pits, chips, and voids, operational NGPF 12/03

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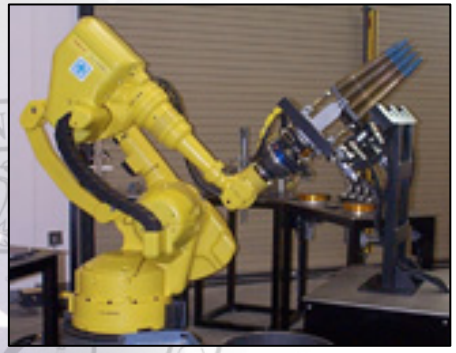
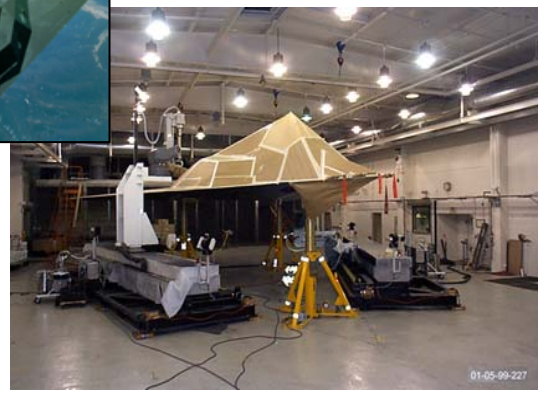
DoD Applications

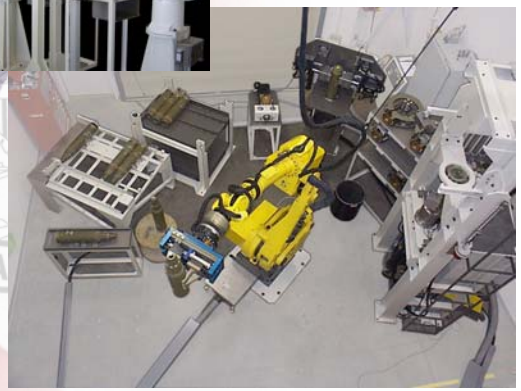


Demilitarization Hazardous Operation Risk Reduction
Customer: Army DAC
Demonstrated automated disassembly of inert 40mm munitions at Army ammunition plant



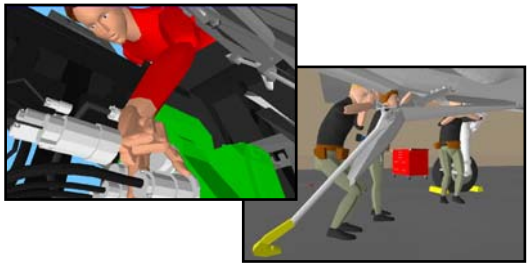
F-117 Robotic Coating System
Customer: Air Force F-117 SPO
Developed & deployed cost-effective robotic system to apply stealth coating for 50 aircraft fleet

F-22 Robotic Coating Upgrades
Customer: Lockheed Martin, Marietta
Developing & implementing hardware & control improvements to existing robotic coating system



155 mm Automated Disassembly
Customer: Army DAC
Developing automated system to disassemble projectiles containing grenade & antipersonnel mine submunitions

Smart Crane
Customer: Navy NSWC
Demonstrating swing-free ship off-loading with sea-state compensation on Navy transport ship



LM/SNL R&D project
Developing automated assembly / disassembly & human motion planner for aircraft logistics & maintenance operations

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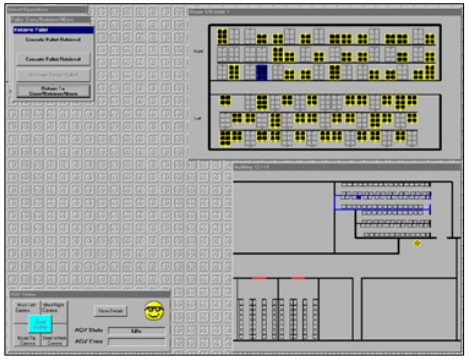
Strategic Reserve Stage Right (SR^2)

Automated Guided Vehicle

User Console



Graphical System Controller

Video Surveillance

Pantex Storage Facility
System Design and Simulation

Track Right

Radiation & Physical Inventory Pallet

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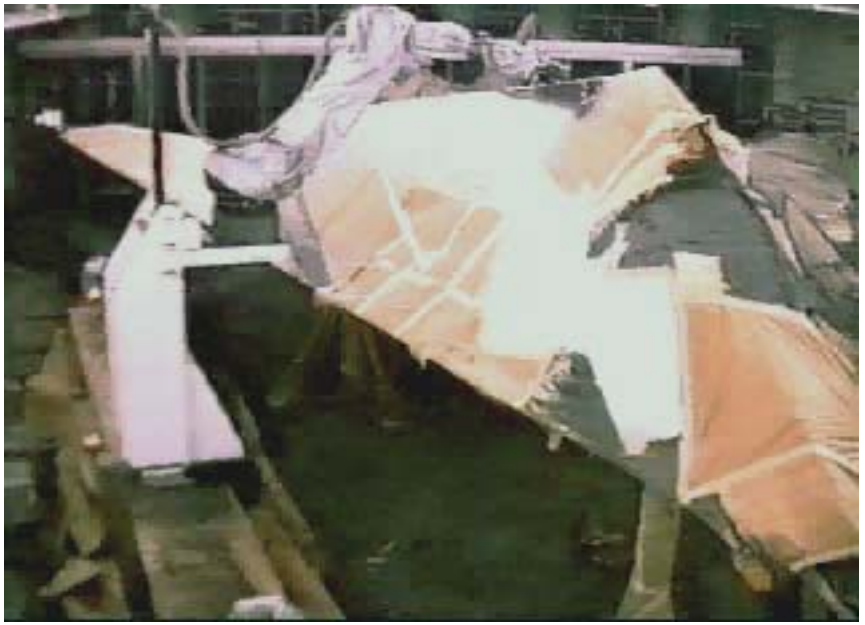
Strategic Reserve Stage Right (SR^2)

F117A Robotic Coating System

Deployed at LMSW



Coating Upper Fuselage

- System designed for variability and flexibility
- Improved quality and reduced cost

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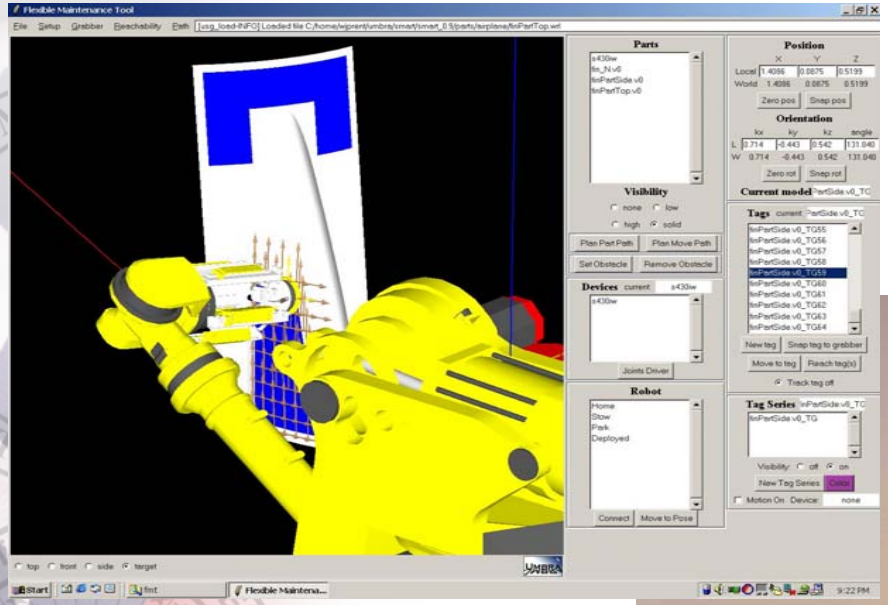
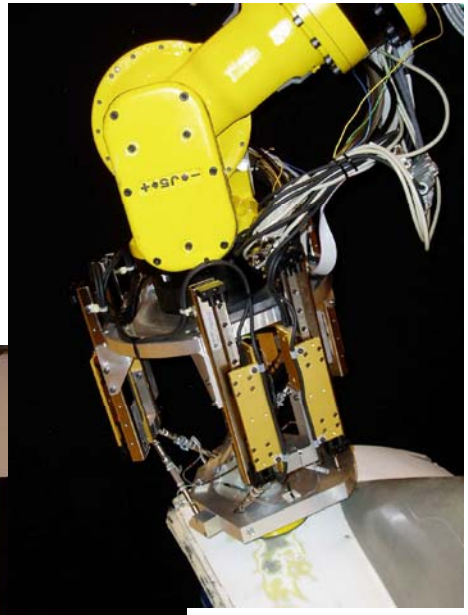
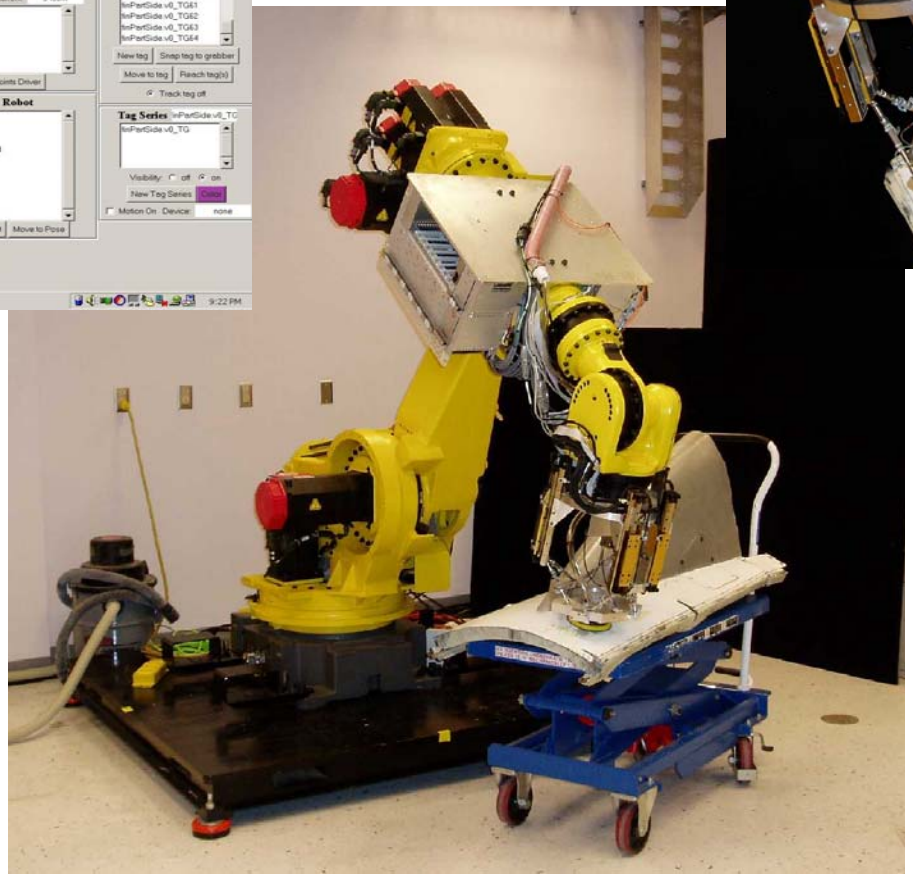
Contact Operations Workcell



Force-controlled tool for finishing curved surfaces





Software Tools for Design, Analysis, and Control

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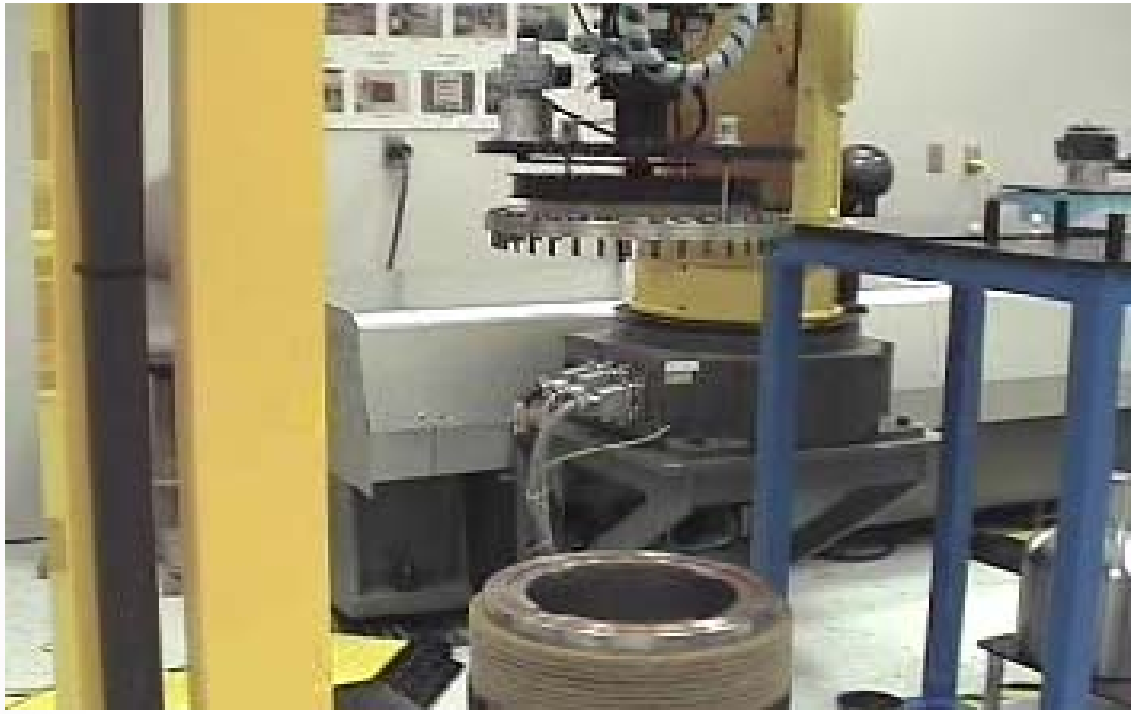
WALS/SI Handling Operations



Vision Control for Demilitarization

Robotic machine vision to pick up tilted projectiles from a pallet

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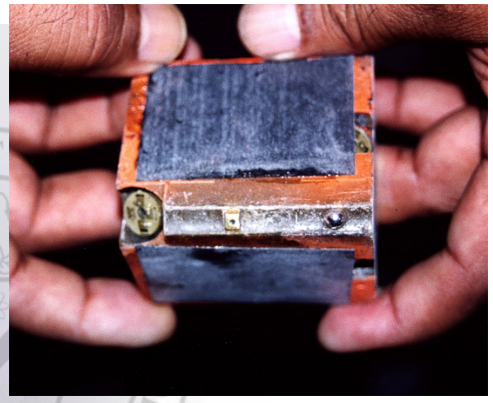
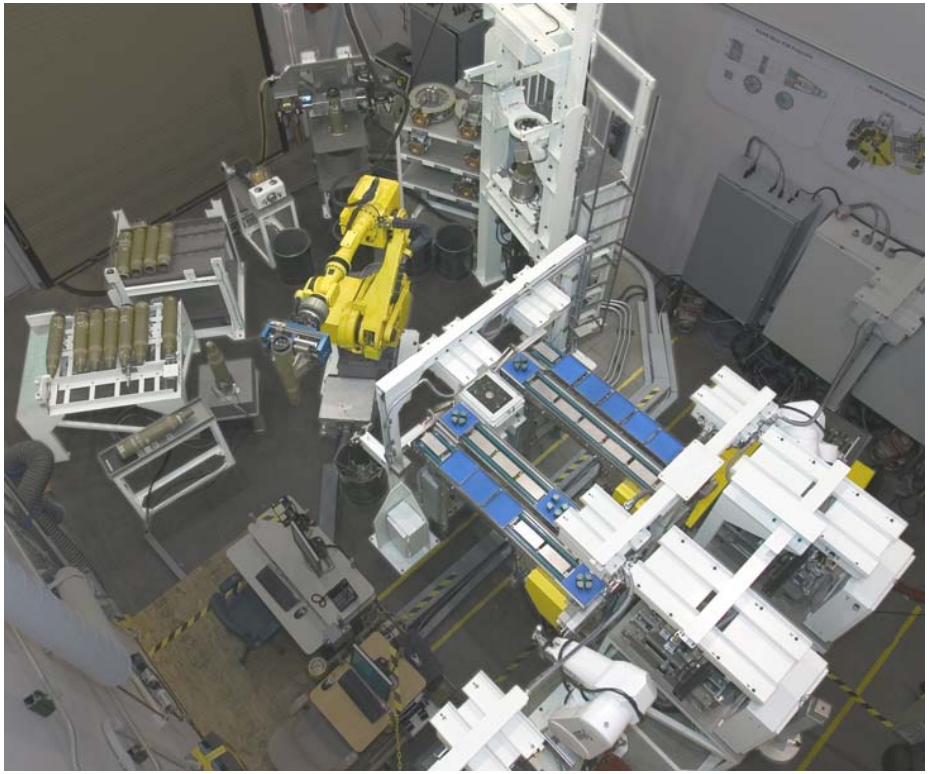
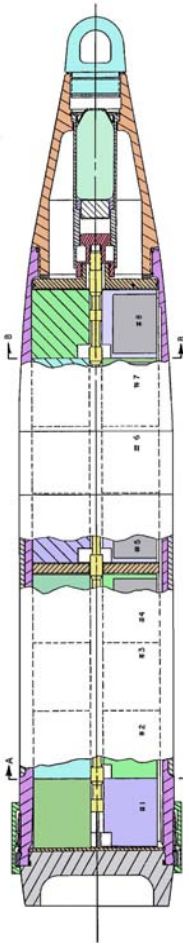
ADAM Demil System Accomplishments







- System integration into new Munitions Cryofracture Demilitarization Facility McAlester Army Ammunition Plant completed summer 2005
- Operations and safety reviews completed fall 2005
- First “real” projectile disassembly in December 2005
- Operator training, and other facility installations need to complete before system operates in a production capacity

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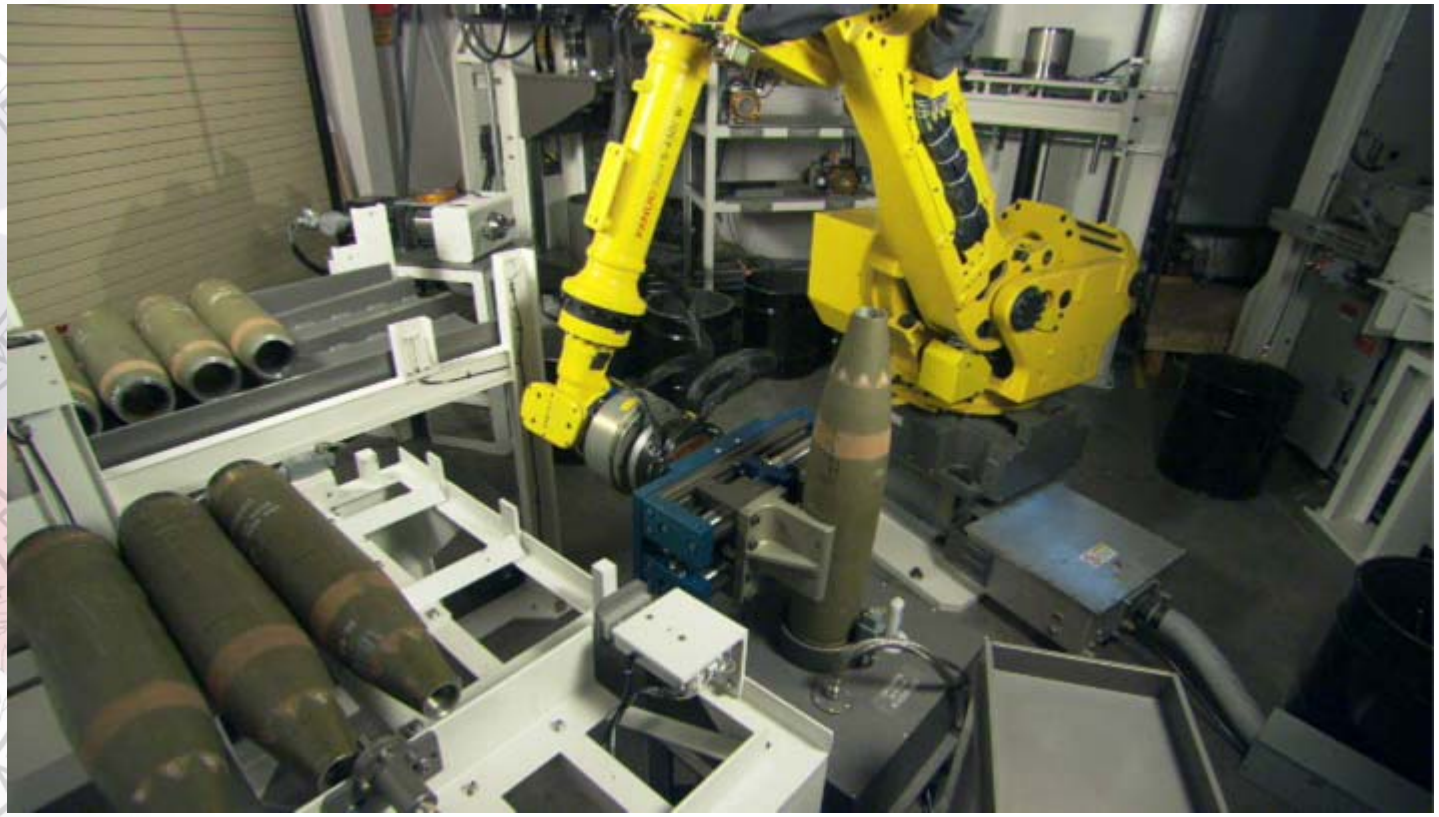
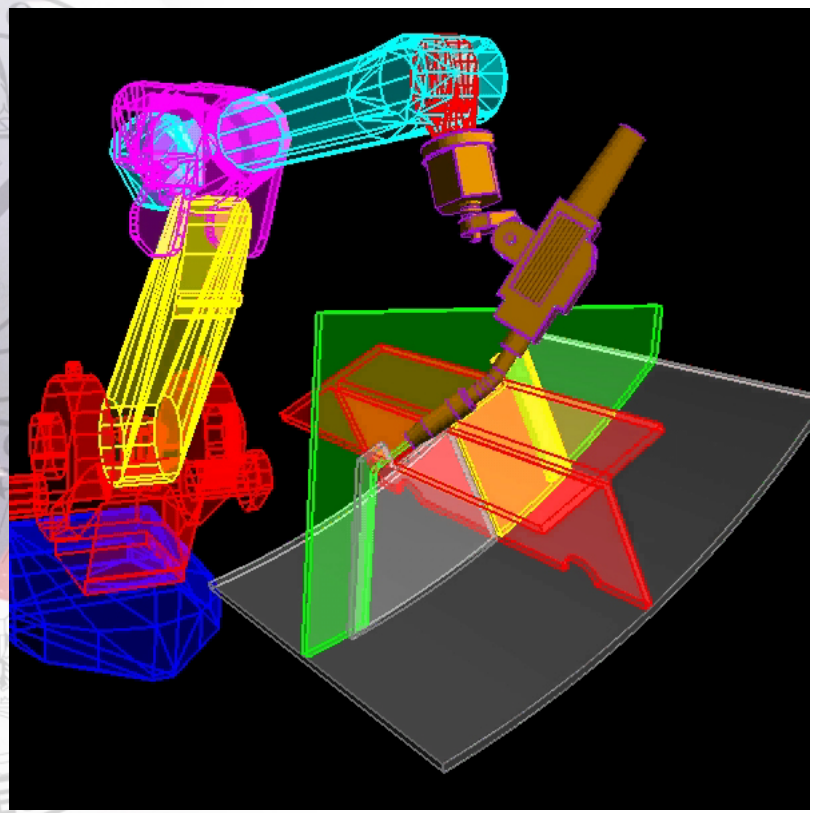
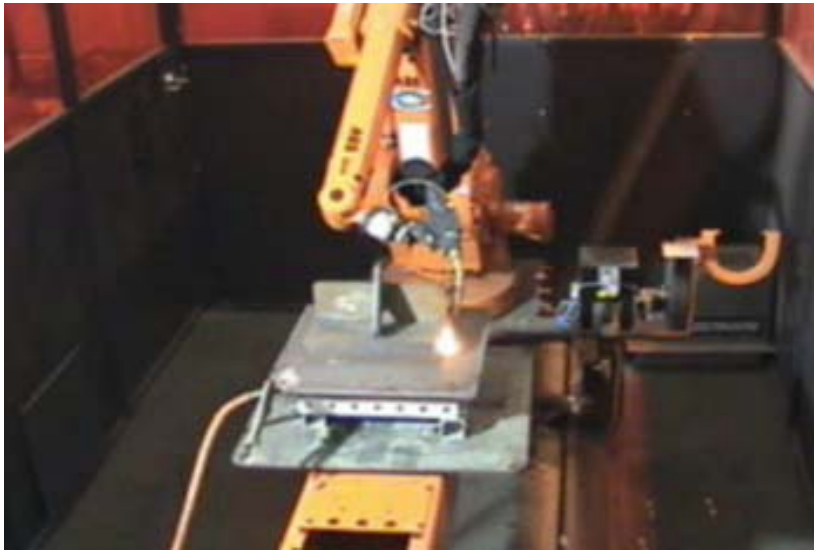
ADAM Demil System



AutoGen





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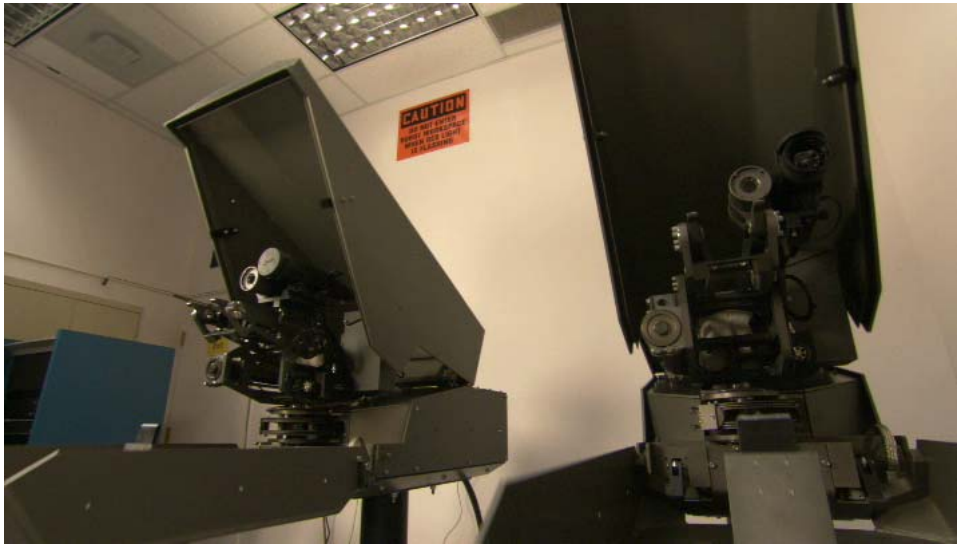
Remotely Operated Weapons System



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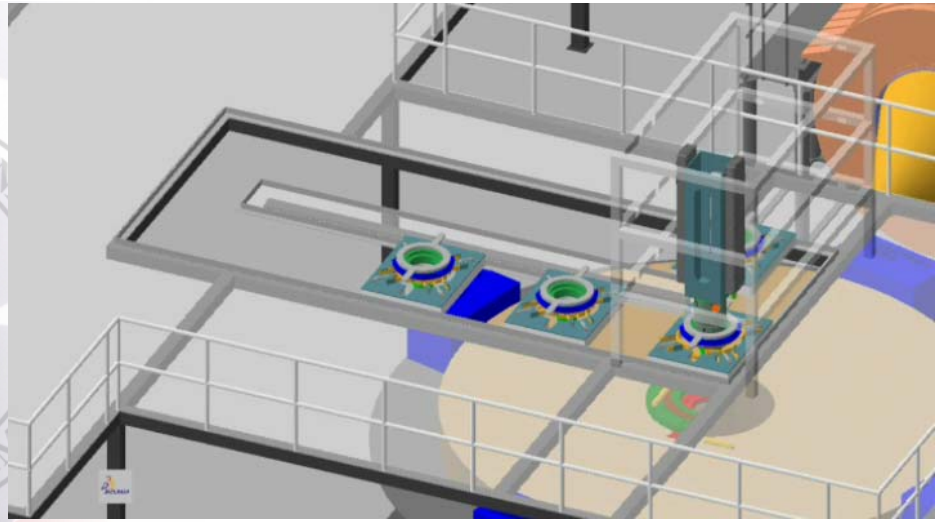
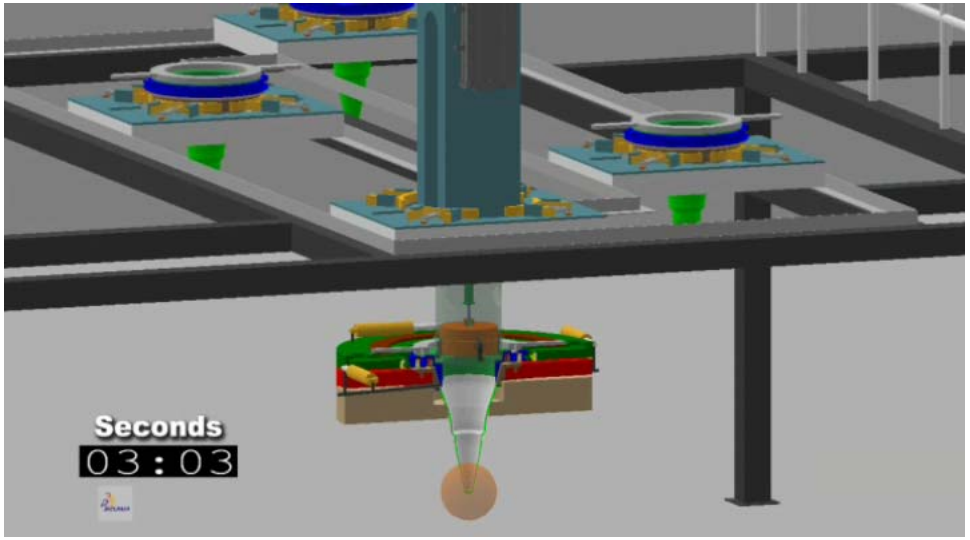
Z-Proof of Principle Experiment





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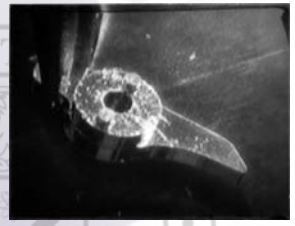
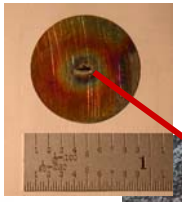
Applied Research and Development

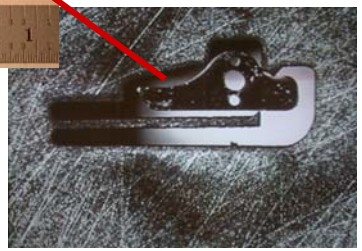
Microassembly

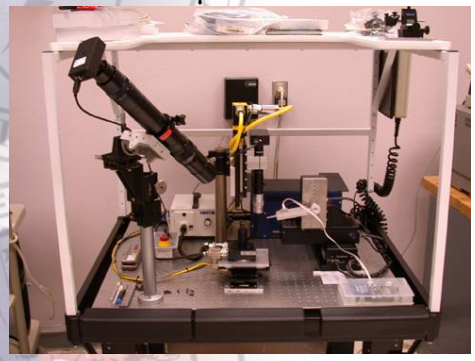


Pawl Washer Assembly with 170μm Pin



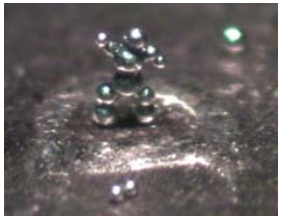
Adaptive Fixturing

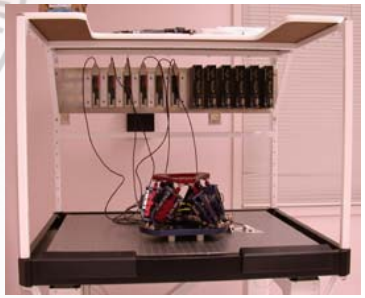




3D Operator Directed Micro Assembly

85 μ m Ball Assembly

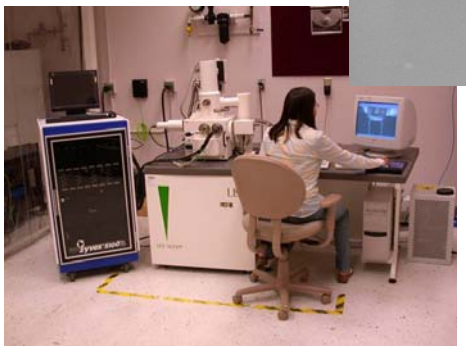




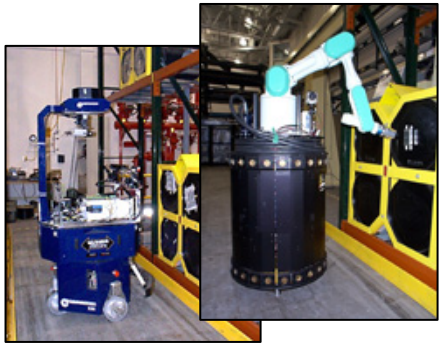
Admittance Control

Nanomanipulation

Placement of the nanotube on a silicon substrate



LEO 1430VP SEM with Zyvex S-100 Nano-manipulator



Near Human Presence

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