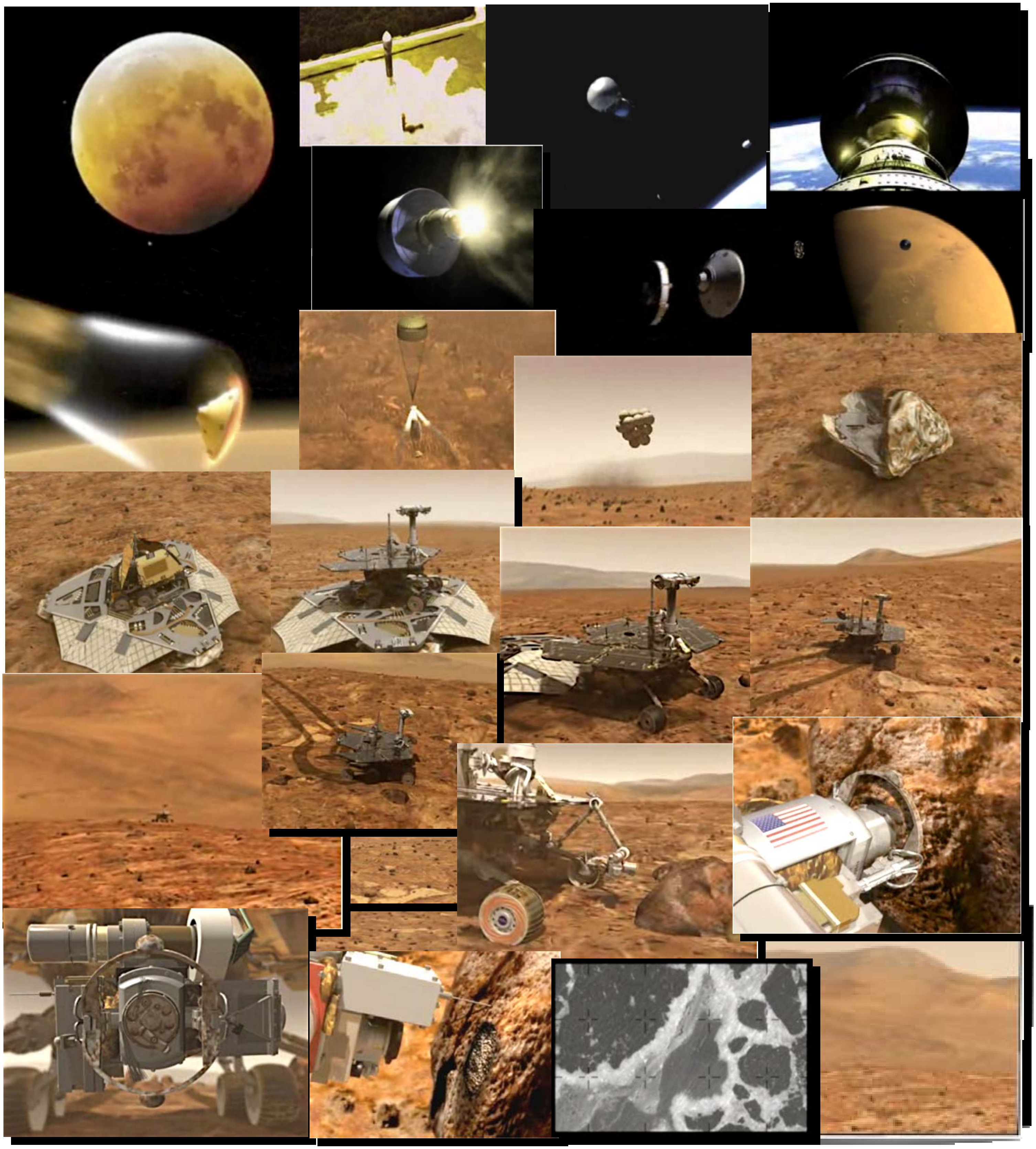
Sample Projects in Robotics at Selected Federal Laboratories



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Robotics/Automation within Government Laboratories

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Robotics

Defense Advanced Research Projects Agency (Arlington, VA)
http://www.darpa.mil

Current Hot Projects Managed

1. **Boeing**
   - A160T Hummingbird Unmanned rotorcraft

The Hummingbird features a unique optimum-speed-rotor technology that significantly improves overall performance efficiency by adjusting the rotor's speed at different altitudes, gross weights and cruise speeds. The autonomous unmanned aircraft, measuring 35 feet long with a 36-foot rotor diameter, eventually will fly more than 140 knots with a ceiling of 20,000 to 30,000 feet (high hover capability up to 15,000 feet) for more than 20 hours.

   - Boeing X-45A Unmanned Combat Air Vehicle

The Unmanned Combat Air Vehicle (UCAV) System Demonstration Program is a joint DARPA/Air Force/Boeing effort to demonstrate the technical feasibility for a UCAV system to effectively and affordably prosecute 21st century Suppression of Enemy Air Defenses (SEAD) and strike missions within the emerging global command and control architecture. The Air Force is committed to an aggressive program of exploiting UAV technology for SEAD in the mid-term and moving into a broader range of combat missions depending on technology maturation, affordability, and migration to other forms of warfare. The UCAV System Demonstration Program will provide the information necessary to enable decision-makers to determine whether it is technically and fiscally prudent to continue effects-based development of a UCAV system to perform the SEAD/Strike mission. The knowledge gained from the System Demonstration Program will be a key input to defining the best force mix for the 2010 timeframe.

2. **Northrop Grumman**
   - X-47B UCAS

The X-47B will be a transformational, carrier-capable, multi-mission, unmanned combat air vehicle. Strike fighter-sized, it is a survivable, long range, high endurance and persistent platform capable of a variety of missions including Intelligence Surveillance, Reconnaissance, and Time Sensitive Targeting Strike

3. **<u>Carnegie Mellon University's National Robotics Engineering Center in Pittsburgh, Penn.</u>**

- <u>The crusher</u>

The Crusher represents a new class of unmanned ground combat vehicles (UGCV) developed under the DARPA/Army UGCV-Perception for Off-Road Robots Integration (UPI) program. Crusher is a highly mobile vehicle designed from the outset to be unmanned. It is being equipped with state-of-the-art perception capabilities, and will be used to validate the key technologies necessary for an unmanned ground vehicle to perform military missions autonomously. Crusher will be equipped with representative sensing and weapons payloads for planned field experiments.

4. **<u>Non Line of Sight Robotic Vehicle</u>**

http://www.nosc.mil/robot/pubs/IASTED_ADCR.pdf

Tactical mobile robots used in military and law enforcement operations normally require a robust, long range, and non-line-of-sight communications link to the remote control station. High frequency digital communications, which overcome problems encountered by tethered links and analog radios, are subject to line-of-sight (LOS) limitations. This is often impossible to maintain in urban environments. The proposed solution is to develop a system that will allow the mobile robot to carry multiple relay radios that are automatically deployed when and where needed in order to maintain this communications link. This process is completely transparent to the operator and is entirely handled by the ad-hoc network formed by the relay radios. In this paper, we present a radio relay deployment system that is plug-and-playable, and can be attached to many unmanned vehicles requiring long-range and non-LOS operational capability.

Figure 1. Convoy formation shown with SSC-SD's Robart III as the lead robot, followed by ActiveMedia Pioneer 2DX relay robots.

Historical Programs managed

UAV Name	Branch	Range Miles / Hours	Payload Wt. Lbs.	Altitude Capability Ft.	Program Timeframe	Program Cost $	Status
AQM-34N Firebee	Air Force	2,400		60,000	1967-1971		was operational/abandoned
Aquila	Army				1979-1987	1 billion	abandoned
Arcturus T-16		12-24 hours	30	15,000			Commercialized
Compass Arrow		2,000		78,000			28 built abandoned
Compass Bin		600		51,300	1960		used in Vietnam
Compass Coup	Air Force	17 hours		55,000	1973-1979		2 prototypes abandoned
Condor		60 hours		67,000	1988	20 million ea.	abandoned
CR-UAV	Marine Corp	50		-	1993-96		6 units accepted abandoned
DarkStar	DOD Joint	8 hours	1000	45,000	1998	10 million ea.	cancelled 1999
Dragon	Marine Corp	50	25	10,000			40 in operation
Eagle Eye	Coast Guard	8 hours	200	20,000	1992- current		?
Gnat 750	CIA	48 hours	330	25,000	1989- present	2.6 million ea.	current
Global Hawk	Army Navy Luftwaffe	42 hours	1960	65,000	1998-present	72 million 1.1 billion 1.3 billion unit cost 123 M ea.	17 ? 5
Hunter	Army	12 hour	200	15,000	1996	171 million	7 abandoned
BQM-145A	Navy Air force	>700		40,000	1993-1997	387 million 346 million	1 plane payload abandoned

UAV Name	Branch	Range Miles / Hours	Payload Wt. Lbs.	Altitude Capability Ft.	Program Timeframe	Program Cost $	Status
Pioneer	Army Navy Marine Corp	5.5 hours	75	12,000	1985	138 million	9 systems 72 vehicles in use
Pointer/Raven	Army	6	2	3,000	1986-present	250,000 ea system	>105
Predator	Air Force	29 hours	700	40,000	1994-1996	4.5 M ea,	
Lockheed D-21	Air Force	3,400		90,000	1966-1971		abandoned
VTUAV	Navy		200		2000-2003	93.7 Billion	1 system
Vigilante		5 hours	300	13,000			current
Fire Scout	Navy	5-8 hours		20,000	2003-present	prod 2.2 billion 15 million ea.	current
Warrior	Army	6 hours	800	25,000	2002-2009	1 billion	11 systems 132 vehicles engine manufacturer bankrupt 4/08

Walter Reed Institute of Research (Washington DC)

http://wrair-www.army.mil

Automated Casualty Stretcher

1. WRAIR is focusing its efforts in combat casualty care on reducing the mortality rate of wounded soldiers, especially within the crucial first hour after injury. WRAIR is helping develop five interrelated computerized devices that will form a system allowing medics to provide quality care to wounded soldiers on the battlefield. When the entire system is fielded, a medic will be able to:
    - Locate a wounded soldier quickly
    - Monitor the soldier's vital signs and detailed physiologic information and display them locally or remotely on a computer readout
    - Get advice from a medical database on the best treatment and step-by-step instructions on unfamiliar procedures
    - Use computer-regulated intravenous pumps and ventilators to tailor resuscitation to the needs of the casualty
    - Evacuate the casualty in an enclosed stretcher that provides continuous medical support and monitoring in transit

NSWC Naval Ship Systems Engineering Center – Carderock (Carderock, MD)
www.nswccd.navy.mil

1. ***Swarm Tactics***
   Low cost, expendable, unmanned air vehicles, operating as a cooperative group, replacing individual losses by re-configuration of the remaining units to complete mission while adhering to basic design philosophy:
   - Design to cost! Max cost of $2,000!! (Including engine, avionics, and secure communications.)
   - Accept performance imposed by cost
   - All subsystems fully modular (Form, Fit and Function)
   - Provide a seamless upgrade path
   - "Plug - n -Play" payload capability
   - missions
     -Ground surveillance
     -Sea search
     -Battle damage assessment
     -Data link relay
     -Gunfire control spotting
     -CBR aerial sampling
     -Close air support
     -Air defense decoy/ spoofing
     -Clandestine tailing of surface contacts

Flight Test Model

Naval Research Laboratory (DC)
www.nrl.navy.mil

Unmanned Projects

1. Unmanned Aerial Vehicle (UAV) Radar (http://www.nrl.navy.mil/content.php?P=04REVIEW127)
   Goals
   - detect and track moving ground vehicles and small boats to a range of 80 nmi
   - provide a simultaneous SAR ground map,
   - provide targeting quality data for weapons
   - provide for low false track rates
   - use low microwave frequencies for foliage penetration
   - fit in a Navy vertical take-off UAV

2. Fuel cell unmanned vehicle (http://www.nrl.navy.mil/pao/pressRelease.php?Y=2005&R=59-05r)
   - The Naval Research Laboratory, in collaboration with industrial partners, demonstrated an unmanned aerial system (UAS) flight solely powered by fuel cell technology.

3. Unattended Ground Sensor Network (http://www.nrl.navy.mil/content.php?P=04REVIEW185) Scientists are exploring a novel unattended ground sensor network, the Adaptive Reactive Sensor and Effector Network and Insertion Capability (ARSENIC) that would be deployed by unmanned asset to provide precise and covert placement.

4. Dynamic Autonomy Interaction (http://www.nrl.navy.mil/content.php?P=03REVIEW149)
   Natural interactions, such as natural language and gestures, facilitate dynamic autonomy. They affect easy communication, allowing the participants to concentrate on the task and not on the ways to communicate. Awareness of the environment is also important.

5. Tactical Micro-satellite (http://www.nrl.navy.mil/content.php?P=04REVIEW207)
   The DOD's Office of Force Transformation (OFT) and the Naval Research Laboratory are working on the development of and experimentation with a tactical micro-satellite system, with emphasis on producing operationally relevant capabilities. Touchstones of this system include: quick response, Joint Task Force (JTF) organic, selectable payloads, coverage for military conflicts and opportunities at any location on Earth, and an unmanned aerial vehicle (UAV) class of cost. This system ultimately integrates space assets into the forces such that the JTF Commander can call up the assets by deciding the payload capability needed, the area of interest, the area for direct downlink, and the date to call-up the assets. Once deployed, the space assets are directly tasked via the SIPRNET, which is also used to distribute the collected data and products.

6. Unmanned Tank Inspection Instrument (http://www.nrl.navy.mil/content.php?P=02REVIEW110)
   
   Currently, U.S. Navy maintenance practices for ballast tank spaces include Fleet-wide inspection of the 20,000 tanks. Approximately 4,000 of these occur annually, at a conservative cost of $24M. Operationally, each tank may see different degrees of service depending on mission requirements, thus creating widely variable maintenance concerns, in addition to those problems routinely anticipated for each tank type. As a result, up to 50% of current tank maintenance is due to hidden damage or unplanned work. Costs for tanks identified for refurbishment soar to $250M/year for a fraction of the total tanks Fleet-wide. NRL has developed a strategy by which the "state of preservation" can be determined by the implementation of Tank Monitoring Systems (TMS), which is essentially an unmanned tank entry method for inspection and qualification of tank integrity. The TMS systems include (1) an in-situ corrosion sensor which is installed in the tank to monitor coating integrity, the corrosion status, and cathodic protection functionality; (2) optical systems that can be inserted for periodic remote visual and analytical assessment of coatings damage; and (3) software to integrate the results of the corrosion sensor and optical measurements, which allow maintenance needs and dollars to be predicted and assessed on a "condition basis" rather than the traditional "time interval" method.

Office of Naval Research (Arlington, VA)

http://www.onr.navy.mil/sci_tech/32/321/ocean_engineering_marine_systems_applied.asp

Application of Autonomous Platform Systems to Mine Warfare

The Team seeks to identify and develop component technologies and system concepts to enable the application of small mobile robotic platform systems to mine countermeasures missions particularly in the very shallow water, surf zone and beach zone environments. Current research and development areas include sensors, communications, navigation, and neutralization technologies which can be integrated into unmanned underwater platforms for the purposes of obstacle detection and avoidance, and detection, classification, identification, mapping/reporting and neutralization of moored, bottom and buried mines. In addition, the Program Executive Office for Littoral and Mine Warfare (PEO-LMW) is addressing this area.

Air Force Office of Scientific Research (Arlington, VA)

www.afosr.af.mil

Robotic Mine Clearing Vehicle

MACE (Mine Area Clearance Equipment), a robotic mine clearing system converted from a man-in-the-seat vehicle to a remotely controlled system by engineers, in order to remove military personnel from dangerous mine clearing situations and to improve driving and position accuracy. The system, developed by the Advanced Robotics Team using the Joint Architecture for Unmanned Systems, is operated via radio frequency using a controller, a laptop computer, and an Operator Control Station that houses the Ethernet and power for the system. A high-end differential Global Positioning System was integrated which allows the remote operator to more precisely control the vehicle and provides positioning feedback to ensure more accurate area coverage.

DOE Office of Science and Technology Policy (DC)

www.pi.energy.gov/orgsummaries.html

The Assistant Secretary for Policy and International Affairs (PI) is the primary policy advisor to the Secretary, Deputy Secretary, and Under Secretary on domestic and international policy analysis, development, evaluation, and implementation. PI has primary responsibility for coordinating the efforts of diverse elements in the Department to ensure a unified voice in our policy and international affairs. PI works closely with organizational elements within the Department, other Federal agencies, national and international organizations and institutions and the private sector to coordinate and align national energy policy, and international energy agreements. PI coordinates DOE initiatives on climate change technology, greenhouse gas reduction reporting, and clean energy technology exports.

Robotics in Manufacturing Technology Roadmap

http://www1.eere.energy.gov/industry/newsandevents/printable_versions/news_detail.html?news_id=10633

Automation of manufacturing environments with robots has many advantages:

- Robots can consistently produce more high quality products than humans
- never tire
- can work nonstop without breaks
- do not require benefits
- increased productivity
- lower manufacturing costs
- reduced use of energy and raw materials

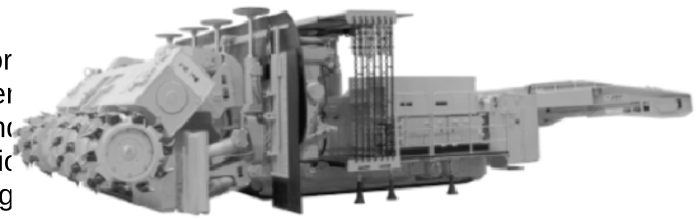
Explorer: Untethered Autonomous Live Gas Distribution Main Inspection System

http://www.netl.doe.gov/technologies/oil-gas/publications/td/41155_Final.PDF

- The Explorer system is intended to be a long-range untethered live in-pipe inspection system for use by the gas utilities in distribution mains ranging in size from 6 to 8 inches ID. The system differs from previously designed , developed and tested systems in that it is far simpler, cheaper to build, deploy and operate, while providing at first live video feedback (e.g. no sampling, no repair, no corrosion sensing, etc.), at complete power-autonomy and at a higher speed, range and duration than is currently possible with tethered systems all this from a single 4 ft. W x 15 ft. L x Pipe-Depth excavation.

ROBOTICS TECHNOLOGY FOR IMPROVING MINING PRODUCTIVITY
http://www.netl.doe.gov/KeyIssues/mining/robotics2.pdf

Underground mines are dark, cramped, and often full of airbor environments. Under these conditions, operators drive equipmer high accuracy and precision. It is difficult for operators to see anc Visual cues are not available to aid the operators. Automatic productivity and decrease the health and safety hazards to mining



Robotic Underground tank cleaner
http://www.rim.doe.gov/GAAT.pdf

This automated apparatus was created to clean the sludge out of the 3 underground Gunite tanks by using a new type of procedure called confined sluicing. A water jet pump removes the sludge and liquids from the tanks. The confined sluicing end effector is moved around inside the tanks by two remotely operated systems. Overview cameras in the tanks and cameras located on the robotic arm and vehicle provide equipment operators a view of the tank interiors and waste removal activities.

Sealing Large Diameter Cast Iron Pipe Joint with robotic insert
http://www.netl.doe.gov/publications/proceedings/02/naturalgas/4-6.pdf

There are over 47,000 miles of cast iron gas mains in service. A major problem is that as the jute in bell and spigot joints dries out these unions begin to leak. Conventional repair methods (external methods (external encapsulation or installing repair sleeves) are expensive and disruptive to the service. Repair made by a robot have the following benefits:

- reduction in excavation requirements
- no interruption of gas service
- 25-35-percent cost savings

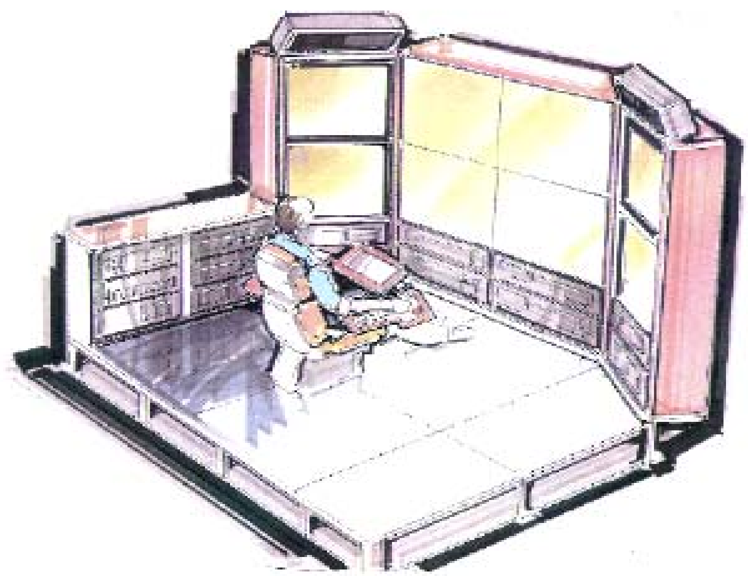
Robot Task Space Analyzer
http://www.netl.doe.gov/publications/proceedings/97/97em/em_pdf/EMPI-11.PDF

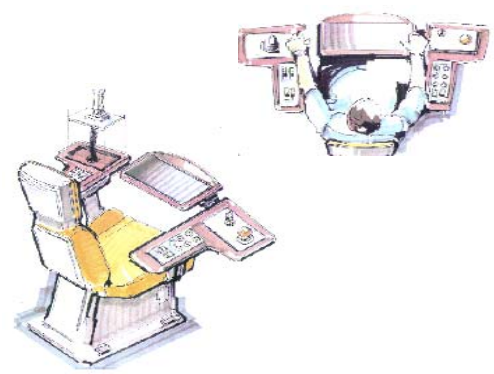
Robot Task Space Analyzer will provide operators of remote work systems the complete set of capabilities needed to create task space models for remote control. It will combine scene data acquisition and processing modules, 2-D and 3-D display modules, and interactive analysis capabilities to help the operator build a task space model that is sufficient and appropriate to automate some or all of the tasks at hand for environmental restoration applications such as decontamination and decommissioning, and tank waste remediation. Operationally, *Robot Task Space Analyzer* will be a collection of software processes running on a computer in the operator's console and linked to physical devices on the remote work system. It will be organized into modules that provide a full spectrum of options to the operator for the timely development of task space models.
Results. The RTSA project has just begun this September. At this point, the initial work on refining functional and performance requirements has been started. By December, the conceptual design of a fully integrated task space scene analysis capability will be complete. In addition, the hardware and software systems used in earlier DOE

Department of Energy's Morgantown Energy Technology Center
RoboCon (http://www.netl.doe.gov/publications/proceedings/96/96em/Em96/Em-p2-10.pdf)

A state-of-the-art robot operator control station, dubbed RoboCon, with standardized hardware and software control interfaces to be adaptable to a variety of remote and robotic equipment currently funded by the DOE's Office of Science & Technology Robotics Technology Development Program (RTDP). The purpose of RoboCon is to provide a state-of-the-art control station for the evaluation and experimental phases of DOE's Robotics Technology Development Program (RTDP)- and Integrated Demonstration (ID)-program for a variety of focus areas, such as Decontamination and Dismantlement (D&D), Tanks and Mixed Waste. The control station provides the latest in display, control and software technologies for the upcoming testing and experimentation phase of the robotics development program underwritten by the DOE's OST. The console is designed to be flexible in terms of hardware and software configurations, to allow for

- testing of optimized display and control configurations
- reconfiguration of the control panels and consoles for varied robot systems
- tailoring of the control station to suit different operators



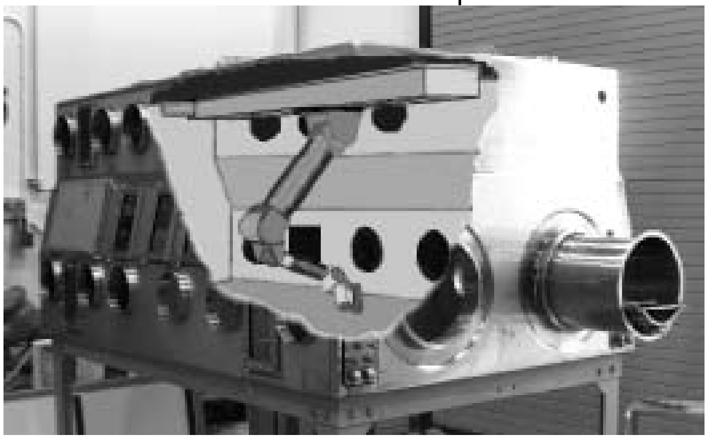


Automation Using Robotic Arms For Environmentally Sensitive Work Areas Within The DOE.
http://www.netl.doe.gov/publications/proceedings/99/99em/grupinski2.pdf

The Department of Energy faces unique and operational challenges to automate operations in each of its environmental management focus areas. Robotics is being considered to reduce worker exposure to harmful contaminants in the following 4 areas:

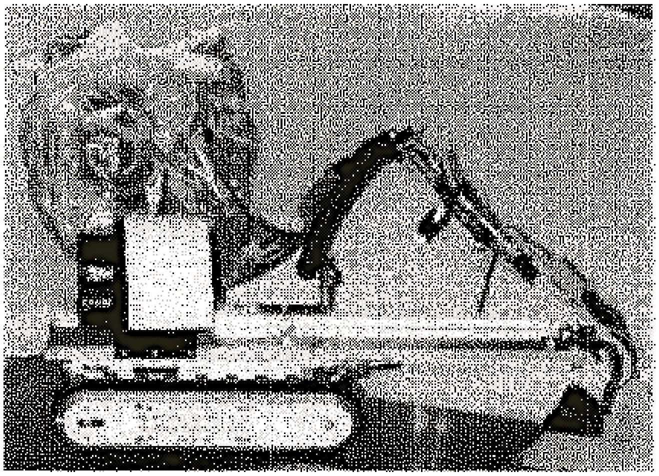
- decontamination and dismantlement
- mixed waste operations
- tanks
- automated plutonium processing

Current initiative have resulted in 2 systems that can operate within two types glove boxes, one at ambient temperatures and the other at cold temperatures. The cold robotic box is designed for bag-in and bag-out procedures



Robotic Monitoring of Contaminated Radiological Areas(DOE Contract)
http://www.osti.gov/bridge/product.biblio.jsp?osti_id=820843

The 224-T Building is a small canyon style facility where plutonium solutions were purified and concentrated from 1945 until the mid-1950s. The last known entry into the process cells occurred in 1986. Limited amounts of information regarding shutdown and status were available. A robotic crawler was deployed into the process cells at the 224-T Building to perform cell characterization. Due to the unknown fissile inventory in the cells and the potential moderation affects of a person, manned entry was considered too high of a risk, and a robotic crawler was determined to be the best option for the initial characterization. The robotic crawler provided maneuverability, allowing access to areas in the cells where debris was found. It provided visual inspection in areas with little light, using a low lux pan and tilt camera system. Also, it provided fissile inventory measurements using a non-destructive assay (NDA) detector. The NDA detector supplied real time data to maintain criticality control.



NASA
Goddard Space Flight Center (Greenbelt, MD)

The thrust for Goddard's Robotic unit is in technologies that will allow robots to interact more safely with one another and with humans.

Robotics Academy

http://robotics.gsfc.nasa.gov/

The NASA Robotics Academy is a 10-week resident summer internship for students specifically interested in robotics. Students who have previously participated in the FIRST Robotics Competition, VEX, Botball, or have taken active interest in robotics in demonstrable ways are given priority. Participants are assigned to a team project sponsored by NASA/GSFC, local industry, or academic institution (4 students per project). In addition to direct guidance from the Principal Investigator (PI) who sponsored the project, an advanced robotic student is assigned as team lead to guide interns and manage the project on a daily basis. The interns and team leads participate in enriching activities such as a group project, lectures, field trips, and meetings with leaders in the field. The University of Maryland, College of Computer, Mathematical and Physical Science is also a GSFC Academy co-sponsor granting 4 credits to participants who successfully complete the Goddard program. Students with disabilities are provided reasonable accommodation services.

Robotic Skin

http://www.nasa.gov/centers/goddard/news/topstory/2005/vladskin.html

Laboratories at Goddard are developing a high-tech covering that would enable robots to sense their environment and react to it, much like humans respond when something or someone touches their skin. Such a technology, is referred to as a "High-Tech Skin," is essential for carrying out the Vision for Space Exploration because the Vision depends heavily on humans and robots working together under a variety of working conditions, many of them highly unstructured. The idea is to develop a "sensitive skin" that technicians could use to cover a robot. This skin will include more than 1,000 infrared sensors that would detect an object, and send the information to the robot's "brain." The brain would digest the information, apply reasoning and react within milliseconds by directing the robot to move. Future skin prototypes likely will have a higher density of sensors on the skin, which will provide the robots with even greater dexterity.

TETWalker Robot
http://ants.gsfc.nasa.gov/documents/ants%20marchdemo%20primidi.pdf

The robot is called "TETWalker" for tetrahedral walker, because it resembles a tetrahedron (a pyramid with 3 sides and a base). In the prototype, electric motors are located at the corners of the pyramid called nodes. The nodes are connected to struts which form the sides of the pyramid. The struts telescope like the legs of a camera tripod, and the motors expand and retract the struts. This allows the pyramid to move: changing the length of its sides alters the pyramid's center of gravity, causing it to topple over. The nodes also pivot, giving the robot great flexibility. When it's done these nanotech swarms will "alter their shape to flow over rocky terrain or to create useful structures like communications antennae and solar sails." The team anticipates TETwalkers can be made much smaller by replacing their motors with Micro- and Nano-Electro-Mechanical Systems. Replacement of the struts with metal tape or carbon nanotubes will not only reduce the size of the robots, it will also greatly increase the number that can be packed into a rocket because tape and nanotube struts are fully retractable.

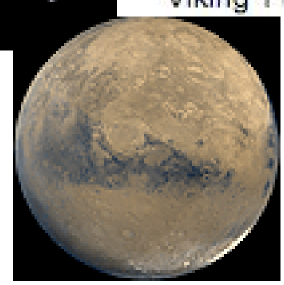
Space Rovers/Landers

- Viking 1 and 2 (1976-1982)
  http://nssdc.gsfc.nasa.gov/planetary/viking.html

  The primary mission objectives were to obtain high resolution images of the Martian surface, characterize the structure and composition of the atmosphere and surface, and search for evidence of life. The results from the Viking experiments give our most complete view of Mars to date. Volcanoes, lava plains, immense canyons, cratered areas, wind-formed features, and evidence of surface water are apparent in the Orbiter images.

Viking 1 Lander

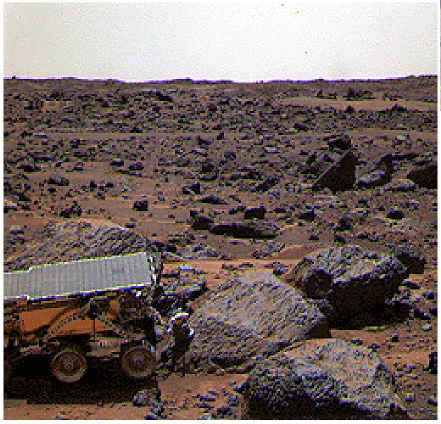
Viking 1 Orbiter



- Mars Pathfinder (1997)
  http://nssdc.gsfc.nasa.gov/planetary/mesur.html

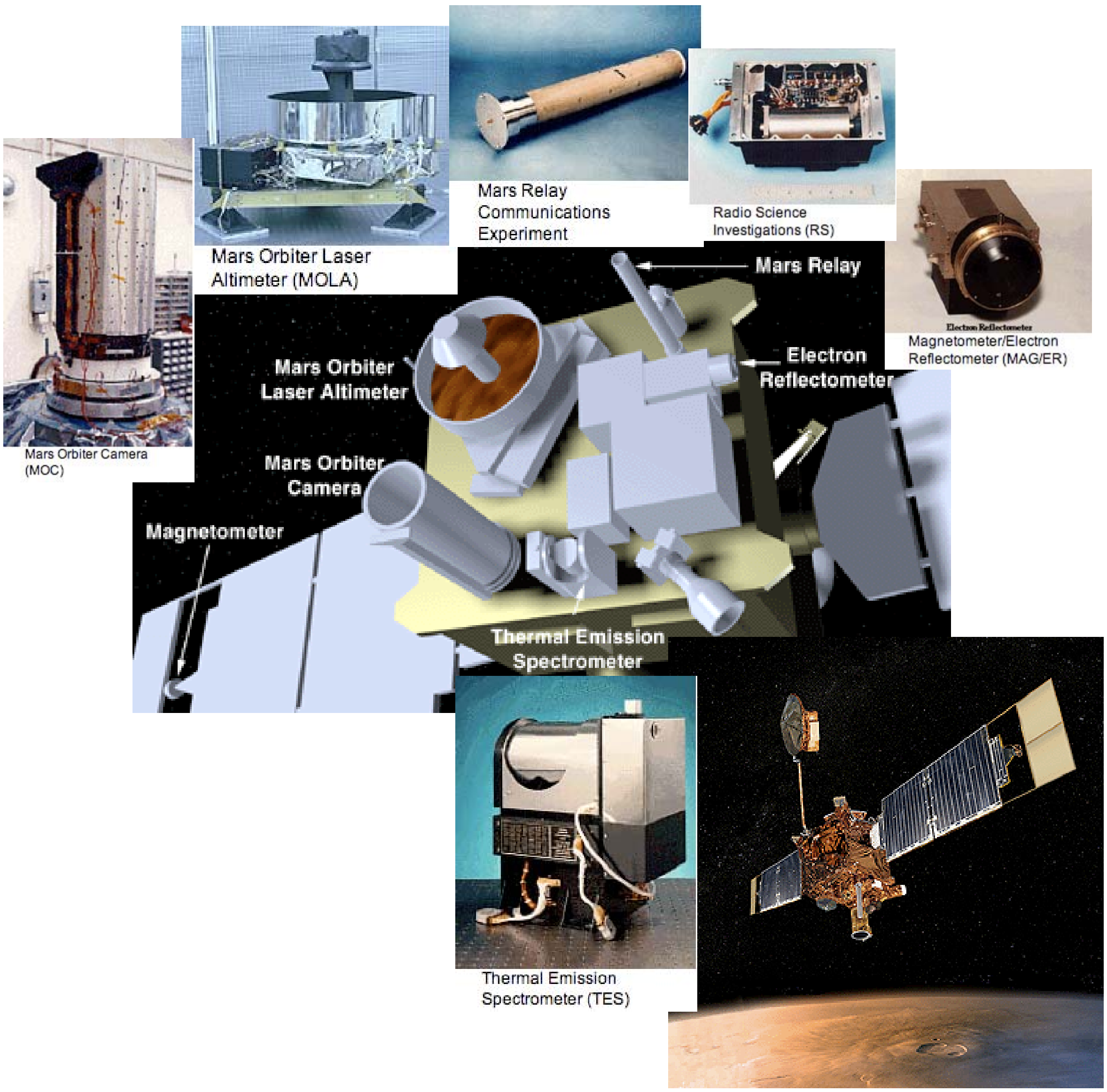
  The Mars Pathfinder (formerly known as the Mars Environmental Survey, or MESUR, Pathfinder) is the second of NASA's low-cost planetary Discovery missions. The mission consists of a stationary lander and a surface rover. The mission has the primary objective of demonstrating the feasibility of low-cost landings on and exploration of the Martian surface. This objective will be met by tests of communications between the rover and lander, and the lander and Earth, and tests of the imaging devices and sensors. The scientific objectives include atmospheric entry science, long-range and close-up surface imaging, with the general objective being to characterize the Martian environment for further exploration. The spacecraft entered the Martian atmosphere without going into orbit around the planet and landed on Mars with the aid of parachutes, rockets and airbags, taking atmospheric measurements on the way down. Prior to landing, the spacecraft was enclosed by three triangular solar panels (petals), which unfolded onto the ground after touchdown.

Mars Pathfinder Rover



- Mars Global Surveyer (1996-ongoing)
  http://nssdc.gsfc.nasa.gov/planetary/marsurv.html

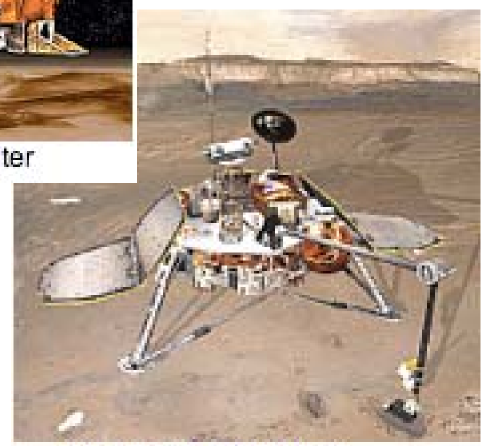
  The Mars Global Surveyor (MGS) mission is designed as a rapid, low-cost recovery of the Mars Observer mission objectives. The science objectives involve high resolution imaging of the surface, studies of the topography and gravity, the role of water and dust on the surface and in the atmosphere of Mars, the weather and climate of Mars, the composition of the surface and atmosphere, and the existence and evolution of the Martian magnetic field.



- Mars Climate Orbiter & Mars Polar Lander (1998,1999
http://nssdc.gsfc.nasa.gov/nmc/masterCatalog.do?sc=1998-073A

The Mars Surveyor '98 program is comprised of two spacecraft launched separately, the Mars Climate Orbiter (formerly the Mars Surveyor '98 Orbiter) and the Mars Polar Lander (formerly the Mars Surveyor '98 Lander). The two missions were to study the Martian weather, climate, and water and carbon dioxide budget, in order to understand the reservoirs, behavior, and atmospheric role of volatiles and to search for evidence of long-term and episodic climate changes. The Mars Climate Orbiter was destroyed when a navigation error caused it to miss its target altitude at Mars by 80 to 90 km, instead entering the Martian atmosphere at an altitude of 57 km during the orbit insertion maneuver. The last telemetry from Mars Polar Lander was sent just prior to atmospheric entry on 3 December 1999. No further signals have been received from the lander, the cause of this loss of communication is not known.


Mars Climate Orbiter


Mars Polar Lander

- Deep Space2 (1999)
http://nssdc.gsfc.nasa.gov/nmc/masterCatalog.do?sc=DEEPSP2


Deep Space 2

The Deep Space 2 (DS2) project is a New Millennium mission consisting of two probes which were to penetrate the surface of Mars near the south polar layered terrain and send back data on the sub-surface properties. On 3 December 1999 the probes were nearing Mars on a trajectory to enter the atmosphere and bring them to their intended landing site, but contact was never made with either probe and the mission was presumed lost. Also named the Mars Microprobe Project, the probe mission had as scientific objectives to: 1) test for the presence of water ice below the surface, and if ice exists, attempt to resolve the mineral phases in which the ice is stored; 2) determine the thermal and physical properties and temperature gradient of the subsurface material; 3) measure the atmospheric pressure and temperature. Data was also to be obtained on the atmospheric density profile and near-surface soil stratification using deceleration measurements during atmospheric entry and landing. The mission was also planned to serve as a technology test for many of the components of the probes and a demonstration of passive atmospheric entry and survivable hard impact. The individual probes were named Amundsen and Scott in honor of the famous polar explorers.

U.S. Geological Survey (Reston, VA)

http://www.usgs.gov

- ***Laboratory Robotics***

  Geochemical studies generate large quantities of samples to be analyzed in the laboratory. Although technological advances have produced vast improvements in analytical measurements and data reduction, the manual preparation of samples has remained a time-consuming problem. As a result, one of the most rapidly growing areas in laboratory automation is the use of robotics for sample preparation. There are several advantages to the use of robotics. Robots have improved productivity by a factor of 2 or 3. Because sample preparation requires the use of hazardous chemicals, the robot minimizes human exposure to these chemicals. By delegating the repetitive applications to the robot, the technician is available to assume greater responsibilities. Finally, robots provide consistency in sample preparation and improve the precision of the data. In USGS laboratories, robotics have been applied to a range of techniques including sample disaggregation, the decomposition of tens of thousands of samples per year for the ICP-AES methods, the weighing of 7,000 charges of flux per year for the XRF major element analyses method, and other similar sample preparation methods. The use of laboratory robotics continues to increase as the benefits from each application are realized.