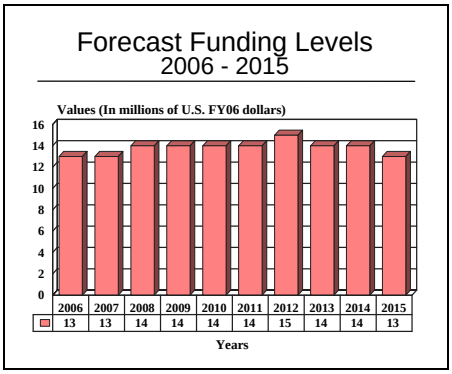
Joint Robotics - Archived 1/2007

Outlook

- Commercially produced robotic systems being successfully used in Iraq fuel interest in the Joint Robotics program
- Through 2015, an estimated $138 million is expected to be spent on various RDT&E efforts



Orientation

Description. U.S. Department of Defense (DoD) program to consolidate robotic programs on unmanned ground systems and related robotic technologies, and to focus military service's robotic programs on operational requirements.

Sponsor

Defense Advanced Research Projects Agency (DARPA)
Special Projects Office
3701 N. Fairfax Drive
Arlington, Virginia (VA) 22203-1714
USA
Web site: http://www.darpa.mil

Status. In research and development.

Total Produced. Not applicable at this time.

Application. This program seeks to develop technologies that are amenable to multiservice applications, provide capability in high-hazard environments, and help to improve battlefield efficiency.

Price Range. Not applicable. Currently in RDT&E.

Contractors

General Dynamics Corporation, HQ, http://www.gd.com, 2941 Fairview Park Dr, Suite 100, Falls Church, VA 22042-4513 United States, Tel: + 1 (703) 876-3000, Fax: + 1 (703) 876-3125, Prime

NOTE(S): The above contractor has been involved in the Joint Robotics from the start, being responsible for early developmental work. Many other companies are currently providing limited products and/or services for a number of robotics requirements. However, none of them could rightly be identified as prime contractors.

Technical Data

Design Features. A large and growing number of robotic systems are under development by numerous companies. The design features of a couple of representative systems funded by the U.S. Defense Advanced Research Projects Agency (DARPA) are provided below. These systems are indicative of the type of technology being developed under this program.

Robotic Perimeter Detection Systems. A system developed by Sandia National Laboratories for U.S. military small-unit operations consisting of three subsystems: Miniature Intrusion Detection System (MIDS), Robotic All Terrain Lunar Exploration Rover (RATLER) vehicles, and a base station. The system includes magnetometer, seismic, passive infrared, and beam break (or active) infrared sensors. Radio communications feature 138-153 MHz radio frequency (partitioned to 600 radio frequency channels), up to 1,000 input devices (magnetometer, seismic, etc.) per channel, and RF output.

The RATLER vehicles include a differential GPS receiver, electronic compass and tilt sensors, video cameras, and RF video transmitters. A laptop computer is provided with the base station, as are a differential GPS base receiver, spread spectrum two-way packet radios, and battery power supply.

Small Smart Machines. These coin-sized systems developed by Sandia National Laboratories are designed to reduce the impact of hazards in risky civil and military operations, being used, for example, to detect hidden bombs. These systems feature miniature and micro-robotic devices, micro-electromechanical systems (MEMS), actuators and sensors, micro-manipulation devices, and low-power, long-range communication devices.

Variants/Upgrades

Joint Robotics is a technology program, and thus there are no product variants or upgrades.

Program Review

Background. This DARPA program consolidates the DoD robotics program for unmanned ground vehicles (UGVs) into two activities: 1) the transition of UGV concepts into advanced development acquisition programs, and 2) the enhancement and exploitation of critical robotic technologies for present and future UGV acquisition requirements.

This program entails the following efforts:

BUGS. The Basic Unexploded Ordnance Gathering System (BUGS) is a joint service Explosive Ordnance Disposal (EOD) effort to locate and dispose of surface unexploded ordnance (UXO).

RACS. The Robotics for Agile Combat Support (RACS) is a U.S. Air Force effort to develop a robotic/ autonomous vehicle capability for force protection and active range protection.

Mobility Enhancements. This program is aimed at improving the mobility of small, man-portable, unmanned vehicles during military police missions.

FTUV. The Family of Tactical Unmanned Vehicles (FTUV) is a joint U.S. Army/Marine Corps effort to provide commanders with a suite of reconnaissance, surveillance, and target acquisition UGVs that are sized to operate in a variety of tactical situations.

MPRS. The Man-Portable Robotics Systems (MPRS) is an effort to develop smaller UGVs as part of the FTUV program.

JAUGS. The Joint Architecture for Unmanned Ground Systems (JAUGS) is an approach to standardizing the protocols and software component interfaces of all DoD unmanned systems.

Gladiator. Gladiator is an effort to develop a light unmanned system for the U.S. Marine Corps (USMC) for use in surveillance and reconnaissance.

MDARS-E. The Mobile Detection Assessment Response System – Exterior (MDARS-E) provides the capability to conduct various patrols and surveillance activities. The system is being designed for use in a variety of installations: chemical storage facilities; arms, ammunition, and explosives storage areas; air fields; and other sites and transportation centers.

Note: Some of these categories are covered as individual reports in the Forecast International *Unmanned Vehicles* Forecast. For the purposes of this report, the focus is on the development of program-related core robotic technology with particular emphasis on such systems as the Small Smart Machines and systems dedicated to surveillance, reconnaissance, and counterterrorism.

Recent Activity. In FY00, the JAUGS was incorporated into the Standardized Robotic System (SRS) contract. (The SRS had previously been called Vehicle Tele-operation, or VT.) In addition, Mesa Associates Tactical Integrated Light-force Deployment Assembly (MATILDA) platforms, produced by Urban Warrior Mesa Associates, were sent to the Civil Support Detachments – Weapons of Mass Destruction for evaluation.

Robotic systems were explored during 2001 for possible use in Agile Combat Support/Force Protection missions – i.e., UXO disposal, WMD threat reduction, structural protection, and physical security. In August 2001, the U.S. Army Robert Morris Acquisition Center, on behalf

of the U.S. Army Research Laboratory, awarded General Dynamics Robotic Systems two contracts for robotics research and development with a potential value of $66 million over an eight-year period. Under the first contract, an alliance was created of 13 academic and commercial members led by General Dynamics. The team was dedicated to developing robotic technologies that would enable high-speed autonomous movement in unstructured environments. These technologies would be applied to future land warfare combat systems. The second agreement was a contract to facilitate the transition of robotic technology to military, government, and commercial customers.

The RACS segment of the Joint Robotics program became the focus of increased activity in 2002. Among the many accomplishments was the development of advanced robotic technologies for integration with existing and future unmanned system platforms. This effort was undertaken in support of the DoD's Agile Combat Support/Force Protection missions – for example, lowering the threat from weapons of mass destruction. A significant portion (over $5 million) of the parent program's FY02 budget was dedicated to this work.

Also receiving new emphasis in 2002 was the MPRS segment, which focused on the development of smaller UGVs to conduct operations in tunnels and in urban terrain.

In late 2002, the U.S. Army started deploying a number of small robotic systems on various surveillance missions in Afghanistan. These missions served as a test of how well these systems performed their intended function of electronically reporting important information to controllers in dangerous, remote places.

For the next major conflict, the U.S.-led Operation Iraqi Freedom in 2003, unmanned ground vehicles specially equipped with sensors for chemical and biological detection were deployed by Joint Robotics program officials.

In another notable development in 2003, the program received a large infusion of RDT&E funding of approximately $27.8 million, almost twice the average annual funding in prior years. This boost was no doubt directly related to various deployments in Afghanistan and Iraq.

The MDARS-E subsegment of Joint Robotics in particular benefited from this funding increase. Program funding of $12.7 million went toward various tests and evaluations and the integration of various sensor technologies, as well as the delivery of the first pre-production platforms.

MDARS-E user tests began around April 2004 at a Nevada U.S. Army depot.

The Army in May 2004 began to deploy some 155 UGVs to aid soldiers in Iraq with explosive neutralization.

In April 2004, DARPA began to solicit proposals for a new program intended to improve the autonomy of UGVs. The program, Learning Applied to Ground Robots (LAGR), will seek to develop software to bring about this new methodology:

iRobot was awarded a contract in June 2004 for the production of small UGVs – another robotic surveillance enhancement system – for U.S. Army applications. No contract amount or quantities were made public.

By late 2004, reports had emerged detailing which commercially produced robotic systems had already been fielded. These included iRobot Packbots, Foster Miller Talon robots, and Remotec Mini Andros II systems.

In August 2005 *Inside The Army* reported that the U.S. Army's Rapid Equipping Force was in the process of handling a service request for 350 robotic systems for explosive ordnance disposal.

Funding

U.S. FUNDING - R&D

	FY05 QTY	FY05 AMT	FY06 QTY	FY06 AMT	FY07 QTY	FY07 AMT	FY08 QTY	FY08 AMT
RDT&E (DARPA) PE#0603709D8Z Joint Robotics Program	-	21.3	-	11.7	-	12.0	-	12.0

	FY09 QTY	FY09 AMT	FY10 QTY	FY10 AMT	FY11 QTY	FY11 AMT
RDT&E (DARPA) PE#0603709D8Z Joint Robotics Program	-	12.0	-	12.3	-	12.6

All $ are in millions.

Source: U.S. Department of Defense (DoD) Defense Advanced Research Projects Agency (DARPA) FY20056/2007 RDT&E Program (R-2 Exhibit)

Recent Contracts

Contractor	Award ($ millions)	Date/Description
General Dynamics	66.0	Aug 2001 – Two contracts for robotics research and development. General Dynamics led 13 academic and commercial members in developing robotic technology for future land warfare combat systems. Second contract called for transitioning robotic technology to military, government, and commercial customers.
Carnegie Mellon University	5.5	Mar 2003 – Modification to a previously awarded contract for Phase III of the Perception for Off-road Robotics program. DARPA is the contracting authority. (MDA972-01-9-0016)
Exponent	15.4	May 2003 – Integration of 20 TM-7 controllers and 15 robots for deployment to Afghanistan for a period of 11 months. The contract was awarded by the U.S. Army's Office of the Rapid Equipping Force.

Timetable

Month	Year	Major Development
	2000	JAUGS standards established by U.S. DoD; documentation describing UGV domain and performance specifications updated
	2001	Research and development in support of the Agile Combat Support/Force Protection missions
Aug	2001	$66 million contract from U.S. Army to General Dynamics for development of robotic technology
	2001	Update of JAUGS based on technology improvements
	2002	U.S. DoD RDT&E funding for program set at $12.5 million
	2002	Joint Robotics systems deployed to Afghanistan
	2003	Joint Robotics systems deployed to Iraq; $27.8 million budgeted for RDT&E
Apr	2004	U.S. Army user tests of MDARS-E
May	2004	Over 150 UGVs begin to be deployed to Iraq
	2005	U.S. Army states need for some 350 robotic systems
	2006-2015	Continued RDT&E of Joint Robotics program

Worldwide Distribution

At this time, Joint Robotics is a **DARPA** program to develop robotic systems for eventual deployment to U.S. military and civil law enforcement agencies.

Forecast Rationale

The war on terrorism continues to fuel demand for unmanned ground vehicles (UGVs) and robotic systems. Already, commercially produced systems in use in Iraq and Afghanistan have been credited with saving lives. The U.S. military's Joint Robotics program secures funding for the development of mobile ground robotic systems for use in electronic surveillance missions in hazardous environments. The program has requested a budget of $72.6 million through 2011. Because of the U.S. military's urgent need for robotic systems and UGVs, steady funding should be assured well into the next decade.

The Joint Service explosive ordnance disposal (EOD) segment of the program is expected to spend some $17.3 through 2011 on RDT&E. Among other tasks, this effort will attempt to come up with new concepts to counteract the deadly tactics of the insurgents in Iraq and Afghanistan, including the use of roadside bombs.

Another well-funded segment is the Robotics for Agile Combat Support (RACS) program. This effort is scheduled to receive $20.3 million in funding through 2011.

In May 2004 the U.S. began deploying some 155 new UGVs to Iraq to aid soldiers in EOD operations, evidence that the U.S. military is starting to make greater use of Joint Robotics technology. By January 2005 it was being reported that the U.S. military had plans to equip every EOD team with at least two portable robots by year's end. Since then, a wide variety of commercially produced systems have been adapted to meet these immediate requirements, presumably until systems coming directly out of the DARPA program can be fielded.

The main challenges for the years ahead will be developing better user/system communications and greater system autonomy. The Defense Advanced Research Projects Agency (DARPA), the program's sponsor, has begun seeking software developers that can bring about these technological advancements.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR FUNDING ($ in millions)

				High Confidence Level			Good Confidence Level			Speculative			
Designation	**Application**	**Thru 05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**Total 06-15**
JOINT ROBOTICS PROGRAM	FORCE PROTECTION (U.S. DARPA)	80.000	13.000	13.000	14.000	14.000	14.000	14.000	15.000	14.000	14.000	13.000	138.000