Military Robotics

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Military Robotics

- "Military Robotics" is an overarching category involving a diversity of robotic platforms, possessing a diversity of capabilities, and addressing a diversity of missions
- UxVs: where x is Air, Underwater, Surface, Ground (on-road, off-road, MOUT, USAR, etc)
- >10⁴ range in size (mass) from micro to maxi
- Systems development important

"Military Robotics" Comprises:

- UxVs with competent mobility and navigation
- Useful sensor and effector (weapons, etc) mission payloads
- Competent mission-level behaviors
- Integration with the force structure
 - Interface -> Interaction -> Interoperability with humans
 - -Robotic teams and swarms
- Tactics and doctrine to exploit robotic strengths, mitigate robotic weaknesses

Major Labs and Investigators (UAVs)

General Atomics Aeronautical Systems

The RQ-1 Predator is a medium-altitude, long-endurance unmanned aerial vehicle system. It is a Joint Forces Air Component Commander-owned theater asset for reconnaissance, surveillance and target acquisition in support of the Joint Force commander.



Northrop Grumman Integrated Systems.

RQ-4A Global Hawk Unmanned Aerial Vehicle is a high-altitude, long-endurance unmanned aerial reconnaissance system designed to provide military field commanders with high resolution, near real-time imagery of large geographic areas



Major Labs and Investigators (UGVs)

GENERAL DYNAMICS

Robotic Systems



iRobot' Robots for the Real World





PackBot products are built on the battle-proven PackBot chasais deployed by U.S. ground troops in Afghanistan (2002) and trag (2003)



Major Labs and Investigators (UUVs)









UGVs at Universities

- CMU
 - Robotics Institute
 - National Robotics Engineering Consortium
 - National Center for Defense Robotics
- Georgia Tech
 - Mobile Robot Lab
 - Intelligent Machine Dynamics Lab (IMDL)
- USC
 - Interaction Lab
 - Embedded Systems Lab
- MIT
 - Computer Science and AI Lab (CSAIL)
 - Field and Space Robotics Lab
- And Many More...





Cardea, MIT



NavLab, CMU



MARS 2020, GT



Multi-Robots, USC

FFRDC and Govt Labs

- ARL autonomous unmanned recon vehicles, horizonal intel fusion, portable robots
- SPAWAR air, land, water autonomy, deployment
- Sandia multi-robot cooperation











Manned Systems





NLOS Cannon Source: U.S. Army



NLOS Mortar

One Team-The Army/Defense/Industry



Maintenance and Recovery



Medical Treatment, Evacuation

Army Position on FCS Life Cycle Costs (FY 03 \$ in Billions)

Appropriation	Amount
RDT&E	\$18.1
Procurement	66.7
MILCON	0.6
Military Personnel	36.7
Operations & Maintenance	25.9
Army Capital Working Fund	1.3
Total	\$149.3

Major accomplishments and practical embodiments in the past 10 years

- Operational fielding of tactical surveillance AUVs (Raptor, Predator, etc).
- Explosion of AUV companies and the creation of an AUV industry.
- Operational deployment of Portable Robots (PackBot, Talon)
- Future Combat Systems built on concept of Unmanned Ground Vehicles.
- UGV development heavily funded by DOD.
- Operational fielding of UUV in Persian Gulf for close to shore surveillance and mine clearance.
- UUV support and deployment built into Navy's newest littoral combat ships.

Major unsolved problems and challenges

- Robust, secure communication links
- Safe, long duration, lightweight power storage
- Robust autonomous control for tactically significant missions
 - —Perception for real-world navigation and for mission operations
- Mobility in challenging environments (e.g., MOUT, USAR)

Need System Development strategies as well as Research Breakthroughs

- Identify the "best" application opportunities (in terms of technical feasibility, payoff, constituency)
- Leverage deployment of useful near-term capabilities to accelerate long-term development of advanced systems
- Exploit machine learning and adaptation

Research Goals

- AUVs: Safe navigation and transit over densely populated civilian areas in the presence of other air traffic.
- UGVs: Robust autonomous navigation through operationally significant terrain (cities, forests, mountain paths, etc).
- UGVs: Tactical mission planning and execution in a dynamic environment.
- UGVs: Better power and communications.
- UUVs: Improved autonomous navigation in a near off-shore environment.
- UUVs: Better power and communications.

Major accomplishments in other countries

Hermes 450 (Israel)

Guardium - Autonomous Security Vehicle IAI/Lahav (Israel)

UUV: Hugin 3000 AUV. Norway







International cooperation

- Research on power systems and long range secure communications.
- Research on 3d vision, multi-spectral camera systems and sound localization systems.
- Research on dense, shock hardened computer systems.