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)
- $>10^4$ 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

LOCKHEED MARTIN

iRobot® Robots for the Real World
PackBot #129
Killed In Action
April 8, 2004
Iraq
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...
FFRDC and Govt Labs

• ARL - autonomous unmanned recon vehicles, horizontal intel fusion, portable robots
• SPAWAR – air, land, water autonomy, deployment
• Sandia – multi-robot cooperation
- **Manned Systems**

- **Unmanned Air Platforms**
  - Class I
  - Class II
  - Class III
  - Class IV

- **Unmanned Ground Vehicles**
  - Mounted Combat System
  - Reconnaissance and Surveillance
  - NLOS Cannon
  - NLOS Mortar

- **Unattended Payloads**
  - Unattended Munitions
    - NLOS LS
    - Intelligent Munitions

- **Unattended Ground Sensors**

- **Unmanned Payloads**

- **Mounted Combat System**

- **Reconnaissance and Surveillance**

- **NLOS Cannon**

- **NLOS Mortar**

- **Armored Robotic Vehicle**

- **Armored Robotic Vehicle-Light**

- **Medical Treatment, Evacuation**

- **Maintenance and Recovery**

Source: U.S. Army
Army Position on FCS Life Cycle Costs

*(FY 03 $ in Billions)*

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<td><strong>Total</strong></td>
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Source: U.S. GAO
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.