

Applications of Autonomous Robots in Safety and Security

4th Biennial Conference



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Mobile Intelligent Autonomous Systems Group

- The Mobile Intelligent Autonomous Systems (MIAS) group was formed as an Emerging Research Area (ERA) in 2007.
 - CSIR did not have existing capability
 - Was deemed to be a important future capability
- First 5 years focussed on capability building – now moving into commercial ventures
- Group focus is on sensors and intelligence for field robotics applications
 - Use existing hardware for prototyping

What is Field Robotics

- MIAS focuses on field robotics.
- These are robotic systems for “real-world” environments.
- They are environments where:
 - Things change
 - People may be present
 - Objects may be obscured by clutter
- Compared to controlled environments (e.g. Factories/Assembly Lines), these environments are much more challenging.

Applications of Autonomous Robots

- When referring to applications of autonomous robots, we often talk about the 5 D's
 - **Dangerous**
 - **Dull**
 - **Dirty**
 - Domestic
 - Dexterous
- These are jobs that people often don't want to, or can't perform.
- Applications include:
 - Search and Rescue
 - Security Patrols and Surveillance
 - Convoy Driving and Equipment Transport
 - Hazardous Materials Handling

Advantages of Autonomous Robots

- There are several advantages to using autonomous robots
 - Operate in extreme environments
 - Do not suffer from fatigue
 - Not bored by repetitive tasks
 - Expendable
 - Require less support infrastructure

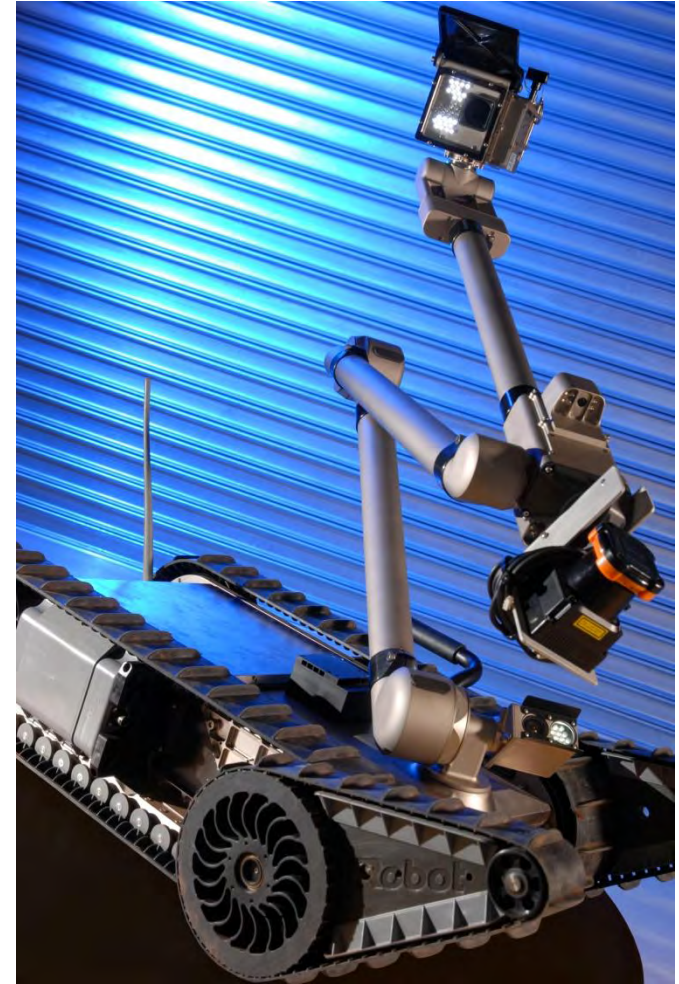
Autonomous Rover

- The autonomous rover project focussed on the creation of a GPS-guided autonomous platform.
- Can autonomously navigate along known paths with collision avoidance.
- Project is completed and can autonomously navigate the CSIR campus.
- Applications of this technology include:
 - Security patrols
 - Transportation of cargo



Mine Safety Platform

- Joint project with CSIR Centre for Mining Innovation and Material Science and Manufacturing.
- System focuses on performing pre-entry safety inspections in deep mines.
- Additional applications of technology include:
 - Search and Rescue
 - Autonomous Exploration and Mapping
- More information tomorrow in the mining track.



Autonomous Mule

- The Autonomous Mule is aimed at providing squad support (compare to a pack mule) in an operational environment.
- Platform can track and follow targets (includes either people or other vehicles).
- Platform assists personnel by carrying equipment.
- Compared to Autonomous Rover, Mule can travel over unexplored terrain.
- Other applications of technology include:
 - Convoy driving
 - Reconnaissance



Active Surveillance and Intelligent View-point Selection

- Aims at making a robot inquisitive.
- Most surveillance systems have a camera with a fixed view point – but viewpoint is important for identification.
- Cannot investigate points of interest (something out of place) or gain additional information about the environment.
- By mounting the camera on a mobile platform, robot can explore and investigate abnormal occurrences



Novel Sensors

- Autonomous robots are not limited by human senses.
- Using additional sensors allow us to gain additional information usually not conventionally available to people.
- Some examples of these sensors include:
 - Directional Microphones
 - Radar
 - Night Vision
 - Thermal Cameras
 - Ultra High-speed Photography (≈ 10 Billion frames/sec)

Novel Sensors

- Thermal cameras can also observe latent thermal prints.
- These are left behind by people when they touch objects.
- Even after the intruder is no longer visible, latent prints are still left behind which can be investigated (Active surveillance)



Novel Sensors

- Using high-speed, gated photography, we are able to see through obstructions such as dust and smoke.
- This form of sensor technology is invaluable in search and rescue scenarios.



Sensor Fusion

- Each sensor has strengths and weaknesses.
- Autonomous systems can focus on multiple inputs simultaneously.
- By combining information from multiple sensors, we can exploit the best traits of each of the sensors.



Assisted Teleoperation

- Teleoperation has multiple uses in environments too dangerous for people to explore (Search & Rescue, EOD).
- Current teleoperation methods suffer from a lack of kinesthesia (awareness of “body parts”).
- Assisted algorithms are aware of the environment and carry out tasks while avoiding collisions.



Target Tracking (Person Following)

- We are able to track and follow designated targets. (Work related to Autonomous Mule)
- System can use a range of sensors:
 - Visual
 - Thermal
 - Laser Range Finder
 - Radar



Systems and Capabilities

- MIAS has a range of systems and capabilities related to the defence, safety and security industries, including:
 - GPS-assisted autonomous navigation
 - Search and Rescue
 - Autonomous exploration and reconnaissance
 - Active surveillance
 - Target tracking
 - Assisted teleoperation
 - Sensor fusion

Conclusions

- Autonomous systems have a range of applications in the safety and security domain.
- The MIAS ERA has built a competence in many field robotics related technologies.
- Many other potential applications can benefit from robotics and related technologies.
- MIAS staff are available for discussion at our stand in the exhibition venue should you want to discuss any potential applications.

Thank you



A simple slide layout

- This is a typical slide with space for headline and body text
- Pictures may be included
- Do not use fonts smaller than 18pts
- Do not use headlines with fonts smaller than 24pts

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Cooperative Robotics



- Future research area involving getting robots to work together with people.

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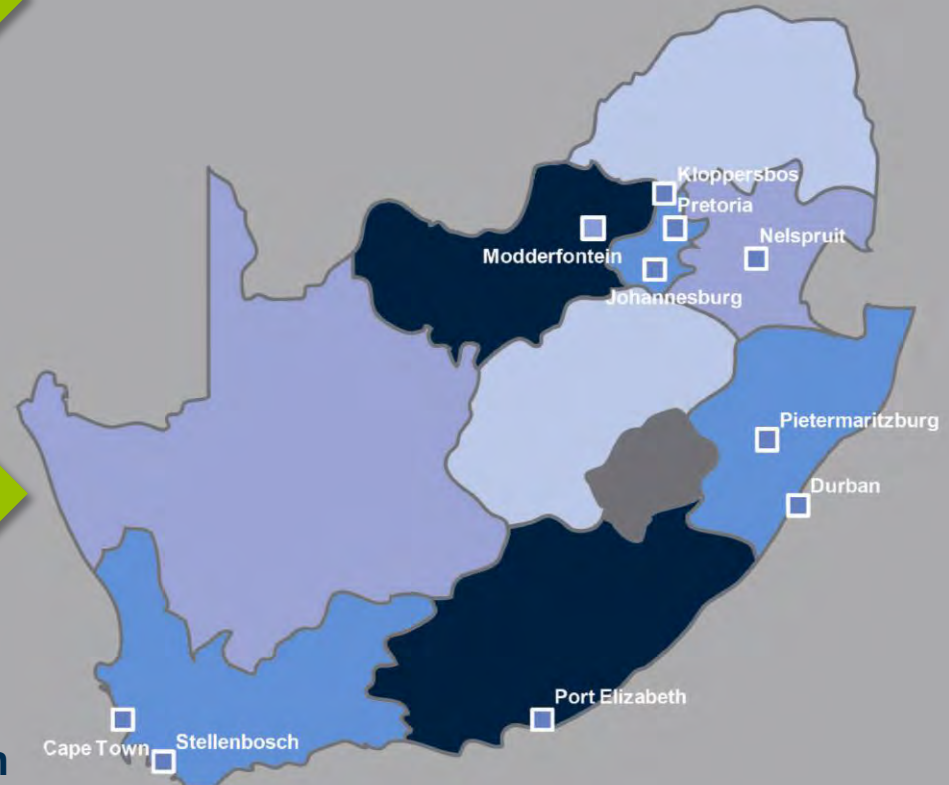
People and demographics (current)

- 2355 members of staff
- 1486 in SET * base
- 295 with PhDs
- 468 with Master's
- 53.3% of SET base black
- 34% of SET base female

Financials (2010/11)

- **Contract Income: R1175.1 m**
- **Parliamentary Grant: R535.3 m**
- **Royalties: R8.6 m**
- **Total operating income: R1.72 billion**
- **Net Profit: R35.5m**

***SET: Science, engineering and technology**



A simple slide layout

