Military University of Technology

8th European Land Robot Trials & 5th Military ELROB

23-27 June 2014

To be under patronage of:

Ministry of National Defence Republic of Poland

Head of the National Security Bureau
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Military University of Technology as a modern university with its over 60 years tradition from the beginning is connected with the Polish Armed Forces not only by the name but most of all by accomplishments for the defense and national security system. The subject of our constant concern is that our concrete achievements and innovative solutions could find deployment way to products and above all recipients. Such way we comprehend innovation and economy based on knowledge – as development pillars of the European Union.

We have world class experience technological and scientific potential on a creative innovation path. However, invaluable in our opinion for the development is the exchange of experience in leading technology areas. Therefore, with open arms and organizational commitment we welcome all of you in our home on 5th Military European Land-Robot Trial M-ELROB 2014 – important on European market engineering teams and producers of future solutions in automatic and robotic area. This meeting will allow for getting hold of closer scientific contacts with benefit for all participants. As well with benefit for those who modernizing the Polish Armed Forces.

Science plays a dominant role in the development of our University. We are creating a modern research university based on the synergies of education process and scientific researches. MUT conducting innovative implementation of advanced defense technologies is a major entity on the European technology market. We want to face the challenges of the XXI century in a globalized world. We believe that technology development will decide about future on the same level as education of society.

Nowadays we have human capital to build a solid foundation to enable future development in Poland. However, it should be remembered that 80% of today’s technologies will be replaced by newer within 10 years. Hence, of the success does not prejudge present state but prepare action to create new technological products that will master the market soon. The future belongs to automation and robotics, nanotechnology and microelectronics, photonics and biotechnology on potential battlefield, as well as in commercial applications.

At least acting rationally on the micro level, we try in MUT accumulate experimental and scientific potential for these areas where the achieved level enables for effective competition or partner cooperation with the best in the world. We have already a lot of experience in building military unmanned ground vehicles. That is why we are hosting this year’s European event.

We also try to be the initiators of new projects which integrate the Polish world of science and industry with important for our country’s challenges connected with our security and crisis management. M-ELROB fits perfectly in our mission and action philosophy.

For all of those who took an active part in efforts and direct organizational work contributed to the realization of such an important event like 5th Military European Land-Robot Trial M-ELROB 2014 let me say in this way cordially THANK YOU.

Commandant–Rector of the Military University of Technology

BGen Prof. Zygmunt Mierczyk, PhD, DSc
Welcome to the M-ELROB 2014 in Warsaw. This year’s event is already the eighth edition of the European Land Robot Trials. Over the years the trials have established themselves as Europe's leading outdoor robotics event.

After exceedingly successful M-ELROB events in Hammelburg (Germany) and Thun (Switzerland) this fifth presentation of the military version of ELROB is kindly hosted and co-organized by the Mechanical Department of the Warsaw Military University of Technology (WAT). Bringing together potential end-users, members of the robotics research community and industry representatives, ELROB once more demonstrates the successful cooperation between the European countries.

The purpose of the European Land Robot Trial is to provide a comparative evaluation of outdoor robotic systems across applications such as basic mobility, scouting, EOD, convoying, etc. The trials will provide important information to potential users in terms of the status of current technologies. Through a baseline comparison of systems, it is also a prominent opportunity for vendors to understand current limitations and needs of end-users. ELROB furthermore provides an important venue for academics to understand challenges of technology transfer from research to field applications and basic research problems that remain unsolved.

The military ELROB addresses the fact that it is generally difficult for companies to get access to user feedback about their systems from actual end-users in the theatre. The event offers a unique insight into possible use cases. ELROB is thus an important event for all participants including end-users, providers, research institutes, and universities.

To promote new and future-oriented innovations, European Robotics, the scientific co-organiser of the event, will award special Innovation Prizes. The purpose of these prizes is to recognize new ways of solving the challenges at hand as well as approaches with very strong potential.

We are convinced that this ELROB will again provide important insight into the state of the art regarding military use of ground robotics and will be a valuable resource in further dissemination of UGV technology.

We wish all ELROB visitors and participants a pleasant and successful stay in Warsaw!

With kind regards

Dr. Frank E. Schneider
Deputy Head of the Research Group Unmanned Systems
Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE
frank.schneider@fkie.fraunhofer.de
ELROB Philosophy

The main purpose of European Land Robot Trials is to provide an overview of the current state of affairs in European unmanned system technology and to evaluate commercial off-the-shelf products for potential military use. In this context the focus is placed on systems or modules that can be implemented in the short to medium-term. The participation of universities, institutes, companies and developers not only of European armed forces allows users, developers as well as representatives of trade and industry to create a community. ELROB is not a “battle of competitors” with high-tech visions but rather a forum to show what is feasible in robotics, to support technological developments in Europe and to find solutions for the current military challenges.

The military ELROB, which takes place for the fifth time now, enables participants and visitors to get a glance at the latest research and development in the area of unmanned outdoor/off-road ground systems. The scenarios have been developed in closest co-operation with the military users and reflect the up-to-date requirements of the forces. This event offers the fantastic opportunity to mingle with the international experts from the user community, the industry and the research and development sector.

The philosophy of the trial:
- ELROB is conducted with a focus on short-term realisable robot systems,
- ELROB is explicitly designed to assess current technology to solve real world problems at hand,
- ELROB in addition is an opportunity to bring together users, researchers and industry to build a community.
**Information of AVRORA team**

Name of team leader: Stanislav Gol  
Team Name: AVRORA  
Team e-mail: likvon@list.ru, pe4alj@mail.ru  
Location: Russia  
Institution/Company: Ryazan State Radio Engineering University (RSREU)  
Address: 390005, Russia, Ryazan, Gagarina Street 59/1  
Telephone: +7 (4912) 46-03-03  
Fax: +7 (4912) 92-22-15

**Team Description**

“AVRORA” team (AV – autonomous, RO – robots, RA – radio engineering university) unites Ryazan State Radio Engineering University students and engineers of various technical specialties, who discovered a new area of their talents application – robotics. The team had developed several wheeled mobile robots (www.kb-avrora.ru), which are the winners of the nationwide robotics competitions “Mobile Robots – 2010” named after Professor Devyanin, „Robokross – 2013“, „Robofest – 2010, 2014.”

**Vehicle AVRORA specification sheet**

**Basic data about vehicle**
- Name of vehicle: AVRORA  
- Height: 170 cm (with antennas 190 cm)  
- Width: 112 cm  
- Length: 190 cm  
- Weight: 290 kg  
- Ground clearance: 25 cm  
- Average noise level: 50 db(A)  
- Climbing performance: 11 degree  
- Wheel or track driven: 4  
- Propulsion: storage batteries (4), gasoline power generator  
- Endurance: 2 hrs  
- Max. speed: 20 km/h  
- Payload: 5 kg

**Communication equipment**
- Function: Remote vehicle debugging  
- Type: WLAN  
- Frequency: 2400 MHz  
- Possible frequency range: 2400 ÷ 2483 MHz  
- Power: 4 W  
- Modulation: OFDM/DBPSK/DQPSK+DSSS  
- Number of channels: 14
Function: Video Downlink
Type: Analogue Video Transmitter/Receiver Unit
Frequency: 945 MHz
Possible frequency range: 907.5 ÷ 1035 MHz
Power: 5 W
Modulation: –
Number of channels: 5

Function: Remote vehicle control, Emergency stop
Type: Wireless Hi Power Radio Modem
Frequency: 433 MHz
Possible frequency range: 432 ÷ 436 MHz
Power: 5 W
Modulation: GFSK
Number of channels: 5

Sensors equipment
Lidar: 3D lidar Velodyne HDL-32E; Laser Class 1 (eye safe), 905 nm wavelength; measurement range 1 m to typically 80–100 m
Laser: Sick LM5511: Field of view - 190°,
Scanning frequency - 100 Hz max,
Operating range - 0 m ... 80 m, x 2
Vision: Beward BD2570-K12, Color, IP67, 5 MP, Ethernet, x 2
GPS: GEOS-3M Module, L1 GPS C/A, L1 ГЛОНАСС СТ, WAAS,
EGNOS Signals, x 4
Inertial Measurement unit: UM6-LT, measurement range: ±2000°/s (gyro), ±2 g (accelerometer),
3 axes: pitch (x), roll (y), and yaw (z)
Encoder Motor-Wheel “Yamasaki” Built-In, 138 PPR, x 4

Computing equipment on vehicle
Number of computers: 1
Number of CPUs: 3
Type of CPU: Intel Core i7-4770S
Operating system(s): Linux

Basic data about control station
Number of operators (mandatory/optional): 1/2
Number of computers: 1
Number of CPUs: 1
Type of CPU: Intel Core i5-3230M
Operating system: Linux/Windows 7
Space needed for control station: 38x25x3.4 cm
Weight of control station: 2.5 kg
Power source needed: Adapter Lenovo ADLX90NCT3A
Information of Bebot team

Picture of team leader:

Name of team leader: Björn Jensen
Team Name: Bebot-team
Team e-mail: bebot.team@gmail.com
Website: http://www.roboticslab.ti.bfh.ch/elrob2014
Location: Switzerland
Institution/Company: Berner Fachhochschule
Address: Quellgasse 21, 3602 Thun
Telephone: +41 32 32 16 414
Fax: +41 32 32 16 500

Team Description

Bebot-team comprises of 6 members of the robotics lab of the Berner Fachhochschule, students and a PackBot robot and a Pelican drone. The team is supported by Dr Thomas Nussbaumer (armasuisse S+T / Swiss MOD UGV research program / RUAG Defence).

Vehicle Bebot specification sheet

Basic data about vehicle
Name of vehicle: Bebot
Height: 17.8 cm (with antennas 50 cm)
Width: 52.1 cm
Length: 88.9 cm
Weight: 22 kg
Ground clearance: 4 cm
Average noise level: 70 db(A)
Climbing performance: 36 degree
Wheel or track driven: track driven
Propulsion: batteries
Endurance: 4 hrs
Max. speed: 9.3 km/h
Payload: < 40 kg

Communication equipment
Function: Communication Link
Type: Pineapple Mark V Standard
Frequency: 2412 (1), 2431 (5), 2452 (9), 2472(13)
Possible frequency range: 2412 ÷ 2484 MHz
Power: <0.1 W
Modulation: half-duplex
Number of channels: 13
### Sensors equipment

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser</td>
<td>Hokuyo Laser UTM-30LX</td>
</tr>
<tr>
<td>Vision</td>
<td>Swiss Ranger SR4000 and PackBot camera</td>
</tr>
<tr>
<td>GPS</td>
<td>yes</td>
</tr>
<tr>
<td>Radar</td>
<td>no</td>
</tr>
<tr>
<td>Inertial Measurement unit</td>
<td>yes</td>
</tr>
</tbody>
</table>

### Computing equipment on vehicle

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of computers</td>
<td>1 + PackBot on-board PC</td>
</tr>
<tr>
<td>Number of CPUs</td>
<td>1</td>
</tr>
<tr>
<td>Type of CPU</td>
<td>Intel Core i7 3517UE</td>
</tr>
<tr>
<td>Operating system(s)</td>
<td>Linux</td>
</tr>
</tbody>
</table>

### Basic data about control station

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of operators</td>
<td>1/0</td>
</tr>
<tr>
<td>Number of computers</td>
<td>1</td>
</tr>
<tr>
<td>Number of CPUs</td>
<td>1</td>
</tr>
<tr>
<td>Type of CPU</td>
<td>Intel Core i7</td>
</tr>
<tr>
<td>Operating system</td>
<td>Linux</td>
</tr>
<tr>
<td>Space needed for control station</td>
<td>Laptop, 37.55 x 25.36 x 2.14 cm</td>
</tr>
<tr>
<td>Weight of control station</td>
<td>2.5 kg</td>
</tr>
<tr>
<td>Power source needed</td>
<td>no</td>
</tr>
</tbody>
</table>
Information of Cobham team

Name of team leader: Dr. Andreas Ciossek
Team Name: Cobham
Team e-mail: andreas.ciossek@cobham.com
Website: www.cobham.com/missionequipment
Location: Germany
Institution/Company: Telerob Gesellschaft für Fernhantierungstechnik mbH
doing business as Cobham Mission Equipment – Unmanned Systems
Address: Vogelsangstrasse 8, 73760 Ostfildern
Telephone: +49 711 34102 115
Fax: +49 711 34102 555

Team Description

To develop machines, equipment and systems that protect or replace human beings in situations where their presence would be either impossible or place them at great risk.

This is the motto, motivation and mission of Cobham – Unmanned Systems. Whether it’s one of our Master- Slave Manipulators being used to dismantle a nuclear facility or an EOD robot being used to disarm a dangerous explosive device, protecting people and their surroundings is always our paramount concern anytime one of our products is deployed.

Our engineers and specialists in the fields of electrical engineering, electronics and precision mechanical engineering combine creativity and competence in the quest for advanced solutions in the worlds of bomb disposal and remote handling technology.

The Cobham range of products encompasses EOD robots (tEODor and teleMAX), completely equipped bomb disposal vehicles (TEL600), bomb disposal equipment, non-magnetic special tools (NOMATOOLS), as well as manipulators for servicing, maintaining and dismantling nuclear facilities (EMSM).

A highly qualified, highly motivated staff provides our worldwide client base not merely with innovative products developed and manufactured in accordance with the very highest standards but also with the training and instruction needed to ensure their effective use. Telerob is an official NATO supplier and development partner (NATO supplier code: C 5152).

Furthermore we conform to the requirements of AQAP 2130.

Vehicle specification sheet

Basic data about vehicle
Name of vehicle: Telemax
Height: 75 cm
Width: 40 cm
Length: 80 cm
Weight: 80 kg
Ground clearance: 10 cm
Average noise level: –
Climbing performance: 45 degree
Wheel or track driven: 4 Tracks
Propulsion: Battery
Endurance: Up to 4 hrs
Max. speed: 10 km/h
Payload: 10 kg

Communication equipment
Function: Data Link
Type: Radio
Frequency: 434 MHz
Possible frequency range: 434 ÷ 435 MHz
Power: 0.5 W
Modulation: FID
Number of channels: 80

Function: Video Link
Type: Radio
Frequency: 2353 MHz
Possible frequency range: 2353 ÷ 23815 MHz
Power: 3 W
Modulation: F3F
Number of channels: 5

Sensors equipment
Vision: 1 x colour camera with 10 x optical zoom, auto focus and integrated LED illumination, 3 x fixed focus colour camera with LED illumination, 1 x fixed focus colour camera and further optional cameras
GPS: Garmin 16-HVS (average accuracy 15 m)
Radiation: Thermo Electron RadEye-PRD or other
Gas: Dräger Xam7000

Computing equipment on vehicle
Number of computers: 1
Number of CPUs: –
Type of CPU: –
Operating system(s): –

Basic data about control station
Number of operators (mandatory/optional): 1/3
Number of computers: 1
Number of CPUs: –
Type of CPU: –
Operating system: –
Space needed for control station: Size of the Sprinter: 7500 x 2500 x 3200 cm
Weight of control station: 5000 kg
Power source needed: not necessary – optional 230 V with 1600 W
Information of E15 team

Name of team leader: Michael Eisele
Team Name: E15
Team e-mail: brainrobots@hotmail.com
Website: www.brainrobots.de, www.e15-project.de
Location: Germany
Institution/Company: Towing service Mozer
Address: Carl Zeiss Street 71, 72766 Reutlingen
Telephone: 0160/96445135
Fax: –

Team Description

We are small group of students which is building autonomous rescue vehicles, planes and boats since 2012.

Vehicle specification sheet

Basic data about vehicle
Name of vehicle: MONIQUE
Height: 130 cm
Width: 160 cm
Length: 490 cm
Weight: 1680 kg
Ground clearance: 32 cm
Average noise level: 101 db(A)
Climbing performance: 51 degree
Wheel or track driven: 4
Propulsion: Batteries with range extender (fuel)
Endurance: 12.5 hrs
Max. speed: 47 km/h
Payload: 5000 kg (on the car) / 16000 kg (when using a trailer)
Communication equipment
Function: Debugging and Emergency Stop
Type: WIFI
Frequency: N/A
Possible frequency range: 2412 ÷ 2472 MHz
Power: 0.1 W (5 W available but only 0.1 W configured)
Modulation: OFDM
Number of channels: 2

Sensors equipment
Laser: IBEO Alasca
Vision: 16x Microsoft Lifecam HD 3000, 5x Bosch night vision camera
GPS: Logitech GPS (USB)
Radar: 3x Bosch LRR3
Inertial measurement unit: Self made 10 DOF (ADXL345 + IMU 3000, BMP085)
Ultrasonic sensors: 60x SF04

Computing equipment on vehicle
Number of computers: 2
Number of CPUs: 2
Type of CPU: i7-4770, i5-?
Operating system(s): Ubuntu

Basic data about control station
Number of operators (mandatory/optional): 0/1
Number of computers: 1
Number of CPUs: 1
Type of CPU: 17-4770
Operating system: Windows 7
Space needed for control station: Laptop
Weight of control station: 2 kg
Power source needed: 230V, 2A but battery for the first 3 hrs is included
Information of ELP team

Picture of team leader:

Name of team leader: Colin Weiss
Team Name: ELP
Team e-mail: cweiss@elp-gmbh.de
Website: www.elp-gmbh.de
Location: Germany
Institution/Company: ELP GmbH, European Logistic Partners
Address: Nützenberger Street 359, Wuppertal
Telephone: +49 202 698940
Fax: +49 202 69894-10

Team Description

ELP GmbH is distributing iRobot’s range of robotic systems within German-speaking Europe and provides Service and Training for these systems within all of Europe. In addition, ELP is developing accessories and additional capabilities for the iRobot equipment.

Vehicle AVRORA specification sheet

Basic data about vehicle
Name of vehicle: PackBot EOD 510
Height: 40.7 cm (with arm extended 221 cm)
Width: 52 cm
Length: 69 cm (with flippers extended 88.9 cm)
Weight: 33.3 kg
Ground clearance: 7.62 cm
Average noise level: N/A
Climbing performance: 43 degree on wood,
38 degree on carpet,
40 degree on metal
Wheel or track driven: track driven
Propulsion: rechargeable Li-Ion Batteries
Endurance: 12 ÷ 15 hrs
Max. speed: 9.3 km/h
Payload: 35 kg

Communication equipment
Function: Telemetry (Video, Data,
Brake/Emergency Stop)
Type: WLAN 802.11a MESH-Networking,
Alternative: WLAN 802.11b/g
Frequency: 4.9 GHz, Alternative: 2.4 GHz
Possible frequency range: 4.9 GHz, 2.4 GHz
Power: 0.4 W
Modulation: OFDM
Number of channels: 4.9 GHz: 3; 2.4 GHz: 11, fixed to channel 6
Sensors equipment
Laser: Hokuyo URG-04LX-UG01
Vision: 4 Colour Cameras, 1 with 312 x zoom and low light mode, one input for an auxiliary camera (FLIR or Wide-Angle as per mission requirements) and additional/optional Cameras: Mobotix S15 Hemispheric Day/Night IP Camera and Asus Xiton Live Pro RGB-D Camera
GPS: uBlox GPS installed in UAP-Module, Additional Adafruit Ultimate GPS Version 3 in ELP-Payload
Inertial Measurement unit: Self-protection IMU in Chassis, uBlox 11 DOF IMU in UAP-Module, razor 9DOF IMU in ELP-Payload

Computing equipment on vehicle
Number of computers: 2 – 1 fixed (main computer in chassis) and 1 optional (ELP-Payload)
Number of CPUs: 1 each
Type of CPU: Intel Core2 (main Computer in Chassis), Intel Core i5 (ELP-Payload)
Operating system(s): Linux

Basic data about control station
Number of operators (mandatory/optional): 1/1
Number of computers: 2
Number of CPUs: 1 each
Type of CPU: Intel Core2 Duo Mobile T5500, 2 x 1.66 GHz Intel Core i7
Operating system: Linux
Space needed for control station: 2 Laptops, approx. 352 x 284 x 64 cm
Weight of control station: 6 – 10 kg
Power source needed: 110/230V @ 150W when operating on mains power
Information of FKIE team

Name of team leader: Dirk Schulz
Team Name: Team FKIE
Team e-mail: bernd.brueggemann@fkie.fraunhofer.de
Website: www.fkie.fraunhofer.de
Location: Germany
Institution/Company: Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE
Address: Fraunhofer Street 20, 53343 Wachtberg
Telephone: +49-228-9435-364
Fax: +49-228-9435-210

Team Description

The FKIE employs currently 300 staff members, who perform studies in computer science and ergonomics with application to diverse research area of command & control, communications, intelligence, surveillance, and reconnaissance (C3ISR).

A distinctive aspect of the FKIE methodology is the fact that we are as accomplished in technology as we are in the so called “human factor”. As experts in ergonomics we know how to equip technologies with user interfaces that are easy to operate and control. Also unique to us is the fact that we handle the entire data processing chain from acquisition to display allowing us to work in highly specialized units or interdisciplinary teams according to the project’s requirements:

1. Analysis, modelling and evaluation of military data formats and processes.
2. Distributed data processing in heterogeneous systems (interoperability).
3. Information and knowledge management.
5. Analysis and evaluation of sensor data sets.
6. Protection of data networks against interference or cyber attacks.
7. Ergonomic user interfaces for intelligent support of users.

The research group Unmanned Systems of the Fraunhofer Institut for Communication, Information Processing and Ergonomics (FKIE) is actively researching in the area of unmanned systems for more than 20 years. Our main expertise is the development and evaluation of complex human-robot systems. The main focus is on the RSTA and CBRNE-reconnaissance missions using heterogeneous multi-robot systems. Working with such multi-robot systems is a competitive task for the operator. Even a single robot utilizes several different sensors and provides a high degree of mobility, which all need to be controlled by the operator. The research group Unmanned Systems approaches this challenge through intelligent assistance functions. The operator is supported by these assistance functionalities on all levels, ranging from navigating a single robot to complex planning problems of multi-robot systems. Assisting the operator is achieved by two key components. First, we enhance the autonomous capabilities of each single robot, and second, we reduce the burden on the operator through the assistance functions. Navigation algorithms like obstacle avoidance in dynamic environments as well as methods to improve the presentation of available information are both examples of such functions. Our key skill is the development of innovative tools for human-robot interaction and cooperation. For this purpose new developments are constantly integrated in experimental systems and evaluated in co-operation with security authorities and organizations as well as the German army.

The Unmanned Systems department – the Research Group Unmanned Systems as part of the FKIE develops innovative techniques for the efficient guidance of human-multi robot systems within military applications. Remote-controlled unmanned mobile systems have high demands on
the operator’s concentration and cognitive abilities, especially if the control is to be maintained over long time periods. In order to increase the efficiency and the available deployment options, the research group develops assistance functions which enable the operator to guide the mobile systems on a high level of abstraction, while the robots execute the required low-level commands autonomously. Additionally, the research group serves as consultant and evaluator for the German army.

The booth presents an overview of the current activities of the FKIE regarding Unmanned Systems, in particular:

– the experimental CBRNE Reconnaissance Platform,
– NEC techniques for multi robot systems,
– Mobile 3D world model generation,
– autonomous outdoor navigation,
– European Land-Robot Trials (ELROB).

### Vehicle specification sheet

**Basic data about vehicle**

<table>
<thead>
<tr>
<th>Name of vehicle:</th>
<th>Garm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height:</td>
<td>141 cm</td>
</tr>
<tr>
<td>Width:</td>
<td>74 cm</td>
</tr>
<tr>
<td>Length:</td>
<td>178 cm</td>
</tr>
<tr>
<td>Weight:</td>
<td>400 kg</td>
</tr>
<tr>
<td>Ground clearance:</td>
<td>10 cm</td>
</tr>
<tr>
<td>Average noise level:</td>
<td>60 db(A)</td>
</tr>
<tr>
<td>Climbing performance:</td>
<td>40 degree</td>
</tr>
<tr>
<td>Wheel or track driven:</td>
<td>track driven</td>
</tr>
<tr>
<td>Propulsion:</td>
<td>batteries</td>
</tr>
<tr>
<td>Endurance:</td>
<td>4 hrs</td>
</tr>
<tr>
<td>Max. speed:</td>
<td>13 km/h</td>
</tr>
<tr>
<td>Payload:</td>
<td>250 kg</td>
</tr>
</tbody>
</table>

**Communication equipment**

<table>
<thead>
<tr>
<th>Function:</th>
<th>Data Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>WLAN 802.11b</td>
</tr>
<tr>
<td>Frequency:</td>
<td>2400 MHz</td>
</tr>
<tr>
<td>Possible frequency range:</td>
<td>2400 ÷ 2500 MHz</td>
</tr>
<tr>
<td>Power:</td>
<td>0.1 W</td>
</tr>
<tr>
<td>Modulation:</td>
<td>GMSK/8PSK/ QPSK/16QAM</td>
</tr>
<tr>
<td>Number of channels:</td>
<td>13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function:</th>
<th>Emergency Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>Radiosafe Link</td>
</tr>
<tr>
<td>Frequency:</td>
<td>433 MHz</td>
</tr>
<tr>
<td>Possible frequency range:</td>
<td>433 ÷ 435 MHz</td>
</tr>
<tr>
<td>Power:</td>
<td>0.01 W</td>
</tr>
<tr>
<td>Modulation:</td>
<td>FM</td>
</tr>
<tr>
<td>Number of channels:</td>
<td>64</td>
</tr>
</tbody>
</table>
Sensors equipment
Laser: 2x Sick LMS 511, 1x Hokuyo UTM-30
Vision: 2x Telemax Manipulator Cameras, 1x PanTilt Camera
GPS: XSens MTi-G
Inertial Measurement unit: XSens MTi-G

Computing equipment on vehicle
Number of computers: 1
Number of CPUs: 4
Type of CPU: Intel Core 2 Duo QX9600
Operating system(s): Linux

Basic data about control station
Number of operators (mandatory/optional): 1/1
Number of computers: 2
Number of CPUs: 4
Type of CPU: Intel Core Duo
Operating system: Linux, Windows
Space needed for control station: 200 x 200 x 250 cm
Weight of control station: 10 kg
Power source needed: None, 230V optional
**Team Description**

The MED-ENG Team is composed of a mixture of individuals with a variety of backgrounds; these include research and design, manufacturing, sales and product managing. Two of the team are former bomb technicians having completed a number of operational tours of duty.

The team has participated in previous ELROBs under the Allen-Vanguard (AV) banner but at the time of Eurathlon last year elements of AV were sold which became Med-Eng LLC.

We intend to show the latest configurations of Digital Vanguard and the Defender D2.1. Both platforms are battery powered and tele-operated. The Vanguard is classified in the small category of ROVs weighing 56 kg and has a superlative tracked drive system complimented by a six DOF arm assembly. The heavier Defender weighs 275 kg, its drive is delivered by six independent electric motors utilising an innovative chassis assembly. Traction is gained via six wheels, as with the Vanguard the Defender has six DOF as standard.

**Vehicle specification sheet**

**Basic data about vehicle**

<table>
<thead>
<tr>
<th>Name of vehicle:</th>
<th>Defender D2.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height:</td>
<td>115 cm (150 cm with antennas)</td>
</tr>
<tr>
<td>Width:</td>
<td>72.5 cm</td>
</tr>
<tr>
<td>Length:</td>
<td>152 cm</td>
</tr>
<tr>
<td>Weight:</td>
<td>275 kg</td>
</tr>
<tr>
<td>Ground clearance:</td>
<td>10 cm</td>
</tr>
<tr>
<td>Average noise level:</td>
<td>N/A</td>
</tr>
<tr>
<td>Climbing performance:</td>
<td>45 degree</td>
</tr>
<tr>
<td>Wheel or track driven:</td>
<td>six wheel independently driven</td>
</tr>
<tr>
<td>Propulsion:</td>
<td>2 x Apollo 12V DC batteries</td>
</tr>
<tr>
<td>Endurance:</td>
<td>nominal 4 hrs</td>
</tr>
<tr>
<td>Max. speed:</td>
<td>2.5 km/h</td>
</tr>
<tr>
<td>Payload:</td>
<td>250 kg</td>
</tr>
</tbody>
</table>
### Communication equipment

<table>
<thead>
<tr>
<th>Function</th>
<th>Data, Video, Audio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>WLAN 802.11b</td>
</tr>
<tr>
<td>Frequency</td>
<td>2400 MHz</td>
</tr>
<tr>
<td>Possible frequency range</td>
<td>2400 to 2482 MHz</td>
</tr>
<tr>
<td>Power</td>
<td>100 mW to 1 W</td>
</tr>
<tr>
<td>Modulation</td>
<td>Digital Sequence Spread Spectrum (DSSS)/(CCK)</td>
</tr>
<tr>
<td>Number of channels</td>
<td>12</td>
</tr>
</tbody>
</table>

### Sensors equipment

| Laser              | –                  |
| Vision             | 6 CCD Cameras      |
| GPS                | Garmin GPS-16      |
|                    | (average accuracy 100cm) |
| Radar              | –                  |
| Inertial Measurement unit | –        |

### Computing equipment on vehicle

| Number of computers: | –                  |
| Number of CPUs:      | 1                  |
| Type of CPU:         | PIC Microprocessor (16F877) |
| Operating system:    | Proprietary        |

### Basic data about control station

| Number of operators (mandatory/optional): | 1/1                  |
| Number of computers:                    | 1                    |
| Number of CPUs:                         | 1                    |
| Type of CPU:                            | Intel P M, 1.4-1.8 GHz |
| Operating system:                       | Windows XP SP2       |
| Space needed for control station:       | 29.9 x 33.3 x 13.4 cm |
| Weight of control station:              | 8.6 kg               |
| Power source needed:                    | 115/230 V            |

### Vehicle specification sheet

### Basic data about vehicle

| Name of vehicle:       | Digital Vanguard   |
| Height:                | 56 cm              |
| Width:                 | 46 cm              |
| Length:                | 104 cm             |
| Weight:                | 58 kg              |
| Ground clearance:      | 5.75 cm            |
| Average noise level:   | N/A                |
| Climbing performance:  | 45 degree          |
Wheel or track driven: tracks driven as standard, can be fitted with wheels
Propulsion: 2 x 12V DC batteries
Endurance: nominal 4 hrs
Max. speed: 2 km/h
Payload: 50 kg

Communication equipment
Function: Data, Video, Audio
Type: WLAN 802.11b
Frequency: 2400 MHz
Possible frequency range: 2400 to 2484 MHz
Power: 100 mW to 1 W
Modulation: Direct Sequence Spread Spectrum (DSSS)/(CCK)
Number of channels: 12

Sensors equipment
Laser: Nil
Vision: 3 CCD Cameras
GPS: Nil
Radar: Nil
Inertial Measurement unit: Nil

Computing equipment on vehicle
Number of computers: Nil
Number of CPUs: 1
Type of CPU: PIC Microprocessor
Operating system(s): Proprietary

Basic data about control station
Number of operators (mandatory/optional): 1/1
Number of computers: 1
Number of CPUs: 1
Type of CPU: Intel P M 1.8 GHz
Operating system: Windows XP SP2
Space needed for control station: 29.9 x 33.3 x 13.4 cm
Weight of control station: 8.6 kg
Power source needed: 115/230 V
MUT Dromader’s Team

Information of Dromader’s team

Picture of team leader:

Name of team leader: Piotr Krogul
Team Name: MUT Dromader’s Team
Team e-mail: pkrogul@wat.edu.pl
Website: www.wme.wat.edu.pl
Location: Poland
Institution/Company: Military University of Technology,
Faculty of Mechanics,
Department of Mechanical Engineering
Address: Kaliskiego Street 2, 00-908 Warsaw
Telephone: +48 22 683 96 16
Fax: +48 22 683 96 16

Team Description

MUT Dromader’s Team is a group of co-workers from the same department dealing with different aspects of unmanned ground systems.

Vehicle specification sheet

Basic data about vehicle
Name of vehicle: Infantry’s tactical support robot „DROMADER”
Height: 170 cm (190 cm with antennas)
Width: 120 cm
Length: 310 cm
Weight: 500 kg
Ground clearance: 25 cm
Average noise level: –
Climbing performance: 31 degree
Wheel or track driven: 4 Tracks driven
Propulsion: Hydrostatic drive
Endurance: 8 hrs
Max. speed: 10 km/h
Payload: 300 kg

Communication equipment
Function: Control and video
Type: Access Point
Frequency: 2400 MHz
Possible frequency range: 2412 ÷ 2462 MHz
Power: 0.2 W
Modulation: QAM
Number of channels: 11
**Sensors equipment**
- Laser: –
- Vision: Colour cameras
- GPS: –
- Radiation: –
- Gas: –

**Computing equipment on vehicle**
- Number of computers: 1
- Number of CPUs: 1
- Type of CPU: –
- Operating system(s): proprietary

**Basic data about control station**
- Number of operators (mandatory/optional): 1/1
- Number of computers: 1
- Number of CPUs: 1
- Type of CPU: –
- Operating system: proprietary
- Space needed for control station: 400x200x300 cm
- Weight of control station: 80 kg
- Power source needed: 230 V AC
Information of Marek’s team

Name of team leader: Mirosław Przybysz
Team Name: MUT Marek’s Team
Team e-mail: mprzybysz@wat.edu.pl
Website: www.wme.wat.edu.pl
Location: Poland
Institution/Company: Military University of Technology, Faculty of Mechanics, Department of Mechanical Engineering
Address: Kaliskiego Street 2, 00-908 Warsaw
Telephone: +48 22 683 96 16
Fax: +48 22 683 96 16

Team Description

MUT Marek’s Team is a group of co-workers from the same department dealing with different aspects of unmanned ground systems.

Vehicle specification sheet

Basic data about vehicle
Name of vehicle: Engineering support robot “Marek”
Height: 250 cm (270 cm with antennas)
Width: 210 cm
Length: 450 cm
Weight: 4200 kg
Ground clearance: 30 cm
Average noise level: –
Climbing performance: 31 degree
Wheel or track driven: 6 Wheels
Propulsion: Hydrostatic drive
Endurance: 8 hrs
Max. speed: 30 km/h
Payload: 1500 kg

Communication equipment
Function: Control
Type: Modem
Frequency: 2400 MHz
Possible frequency range: 2400 ÷ 2483 MHz
Power: 50 mW
Modulation: Frequency Shift Keying
Number of channels: 25
### Function
- **Video**

### Type
- **Access point**

### Frequency
- **2400 MHz**

### Possible frequency range
- **2412 ÷ 2462 MHz**

### Power
- **200 mW**

### Modulation
- **QAM**

### Number of channels
- **11**

### Sensors equipment
- **Laser:** –
- **Vision:** Colour cameras
- **GPS:** –
- **Radiation:** –
- **Gas:** –

### Computing equipment on vehicle
- **Number of computers:** 1
- **Number of CPUs:** 1
- **Type of CPU:** –
- **Operating system(s):** proprietary

### Basic data about control station
- **Number of operators (mandatory/optional):** 1/1
- **Number of computers:** 1
- **Number of CPUs:** 1
- **Type of CPU:** –
- **Operating system:** proprietary
- **Space needed for control station:** 400x200x300 cm
- **Weight of control station:** 80 kg
- **Power source needed:** 230 V AC
Information of MULE team

**Picture of team leader:**

Name of team leader: Rafal Typiak  
Team Name: MULE Team  
Team e-mail: rtypiak@wat.edu.pl  
Website: www.wme.wat.edu.pl  
Location: Poland  
Institution/Company: Military University of Technology, Faculty of Mechanics, Department of Mechanical Engineering  
Address: Kaliskiego Street 2, 00-908 Warsaw  
Telephone: +48 22 683 96 16  
Fax: +48 22 683 96 16

Team Description

MUT MULE Team is a group of co-workers from the same department dealing with different aspects of unmanned ground systems.

Vehicle specification sheet

**Basic data about vehicle**

<table>
<thead>
<tr>
<th>Name of vehicle:</th>
<th>ATV MULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height:</td>
<td>193 cm</td>
</tr>
<tr>
<td></td>
<td>(230 cm with antennas)</td>
</tr>
<tr>
<td>Width:</td>
<td>145 cm</td>
</tr>
<tr>
<td>Length:</td>
<td>317 cm</td>
</tr>
<tr>
<td>Weight:</td>
<td>660 kg</td>
</tr>
<tr>
<td>Ground clearance:</td>
<td>18 cm</td>
</tr>
<tr>
<td>Average noise level:</td>
<td>–</td>
</tr>
<tr>
<td>Climbing performance:</td>
<td>44 degree</td>
</tr>
<tr>
<td>Wheel or track driven:</td>
<td>Wheel driven</td>
</tr>
<tr>
<td>Propulsion:</td>
<td>Four-stroke, liquid-cooled, overhead valve V-twin</td>
</tr>
<tr>
<td>Endurance:</td>
<td>6 hrs</td>
</tr>
<tr>
<td>Max. speed:</td>
<td>40 km/h</td>
</tr>
<tr>
<td>Payload:</td>
<td>600 kg</td>
</tr>
</tbody>
</table>

**Communication equipment**

<table>
<thead>
<tr>
<th>Function:</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>Low power industrial modems with omnidirectional antenna</td>
</tr>
<tr>
<td>Frequency:</td>
<td>868 MHz</td>
</tr>
<tr>
<td>Possible frequency range:</td>
<td>863 ÷ 870 MHz</td>
</tr>
<tr>
<td>Power:</td>
<td>0.5 W</td>
</tr>
<tr>
<td>Modulation:</td>
<td>–</td>
</tr>
<tr>
<td>Number of channels:</td>
<td>19</td>
</tr>
</tbody>
</table>
**Function:** Video  
**Type:** Low power dedicated vision system

**Frequency:** 1400 MHz  
**Possible frequency range:** 0 MHz

**Power:** 1 W  
**Modulation:** COFDM

**Number of channels:** 1

### Sensors equipment
- **Laser:** –
- **Vision:** Colour cameras with IR lighting
- **GPS:** –
- **Radiation:** –
- **Gas:** –

### Computing equipment on vehicle
- **Number of computers:** 1  
- **Number of CPUs:** 1  
- **Type of CPU:** –
- **Operating system(s):** proprietary

### Basic data about control station
- **Number of operators (mandatory/optional):** 1/1
- **Number of computers:** 1  
- **Number of CPUs:** 1  
- **Type of CPU:** –
- **Operating system:** proprietary
- **Space needed for control station:** 400x200x300 cm
- **Weight of control station:** 80 kg
- **Power source needed:** 230 V AC
**Information of University of Oulu team**

Name of team leader: Juha Röning  
Team Name: University of Oulu  
Team e-mail: eurathlon@ee.oulu.fi  
Website: www.oulu.fi/cse/isg/robotics  
Location: Finland  
Institution/Company: University of Oulu  
Address: CSE/Robotics, BOX4500, FIN-90014 University of Oulu  
Telephone: +358 40 518 1821  
Fax: –

**Team Description**

Team OULU is a research group related to advanced robotic systems doing research on mobile robotics operating in outdoor conditions. Team will have 1 ground vehicle and 2 flying drones for scouting tasks on the area.

**Vehicle specification sheet**

**Basic data about vehicle**

<table>
<thead>
<tr>
<th>Name of vehicle:</th>
<th>MDK-2014 and ARDRONE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height:</td>
<td>60 cm (120 cm with antennas)</td>
</tr>
<tr>
<td>Width:</td>
<td>80 cm</td>
</tr>
<tr>
<td>Length:</td>
<td>110 cm</td>
</tr>
<tr>
<td>Weight:</td>
<td>60 kg</td>
</tr>
<tr>
<td>Ground clearance:</td>
<td>40 cm</td>
</tr>
<tr>
<td>Average noise level:</td>
<td>40 db(A)</td>
</tr>
<tr>
<td>Climbing performance:</td>
<td>15 degree</td>
</tr>
<tr>
<td>Wheel or track driven:</td>
<td>wheel driven, optional tracks</td>
</tr>
<tr>
<td>Propulsion:</td>
<td>LiPo batteries</td>
</tr>
<tr>
<td>Endurance:</td>
<td>4 hrs</td>
</tr>
<tr>
<td>Max. speed:</td>
<td>20 km/h</td>
</tr>
<tr>
<td>Payload:</td>
<td>150 kg</td>
</tr>
</tbody>
</table>

**Communication equipment**

<table>
<thead>
<tr>
<th>Function:</th>
<th>Video Downlink</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>Analog video link</td>
</tr>
<tr>
<td>Frequency:</td>
<td>2380 MHz</td>
</tr>
<tr>
<td>Possible frequency range:</td>
<td>2370 ÷ 2390 MHz</td>
</tr>
<tr>
<td>Power:</td>
<td>max 5 W</td>
</tr>
<tr>
<td>Modulation:</td>
<td>FM</td>
</tr>
<tr>
<td>Number of channels:</td>
<td>3</td>
</tr>
</tbody>
</table>
Function: Radio Modem
Type: Radio Modem
Frequency: 869.4125 MHz
Possible frequency range: 869.400 ÷ 869.650 MHz
Power: 0.5 W
Modulation: FSK
Number of channels: 10

Function: WLAN
Type: WLAN
Frequency: 2452 MHz
Possible frequency range: 2412 ÷ 2472 MHz
Power: 0.5 W
Modulation: DSSS
Number of channels: 13

Sensors equipment
Laser: Hokuyo UTM-30
Vision: 4x Axis M1054, 2x Flir thermal camera
GPS: uBlox
Radar: –
Inertial Measurement unit: xSense, 4 proprietary IMU

Computing equipment on vehicle
Number of computers: 2
Number of CPUs: 8
Type of CPU: Quadcore 64bit
Operating system(s): Linux

Basic data about control station
Number of operators (mandatory/optional): 1/2
Number of computers: 1 - 2
Number of CPUs: 2
Type of CPU: PC
Operating system: Linux
Space needed for control station: 40 x 20 x 30 cm + person
Weight of control station: 15 kg
Power source needed: batteries, optionally AC
Information of PIAP team

Name of team leader: Łukasz RÓŻYCKI
Team Name: PIAP
Team e-mail: lrozycki@piap.pl
Website: www.antiterrorism.eu
Location: Poland
Institution/Company: Industrial Research Institute
For Automation & Measurements PIAP
Address: Aleje Jerozolimskie 202, 02-486 Warsaw, POLAND
Telephone: +48 22 874 03 26
Fax: +48 22 874 03 40

Vehicle specification sheet

Basic data about vehicle
Name of vehicle: PIAP GRYF®
Height: 19 cm (46 cm with antennas)
Width: 59 cm
Length: 69 cm
Weight: 38 kg
Ground clearance: 7 cm
Average noise level: 50 ÷ 65 db(A)
Climbing performance: 45 degree
Wheel or track driven: Both
Propulsion: Batteries
Endurance: 2 hrs
Max. speed: 3.6 km/h
Payload: 60 kg

Communication equipment
Function: Telemetry
Type: Information restricted
Frequency: Information restricted
Possible frequency range: Information restricted
Power: Information restricted
Modulation: Information restricted
Number of channels: Information restricted

Function: Video
Type: Information restricted
Frequency: Information restricted
Possible frequency range: Information restricted
Power: Information restricted
Modulation: Information restricted
Number of channels: Information restricted
Sensors equipment
Laser: –
Vision: –
GPS: NV08C-CSM
Radar: –
Inertial Measurement unit: –

Computing equipment on vehicle
Number of computers: 1
Number of CPUs: –
Type of CPU: –
Operating system(s): –

Basic data about control station
Number of operators (mandatory/optional): 1/2
Number of computers: 1
Number of CPUs: –
Type of CPU: –
Operating system: –
Space needed for control station: 52 x 36 x 18 cm + person
Weight of control station: 12 kg
Power source needed: 110 – 230 V AC
Information of ROBOKIS team

Picture of team leader:

Name of team leader: prof. Dominik Sankowski DSc. eng.
Team Name: ROBOKIS
Team e-mail: robot@iis.p.lodz.pl
Website: http://www.iis.p.lodz.pl/research,mr.html
Location: Poland
Institution/Company: Institute of Applied Computer Science
                      Lodz University of Technology
Address: Stefanowskiego Street 18/22,
         90-924 Łódź
Telephone: +48 42 631 27 50
Fax: +48 42 631 27 55

Team Description

A group of young computer scientists and graduate students of robotics enthusiasts led by visionaries with experience.

The platform was designed in the Institute of Applied Computer Science, Lodz University of Technology, by a research team: Marcin Bąkała, Sylwester Błaszczyk, Wojciech Dadan, Piotr Duch, Rafał Jachowicz, Roman Krzeszewski, Maciej Łaski, Piotr Ostalczyk and Adam Wulkiewicz. The team, headed by prof. Dominik Sankowski, developed the current version of the platform in cooperation with the companies: Sochor and GreenPoint. The platform features several innovative solutions and it has attracted a considerable interest during one of the world’s major fairs of military equipment - 21st International Defense Industry Exhibition which that took place in Kielce, Poland, in September 2013.

Vehicle specification sheet

Basic data about vehicle

Name of vehicle: ROBOKIS
Height: 130 cm
Width: 80 cm
Length: 100 cm
Weight: 75 kg
Ground clearance: 7 cm
Average noise level: –
Climbing performance: 16.7 degree
Wheel or track driven: Wheel
Propulsion: DC
Endurance: 1 hrs
Max. speed: 5.4 km/h
Payload: –
Communication equipment
Type: –
Frequency: 433 MHz / 2.4 GHz
Possible frequency range: 433 MHz / 2.4 GHz
Power: 0.1 W
Modulation: –
Number of channels: 1 for each

Sensors equipment
Laser: HOKUYO UTM-30LX
Vision: Daylight camera, nightvision camera and thermovision camera
GPS: Yes

Computing equipment on vehicle
Number of computers: 1
Number of CPUs: 18
Type of CPU: i7, DSP, MCU
Operating system(s): Linux / Platform Management Real Time System

Basic data about control station
Number of operators (mandatory/optional): 1/1
Number of computers: 1
Number of CPUs: 1
Type of CPU: Intel Atom
Operating system: Windows/Linux
Space needed for control station: 80 x 60 x 40 cm
Weight of control station: 5 kg
Power source needed: 230 V
Robotics Inventions is a New Product Development company delivering in 6 months preproduction prototypes (including Bill of Material), excelling in fully- and semi-autonomous robots, vision systems, the autonomy module RI SPIRIT, the robot swarm management system RI FLEET, innovative user interfaces and various components, having a dedicated production facility, as well as the robotics professional services. Our mission is to design and manufacture semi- and fully-autonomous robots and its parts to allow human tele-presence in harsh and extraterrestrial environments as well as to undertake dangerous & repetitive tasks on human behalf. Moreover we offer RI Professional Services to companies and organizations seeking support in designing and implementing solutions that require dedicated electronics, mechanical constructions, automatics, robotics, autonomous software and artificial intelligence. In addition Robotics Inventions aspire to deliver a flexible autonomous component to animate any hardware.

Robotics Inventions is going to present its cornerstone terrestrial products for Industrial, Prevention and Public sectors: A-BOT robot light and standard configurations. The A-BOT robot is designed to be a powerful semiautonomous mobile vehicle suitable for urban and off-road applications. Robotics Inventions’ robots are suitable for autonomous patrol, reconnaissance and mule missions.

**Basic data about vehicle**

- **Name of vehicle:** RI A-Bot
- **Height:** ~60 cm (~100 cm with antennas)
- **Width:** 60 cm
- **Length:** 110 cm
- **Weight:** ~90 kg
- **Ground clearance:** 10 cm
- **Average noise level:** 70 db(A)
- **Climbing performance:** 40 degree
- **Wheel or track driven:** Tracks
- **Propulsion:** Batteries
- **Endurance:** 4 ÷ 8 hrs
- **Max. speed:** 20 km/h
- **Payload:** 50 kg
Communication equipment

Function: Telemetry Link
Type: Linksys WRT54GL
Frequency: 2412 MHz
Possible frequency range: 2412 ÷ 2484 MHz
Power: 0.1 W
Modulation: DSSS
Number of channels: 14

Sensors equipment

Laser: Sick LMS111
Vision: Logitech c920
GPS: Trimble SPS855
Radar: No
Inertial Measurement unit: Xsens MTi-700

Computing equipment on vehicle

Number of computers: 1
Number of CPUs: 1
Type of CPU: Intel Atom
Operating system(s): Linux

Basic data about control station

Number of operators (mandatory/optional): 1/1
Number of computers: 1
Number of CPUs: 2
Type of CPU: Intel i5
Operating system: Linux
Space needed for control station: Generic Laptop + controller
Weight of control station: 3 kg
Power source needed: 250 W
EXHIBITORS
**Description of Institution/Company**

To develop machines, equipment and systems that protect or replace human beings in situations where their presence would be either impossible or place them at great risk – this is the motto, motivation and mission of Cobham – Unmanned Systems. Whether it’s one of our Master-Slave Manipulators being used to dismantle a nuclear facility or an EOD robot being used to disarm a dangerous explosive device, protecting people and their surroundings is always our paramount concern anytime one of our products is deployed.

Our engineers and specialists in the fields of electrical engineering, electronics and precision mechanical engineering combine creativity and competence in the quest for advanced solutions in the worlds of bomb disposal and remote handling technology.

The Cobham range of products encompasses EOD robots (tEODor and teleMAX), completely equipped bomb disposal vehicles (TEL600), bomb disposal equipment, non-magnetic special tools (NOMATOOLS), as well as manipulators for servicing, maintaining and dismantling nuclear facilities (EMSM).

A highly qualified, highly motivated staff provides our worldwide client base not merely with innovative products developed and manufactured in accordance with the very highest standards but also with the training and instruction needed to ensure their effective use. Telerob is an official NATO supplier and development partner (NATO supplier code: C 5152).

Furthermore we conform to the requirements of AQAP 2130.

For more information please feel free to contact us or visit: www.cobham.com/missionequipment
Diehl Defence Holding GmbH

Name of Institution/Company: Diehl Defence Holding GmbH
E-mail: stefan.bullmer@diehl-bgt-defence.de
Location: Germany
Address: Alte Nussdorder Street 13, 88662 Überlingen
Telephone: +49 911 857 2133
Fax: +49 911 857 2550

Description of Institution/Company

DIEHL is a family-owned German company situated in Nuremberg, Germany. DIEHL Defence as a corporate division of DIEHL is a valued industrial partner for defence forces worldwide.

The traditional product portfolio of DIEHL Defence focuses on seeker-guided missiles, system solutions for ground-based air defence, intelligent and conventional ammunition and training systems. Furthermore DIEHL Defence has established itself in the market of reconnaissance and surveillance, protection and security with technologically outstanding product solutions.

Since 2002 DIEHL Defence has gained a high reputation within one of its new strategic domains – the sector of unmanned, autonomous systems for military demands.

In the sector of unmanned ground vehicles DIEHL Defence has consequently developed a platform-independent add-on. The system is based on an open software architecture which allows the implementation of existing and new autonomous capabilities, as well as existing and new sensors.

Landbased platforms may differ in size and weight – the employed DIEHL Defence software and system architecture is basically the same. All platforms can be operated in the modes ‘Manned – Teleoperated – Semi-Autonomous – Autonomous using the same technological solutions.

TULF and StrAsRob are two projects currently contracted by the German Procurement Agency BAAINBw (Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr). The platform in both projects is a RMMV HX 58 – a 27 to GVW military truck produced by Rheinmetall MAN Military Vehicle.

The main goal of the two projects is the step-by-step realization of autonomous capabilities suitable for military demand and at the same time certified by German traffic authorities to be employed in regular street traffic.
In order to guide R&T investigations and projects definition at European level in multi-robotics field with a focus on control and man machine teamwork from the guidance and control perspectives, the European Defence Agency (EDA) launched the “MuRoc” Project: Technologies for Multi-Robots Control in support of the soldier. This project is a part of the Strategic Research Agenda (SRA) of the EDA GEM41 CapTech on guidance and control. The project is contracted by a consortium involving three European companies experienced in robotic field:

1. DIEHL BGT Defence (leader) – it is a German company belonging to the Corporate Division Diehl Defence of the Diehl Group. DBD combines the defence, reconnaissance, warning and vehicle protection activities; www.diehl-defence.com.

2. SENER (subcontractor) – it is an Engineering and Construction company from Spain with activities in Defence, such as Control and Actuation Systems or Intelligence, Surveillance, and Reconnaissance; www.sener.es.

3. ECA Robotics (subcontractors) – it is a French company and is present in ground intervention robotics, purely military or presenting strong similarities as civil security services or fire brigades; www.eca-robotics.com.

To perform the study, EDA aims to identify European key competences in order to create a Network gathering essential stakeholders able to contribute in the multi-robot control field and more generally in global robotic developments. The objective of EDA, through MUROC study, is to draw up a list of key players which could be part of future projects addressing multi-robot control issues.
Name of Institution/Company: ELP GmbH European Logistic Partners
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Location: Germany
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Description of Institution/Company

Equipment for police, security services and personal protection.
Since establishment in 1989, ELP GmbH has been involved with the needs of military and police bomb disposal units and their required equipment.
At first focused on remote manipulation equipment only, such as hook and line sets and remote controlled vehicles, portable X-ray equipment, ballistic protection devices as well as drug detection and explosives detection were incorporated into our offered range of products.
Being closely involved in the conception and design of such equipment as well as developing our own designs and patents, we now provide state of the art products for the very special needs and requirements found in the area of safety and security minded applications.
Our primary goal is to maintain the high standard of expectations of our long time customers.
Foresight Operations GmbH

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E-mail: info@foresight-operations.com
Location: Germany
Address: Merseburger Street 65a, 06268 Querfurt
Telephone: +49 34771 739163
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Description of Institution/Company

Foresight Operations GmbH is supplier of video / audio / data surveillance products and systems for tactical operations. Our products are available for governmental, military and authority use only. We can provide standard systems as well as customised products.

We provide special transmission systems for UAV and UGV applications, such as COFDM but also extremely small and robust analogue radio systems. Our product range includes bracket and installation solutions for rapid deployments to be used in harsh environments and demanding locations. Ruggedized video/audio/data recorders for vehicle installation guarantee that all video or sensor data will be stored effectively and depending on the location (GPS) and condition of the UGV or UAV. Thermal imaging sensors will help UGV or UAV users to reconnoiter the environment and help navigate the vehicle in dangerous areas. We show and demonstrate our wide range of products at ELROB 2014.

Due to firsthand experience and our extensive technical background we are able to modify, integrate and enhance existing products to ensure they are ‘fit for purpose’. Our vigilant management, direct approach and tactile understanding of our clients allow us to focus effectively on the issues that matter.
IBCOL Polska Sp. z o.o. – founded in 1996, office in Warsaw. IBCOL provides solutions in areas of aviation, security and defense. Supported products are:

1. NVG lightings systems, LINK-16, self protection for aircrafts, helicopters, vehicles and ships.
2. Electrical power supply systems, gun and turret drive systems and APU for military vehicles.
3. Mine, bomb, explosives, narcotics and CW detectors.
4. Remote operated vehicles, disruptors, other EOD, IEDD and C-IED equipment.
5. Shooting simulator and equipment for different training systems.
6. VIP and personal equipment.
7. Meteorological equipment for military purpose.
Institute of Applied Computer Science is dynamically developing organizational unit at the Faculty of Electrical, Electronic, Computer and Control Engineering. It is responsible for coordinating research and teaching activities in the discipline of Computer Science. At present, the Institute of Applied Computer Science employs: 3 professors, 7 associate professors, 27 doctors of philosophy and 25 PhD students.

The research in the Institute covers the following areas: process tomography, image processing and analysis for measurements of physical-chemical properties of selected materials at high temperatures, application of artificial intelligence techniques for modelling, identification and control, fractional calculus, machine vision systems, industrial computer systems, image processing and analysis in ecology, biology and medicine, image processing algorithms in education, security of computer systems, databases, grid systems and software engineering, information technology in economy, organization and management and mobile battlefield robot.

As a result of the research conducted in the Institute, around 100 papers are published yearly in conference materials and journals, many of which are of international interest.

The Institute actively cooperates with many scientific institutions and enterprises on commercialization of knowledge and the implementation of innovative concepts including results of research.

The robot is equipped with developed at the institute proprietary modular, scalable and adaptable control system, which can be transferred to other unmanned platforms.
Name of Institution/Company: Med-Eng
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Fax: 1613 482 4991

Description of Institution/Company

Med-Eng is a world leader in providing blast threat solutions for Explosive Ordnance Disposal (EOD) and military vehicle Crew Survivability. Bomb disposal technicians in over 100 countries and territories, including Canada, trust Med-Eng bomb suits & helmets, robots and specialized tools for disposing of Improvised Explosive Devices (IEDs) and other explosive threats.

The Defender and Digital Vanguard robots offered by Med-Eng provide a full range of capabilities for investigating and disposing of explosive devices. Both the Defender and Digital Vanguard are trusted around the world by military and public safety agencies. They can be fitted with a wide variety of accessories to deploy disruptors, sensors and other technologies. We invite users to provide us with their requirements so that we may provide specific solutions for their needs.

Med-Eng Crew Survivability systems include customized Blast Attenuation Seats to help protect military vehicle occupants from powerful blast threats. Med-Eng Thermal Management Systems protect vehicle occupants and their critical electronics from heat stress and other extreme operating conditions. Med-Eng is a brand of The Safariland Group, following acquisition in 2013.

For further information, please visit www.med-eng.com
Name of Institution/Company: Industrial Research Institute for Automation & Measurements PIAP
E-mail: mds@piap.pl
www: www.antiterrorism.eu
Location: Poland
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**Description of Institution/Company**

Industrial Research Institute for Automation and Measurements PIAP is the first and biggest producer of high quality mobile robots for counter-terrorism applications in Poland. PIAP has been established as a state scientific institute in 1965 and for the last 15 years, it has also conducted innovative activities in the field of mobile robotics applications for security and defence, which include: C-IED and EOD operations, protection of borders and infrastructure, protection of convoys and patrols, reconnaissance and remote observation, surveillance and patrolling, search and rescue.

Challenges faced by forces responsible for public safety, security and defence are now more demanding than ever. This is why today’s innovative solutions such as EOD equipment must be able to integrate the newest technologies available on the market. Our long-term experience and vast network of partners allow us to create and implement complex system solutions in the security area.

Mobile robots for special applications (Unmanned Ground Vehicles – UGVs, Remotely Operated Vehicles – ROVs) are the flagship products of PIAP. They are successfully developed and supplied to both domestic and foreign security and law enforcement services (Army, Police, Border Guard, etc.).

PIAP robots can be used for identification, transfer and neutralization of explosives. The robots’ construction allows using them for reconnaissance, various types of work in dangerous areas, demining with countercharges and for anti-terrorist activities.

Our goal is to protect the life and health of the services responsible for security and defense; therefore, we make every effort to ensure that solutions developed in PIAP are of the highest quality and especially adapted to the characteristics of work performed by these services.

For more information visit: www.antiterrorism.eu
Probot is a high-tech robot company located in Oulu, Finland. We provide custom project design and implementation for various platforms in robotics and automation. Our services include software implementation, customisation and improvements for existing systems.

The company was founded in 2006 to fulfill the gap between the research world and industry. The vision of the company is to transfer results of research world to the end-users and real world applications. Probot is also active partner in several EU funded project consortiums.

Probot is pleased to introduce you to a whole new way to build modular mobile robots and automatic real world applications. With the different robotic modules of Probot you are able to fast prototype mobile robots with high payload capability. The expanding variety of ProbotModules™ already includes products like: MobilityModule™, FrameModules™ and ProbotPowerModule™. For more information contact us at any time.

The company represents also several other state-of-the-art robot products from the following manufacturers: Kinova Technology, Barrett Technology, PAL Robotics, F&P PersonalRobotics and as the latest the Shadow Robot Company. Our goal is to offer our customers the latest knowledge for creating efficient automation solutions for their needs.

For more information visit: www.probot.fi
Follow us at LinkedIn: www.linkedin.com/company/probot
Description of Institution/Company

Robotics Inventions is a Polish dynamic commercial company operating in the cutting edge High-Tech industry. Robotics Inventions designs and develops new products for the growing robotics market.

Robotics Inventions is in the process of becoming present on a stock exchange market (the New Connect Polish stock exchange for SMBs). And the company currently delivers innovative autonomous robotics solutions for industry as B2B products and for a house appliance market as B2C products, outsourcing of the R&D and a new product development projects and the working prototypes and a specific product know-how as well as the propriety autonomy module RI SPIRIT faster, better and more effectively financially than Robotics Inventions’ global competition (mainly USA) thanks to its geographical location in Eastern Europe and thus lower operating costs.

Robotics Inventions team consists of about twenty experienced specialists, engineers as well as managers with passion to robotics, who has more than ten years of professional experience in engineering, high-tech, sales and management.

Robotics Inventions phased its business development in the following steps:

1. Development of the new products and prototypes with know-how transfers and licensing of the autonomy module for companies, as well as the professional facility managers in USA.
2. Development of robotics autonomy thanks to EU funds (for example RI FLEET project).
3. Small scale production of inspection and cleaning robots for an American business partner.

Robotics Inventions was awarded with the main prize: BEST SCIENTIFIC SOLUTION for its participation in Military ELROB 2012 in Switzerland organized by European Robotics.

For more information visit: www.roboticsinventions.com
RUAG Defence is the strategic technology partner for land forces, law enforcement, plus the international defence and security industry. Its focus is on products and services for secure and reliable command, realistic training, armoured vehicles, protection systems and robotics. This includes system engineering, development for hardware and software, system integration, system upgrades plus Integrated Logistic Support.

All products and services are designed and manufactured in accordance with strict processes and meet all necessary international requirements.
Description of Institution/Company

Tespol is a Polish company, which is an authorized representative of leading manufacturers of control - measurement and radio communication systems. We provide a comprehensive range of products and services in the field of cutting-edge technology and measurement systems, communications and TV transmitters following manufacturers with whom we are bound by long-term contracts and service: Tektronix, Rohde & Schwarz, Fluke, Keithley, Spectracom, Sonel, ABI and Dewetron.

Individual approach to the client and professionalism is our goal and it results from the skills and experience of our engineers. To ensure the highest quality of products and services Tespol implemented the quality management system ISO 9001:2009 and AQAP 2120 in 2009. Company profile, especially military cooperation with the sector and the state security services meant that we have a division of Classified Information Protection and secret registry. Our employees who cooperate with the military sector hold a security clearance to secret and confidential levels. We also have a Ministry of Interior license to trade goods for military use.

The company provides full service for implemented and delivered products, authorized service for products, calibration of measuring equipment and training. The reliability of our company has been confirmed by Business Gazelles club membership and the Certificate of Business Credibility by D & B Poland. We are also awarded the Business Cheetah title for our fast development.
WB Electronics, a private company of Ożarów Mazowiecki, with entirely Polish capital, is one of the major companies of the Polish arms market. The company, as one of the major supplier for the Armed Forces of the Republic of Poland, has been actively contributing to improving the defence capabilities of the Polish army for more than ten years.

WB ELECTRONICS for years has consequently been conquering new areas of electronics and IT applications in the military technology. Proprietary solutions in new technology make it possible to develop innovatory products with unique utility properties. The primary client of WB Electronics are the Armed Forces of the Republic of Poland. The company is also actively involved in overseas trading.

The technology offered by WB Electronics is based on long-term experience resulting from the use of the company’s solutions implemented in the Polish army as well as from participation of WB Electronics in international tenders and long-term cooperation with the most demanding customers from around the world.

For more information visit: www.wb.com.pl
ORGANIZATORS

Military University of Technology

Fraunhofer FKIE

EUROPEAN ROBOTICS

NATO

S&T organization
Military University of Technology

The Military University of Technology (MUT) was founded in 1951 as a military academy. It is currently the largest military technical university in Poland. There are currently six academic faculties at the MUT: Cybernetics, Electronics, Civil Engineering and Geodesy, Mechanical Engineering, Mechatronics and Aerospace, Advanced Technologies and Chemistry as well as an independent Institute of Optoelectronics which functions as the university technology transfer centre.

The University educates and trains cadets for the needs of the Polish Armed Forces as well as civilian students. The MUT offers studies at the undergraduate (B.Sc) and graduate (M.Sc.) level in 15 fields: aviation and cosmonautics, civil engineering, chemistry, computer science, electronic and telecommunication, geodesy and cartography, logistics, management, materials engineering, mechanical engineering, mechatronics, national security, power engineering, security engineering, technical physics. The University also offers Ph.D. studies in 11 fields as well as specialist and language courses.

The MUT is renowned for its highly qualified academic and research staff as well as excellent facilities. The university is authorized to grant postdoctoral degrees (7 disciplines) and doctoral degrees (10 technical disciplines and chemical science) in the technical sciences.

The MUT is an important academic and research centre carrying out top-level scientific, implementation and modernization work within the fields of technology, mathematics, physics, chemistry, management and military science. The results of this research have wide application in industry, environmental science and medicine. A considerable part of the university's intellectual potential is engaged in solving technical problems affecting the national economy and what the University’s researches have achieved, within the fields of environmental protection, medicine and industry. The high level of scientific research works along with numerous inventions, innovations, as well as, patents and prestigious prizes, both national and international, confirm this.
The MUT cooperates with several dozen national research institutions as well as over 60 institutes and universities from over 20 countries worldwide. The university has the capacity to lead complex research and development projects, including the implementation of solutions. Within the field of military technology, the MUT also focuses on design studies and systems development as well as military equipment.

The Military University of Technology’s achievements in scientific research activity include national prizes, the prize of distinction from the Ministry of Science and Higher Education, a prize from the Polish Academy of Sciences, as well as, over 1000 patents and copyrights, 60 of which are foreign. The effects of research work by the Military University of Technology, presented at many national and foreign exhibitions, verified by the conditions of international competition, has won acknowledgment, medals and various prestigious prizes world wide.

The Military University of Technology makes use of development programmes offered by the European Union and is effectively involved in the realisation of important international scientific research funded by Structural Funds and the European Union’s Found.

The experience of the MUT in the realization of international research projects testifies, that it is the perfect partner for the undertaking cooperative scientific work in the sphere of European development programme, R&D coordination and also in the realization of research with international research teams giving a huge opportunity for students and young scientists at the Academy, to participate and develop their skills.

The highly qualified experts at the Military University of Technology participate in scientific research works within the framework and organization of NATO, as well as, the European Defence Agency, where the problem solving of civil planning, connected with technologies development, fighting the threat of international terrorism are concerned. The scientific research realized by scientific researchers at the Military University of Technology involve, in particular:

- security assurance in the face of terrorist threat attacks,
- increase efficiency and security of command systems,
- integration and protection of informative and contact systems,
– development of modern weapons and ammunition,
– protection against weapons of mass destruction,
– electronic warfare systems.

The university acts as the coordinator of the Polish Security Systems Technological Platform (PPTSB), whose goal is to integrate the academic, research and industrial communities through research and development programs in the field of national security. The thematic range of the Platform's research areas came into being as a result of wide consultations with representatives of industry and scientific research centres and it correlates directly with the Ministry's proposed directives for the development of science, in conjunction with technology. The research areas within the framework of the Strategic Programme (PPTSB) were grouped into five main areas:

– early warning systems for crisis situations,
– materials, components and structure for security systems,
– sensors for monitoring systems,
– management security systems,
– informative systems security.

The university provides expert advice to the Scientific-Industrial Task Force at the Ministry of National Defence Armament Council and other Ministry of National Defence agendas. The university's experts also take part in research projects and programs coordinated by NATO and the European Defence Agency. Team assignments consider, in particular, representing the opinions and proposals within an industrial and scientific environment for the means of the possible implementation, within the country’s modernization development and the purchase of armaments and military equipment for the Polish Armed Forces.

ELROB’s philosophy ideally fits into MUT’s aforementioned development policy and that is why it had been applying to host the 2014 edition of ELROB trials. Within MUT's structure the topic of unmanned ground vehicles has been handled by the Department of Mechanical Engineering which took upon itself the weight of organizing this event.

**Department of Machine Engineering**

The Department of Machine Engineering was founded in 1951 together with the establishment of the Military University of Technology. At the time it was called the Department of Engineering Armament but in subsequent years the name has been changed several times till 2006 when it was given the name it currently has.

From its establishment, the Department took upon itself to carry out two missions: educating new military personnel and civilian specialists and carrying out research in service to its nation and its citizens. Department's graduates are very well prepared to enter the dynamically changing job market and a considerable part of its students begin their careers before graduation.

Department's extensive staff experience and its unique laboratory equipment allowed it to carry out multiple groundbreaking researches on a national scale. One of the examples of such research were works on operating hydraulic drive systems in harsh climate conditions which were carried out using the Department's dyno and climate chamber. Other works focused on developing modification concepts for a range of hydrostatically driven excavators as well as new vehicles for airstrip
maintenance and renovation: the magnetic airfield cleaner MOL-3800, the blowing cleaner POL-120, the hydraulic airfield cleaner OHL-4500A, the airfield snow remover PD-470/82 and the bituminous mortar paver RZBE-2500. Over the years, along with developing new vehicles for the industry, the Department devoted much of its attention to elaborating new maintenance procedures, servicing and upgrading both industrial and military machinery. An example of research on improving the work effectiveness and accuracy of construction equipment is the development of a laser beam aided control system for a single bucked excavator. This research was the first of its kind in Poland.

Currently a lot of effort is devoted to control problems of hydrostatic drive systems working in an LS configuration and CAN-bus control. These problems directly influence other areas of Department’s interest which are the Unmanned Ground Vehicles (UGVs) and engineering robots. One of the first unmanned concepts to be developed in the 70’ of the last century was a remote controlled excavator which was made famous by a TV show aired at that time. Nowadays works are being made on developing completely new UGV structures and their control stations. This is also where the control problem come in, as the UGVs created by the Department are remote controlled. Research is being conducted on improving the control process by optimizing vision systems used as well as integrating data from a wide range of sensors, such as GPS, vision, laser scanners, inertial or radar sensors. These works are being conducted with the help of the industry and other research centers, especially: Hydromega, WB Electronics, WITPiS, PIMR and IPPT PAN. With their help, the Department was able to develop seven unique UGVs. At this time other works are being made to develop an Engineering Support Robot for the Polish Armed Forces, which would be able to conduct missions in danger zones though the use of remote control. An integral part of these works are research on constructing new manipulators and attachments. In 2013 the Department had
undertaken an initiative to create a Centre of Mobile Robots (CMR) – an interdisciplinary body focused on initializing R&D works on mobile robots based on hi-tech simulation software, prototyping and field tests. Results of these works are then to be used in the process of training military and civilian specialists through the use of simulators.

Other areas of Department’s interest include material and structure strength tests. They include construction stress tests, material short cracks detection, element durability after surface improvements, low cycle material stress tests with overload and laser based machine’s surface improvements. Stress tests include material such as aerial titanium and aluminum alloys in simple and complex load states.

To date, Department’s employees have filed 54 PhD theses, 10 habilitation theses and have received 6 professor titles. As an effect of Department’s research, the Military University of Technology has secured 32 patents, 17 utility models and published several hundred science papers, articles, scripts, monographs and academic books. For their achievements, Department’s employees were awarded with numerous national, ministerial, military and Polish Academy of Science awards as well as their work had been awarded with medals and diplomas on exhibitions in Poland, Europe and Asia.
The Fraunhofer FKIE

The Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE carries out applied research in the area of defense and security issues. The increasingly complex global political situation is a threat to all modern societies on many different levels. FKIE puts in place innovative precautions for protection and safety and pushes the boundaries of international research in information and communication technology. Approximately 350 members of staff are currently working on the development of innovative technologies targeted at analyzing intelligence and the early detection and prevention of potential threats.

The institute's expertise is also being applied increasingly to the civil sector, in areas such as the protection of the environment and the prevention of natural disasters right through to business management and the protection of business-critical infrastructures.

The Research Group Unmanned Systems US

FKIE's Unmanned Systems Research Group is actively working in the area of land robotics and unmanned vehicles for more than 20 years now. Thereby, US is laying important foundations for the development of complex multi-robot systems which can be handled easily and more intuitively. Another focus is developing software for intelligent support functions for controlling the robots and designing tools to improve the coordination of multi-robot systems.

Whether a situation requires poisonous substances to be detected or removed from industrial plants or a temporary communications network to be built in a disaster zone, mobile robots can save people from being exposed to extreme danger. However, the demands on the control systems required for such robots are very exacting. A single robot is already equipped with a wide range of sensors and can carry out movements that must all be monitored and controlled, a task which can quickly overwhelm even trained remote operators. If several robots are employed in the loop, the burden on the operator increases even more so as they monitor the interaction of all of the equipment being used.
The research into “Human-Multi-robot systems for defense and security related missions” meets the challenges outlined above on two levels:

1. Assistance Functions for Controlling Robots: The operator can be relieved of many cognitively demanding control tasks by means of intelligent software. For this purpose US develops algorithms that continuously monitor the robots’ sensor data and consolidate it into intuitively understandable situational information. Current results from our research into autonomous robots increasingly enable us to utilize this information for carrying out more complex motion and manipulation tasks automatically.

The assistance functions provide the user with an understandable representation of the environment as perceived by the robot system as well as its intended actions. Consequently, a high-level system control emerges from the development which is altogether more user-friendly.

2. Coordinated Use of Multi-Robot Systems: Many tasks require the coordinated use of several mobile robot systems at the same time, such as for the deployment of mobile manipulators in pairs when neutralizing explosives or the application of an entire team of unmanned vehicles for constructing a communication network in a disaster zone. The additional time and effort required for coordination causes the burden of work on a multi-robot system to rise disproportionately.

US develops software-based coordination techniques which allow us to reduce this additional effort considerably. Therefore, planning algorithms are used to propose an efficient and coordinated course of action of the group of robots. During routine tasks the planning software can even take over the full control of the individual robot systems.

At both levels the research group continually integrates promising technical innovations into new concepts and methods and evaluates them using prototypical application systems. This is carried out in close collaboration with our clients which include the German Army (Bundeswehr) and other organizations entrusted with security assignments.
Unmanned systems are becoming increasingly relevant in the modern battle-space. This is especially true in the air domain, where unmanned air vehicles (UAV) provide relevant and timely intelligence, surveillance, and reconnaissance (ISR) data. Initially, UAVs were stove-piped systems that were neither interoperable at national level nor at the coalition level. The wide spread acceptance of UAVs has led to the adoption of standards that allow to enable interoperability between coalition ISR efforts. The preceding NATO Research Task Group (RTG) on “Applied Interoperability and Autonomy for Military Unmanned Systems” investigated standards that promote interoperability. Its upcoming report recommends that UGVs build upon the standards that have been currently adopted in the UAV domain, plus augmenting UGVs with other standards where applicable. Recommending standards is only the first step along the path to interoperability. The next step is to demonstrate that the selected standards are applicable, implementable and that they provide utility. Therefore, this group has decided to follow up the previous RTG’s recommendations by implementing and testing the proposed standards on physical robots, and by exercising these systems at the “Military European Land-Robot Trial (ELROB)”. 

This RTG’s objectives are to validate the proposed UGV standards issued by the previous RTG. The specified STANAGs and other standards will be implemented on physical robots. The mission goal is the acquisition of ISR data and, the storage and publication of this data such that it is available to coalition members.

The RTG will reach the objectives via a staged process, where each demonstration stage builds upon the previous. The stages will include:

- the definition of the generic ISR mission,
- implementation of the standards and their testing,
- implementation and test on a single physical robot,
- implementation and test within a coalition environment.

The result will emerge in a «Concept Capability Demonstrator» that shows the interoperability between the involved systems. Currently, the following nations are involved in this activity: Germany, Spain, Belgium, Switzerland, Canada, Poland and Finland.

As mentioned above ELROB is a magnificent opportunity to introduce our finding already in the earliest stadium of R&D. The benefits of this kind of standardisation are obvious:

- increase interoperability between existing systems,
- improve cooperation between industry and academia,
- ease the interaction among the teams,
- speed up academic research in robotics.

So, the RTG-052 would like to encourage the participants of ELROB 2014 not only to focus on the problems at hand but also to envision the possibilities behind this process. Boost your and the performance of the whole domain by improving your system’s interoperability!
European Robotics

European Robotics is a non-profit organization, which aims to bridge the gap between users’ requests, industry activities and current research in the field of Hazardous Materials Incident Response Operations (HAZOPER) - all with a special focus on ground robotics. Any interested party is invited to take part and contribute. All activities of European Robotics are carried out on a purely honorary and complimentary basis.

Nowadays industry plays the „leading” role in robotics in the sense that companies often define the robotic capabilities available. Many times this results in more or less standard robots being introduced into the HAZOPER domain without very thoroughly defined functional requirements.

This might be an appropriate approach for those cases where the users have no vision themselves on how to use robotic support in HAZOPER. But many users do have own ideas and concepts on their desired use of robotics. These views are often characterized by short-term objectives and a limited understanding of technical issues.

Research instead has usually no short-term objective and often fails to provide practical applications. Ignoring scientific results, however, prevents interesting and innovative developments. Industry, especially medium-sized enterprises, should use research to fertilize their strategic development process.

So, many times there is a gap between the industry’s understanding of robots needed, the appliance of research results and the HAZOPER users’ understanding of robot technology as well as the technical feasibility of their requirements.

European Robotics is a co-operation between representatives of potential end-users, industry and smaller manufacturers, and the research community:

1. Users
   These are (future) professional users of ground robots that are designed for HAZOPER. These tasks are generally outdoor tasks in unstructured or urban terrain with specific threats and accuracy requirements.

2. Industry
   These are designers and manufacturers of integrated ground robots focusing on HAZOPER.

3. Research
   These are universities and other research facilities focusing on partial solutions relevant for HAZOPER, like sensor technology or outdoor navigation algorithms.

To promote new and future-oriented innovations, European Robotics has been the scientific co-organiser of the European Land-Robot Trials (ELROB) since the foundation if this robotic competition in the year 2006. On the one hand, members of European Robotics always play an active part in the scenario and task design. On the other hand, European Robotics awards special Innovation Prizes for the ELROB participants. The purpose of these prizes is to support new ways of solving the challenges at hand and to reward impressive and novel scientific solutions as well as their practical implementations and integrations in robust and functioning robot systems usable for the HAZOPER domain.
GENERAL INFORMATIONS
ELROB is a trial!

It allows to demonstrate and compare the capabilities of unmanned systems in realistic scenarios and terrains. Therefore it is as close as possible to the typical deployment scenario for today. This year’s tasking are:

**Transport – repeated shuttling between two camps**

Transport tasks are an important element of military operations. Movements of personnel, material, humanitarian aid etc. are often necessary. Robotic transport systems should be able to support in many of these situations. The environment of this scenario is non-urban area with bushes and trees, grass, sand, water, stones, small paths, ditches and trenches. A vehicle should serve as a “mule” between the two camps, carrying as much payload as possible.

**Search and retrieval of human casualties in outdoor environments**

The rescue of wounded persons is an important yet often difficult task in civil catastrophes as well as in military scenarios. The use of robotic vehicles, first, to find injured persons and, second, to autonomously pick them up and transport them back to safe areas would obviously be a great improvement. During this task the vehicle should find the imitated body (twice, in the vicinity of points with received coordinates), move it back to the starting point in any way and place as near to the starting point as possible. The environment is non-urban terrain with lawn, garden-like grassland, some bushes and trees, sand, water, stones, small roads and paths, ditches and trenches; fences and other obstacles.

**Reconnaissance and surveillance in non-urban environments by day and night**

Reconnaissance and surveillance is a key military task. Generally, it can be divided into two parts: first, the approach of the target area and, second, the reconnaissance of the target area. In ELROB 2014, only the reconnaissance element is part of the trials. The terrain is challenging: non-urban area, partially forest, hills, bushes and trees, grass, sand, water, stones; roads and paths, ditches and trenches. This tasking will be conducted by day and by night; the daylight scenario serves as qualification for the identical night scenario.

**Reconnaissance and disposal of bombs and explosive devices**

Reconnaissance and disposal of bombs and improvised explosive devices (EOR, EOD, IEDD, CIED etc.) is becoming an increasingly important task. It can be divided into two parts. First will be the reconnaissance of the area of interest consisting of multiple locations and objects together with their surroundings and second – the clearance of the target area. Scenario will take place in semi-urban structures, surrounded by grass, connected by small footpaths. Dynamic objects and static obstacles on the vehicle’s route can be expected.

**Reconnoitring of building structures**

Reconnaissance of structures and buildings and the surrounding environment is an important prerequisite for urban and semi-urban combat operations. At the same time, this is one of the most dangerous tasks soldiers face during a mission. Therefore, having robots for autonomous reconnoitring of buildings definitely means a great relief for the troops. Environment: semi-urban structures, surrounded by grass, connected by small footpaths; stairs, low and no light, curtains, closed doors, sand, water, stones, rubble and debris. The buildings that have to be entered are approx. 15m in square, can be dilapidated or even partially wrecked and may have more than one level.