M-ELROB

at the

INFANTRY SCHOOL HAMMELBURG

2008

30. JUNE - 03. JULY

CONTENT

M-ELROB

2008

Dear Guests, Dear Visitors!
Welcome to ELROB 2008

As host for the European Land Robot Trials 2008, the German Army wishes to highlight our continuing support for developing and deploying unmanned systems into military service. Beginning with initial German Army concepts in 2004 and continuing with the first ELROB in 2006, this year's trials should underline our efforts to quickly develop and deploy these systems to support our soldiers in the field.

The current operational environment includes many challenges for our military forces. Whether conducting Stability Operations, high intensity warfare operations or responding to natural disasters or terrorist threats, our forces face very complex operational environments. The employment of land forces remains as important as ever and is still key to success throughout the whole mission spectrum. Unmanned systems of all types can not only improve the performance and capabilities of our soldiers in the field, they can as well enhance force protection significantly. That applies especially to operations in urban terrain where our soldiers are exposed to every kind of threat, e.g. improvised explosive devices (IED), suicide attacks or snipers.
Furthermore Robotics is an additional option for the intelligent substitution of personnel on dangerous and tedious operations. Equipping the armed forces with unmanned systems is one of the decisive challenges we are facing. The German Army gained significant experience with unmanned systems on operations. Remote-controlled mine-clearing devices and reconnaissance drones improve the Army's capabilities since the 1990s. Technological developments and miniaturization are now setting up the conditions to focus on unmanned ground systems being able to meet the requirements of different terrain conditions. ELROB 2008 offers an international forum for this approach.

Unmanned ground vehicles must operate in a more difficult and complex environment than their airborne counterparts, and their development and deployment presents an even greater challenge. The main purpose of ELROB 2008 is to continue to work on solutions that can be quickly developed and fielded to support our ground forces. We hope for and encourage a free exchange of ideas and technologies, and look to you to help us weigh risks and benefits so that we may find solutions to the challenges of today's complex operating environment.

I would like to address my special thanks to the German Army Infantry School for having hosted this years European Robotics Exhibition, and to all participants who have contributed to its success. I wish all participants and visitors to ELROB 2008 an interesting and profitable stay in Hammelburg, and look forward to challenging and successful trials.

Hans-Otto Budde
Generalleutnant

Welcome note by Ministerialdirektor Dirk Ellinger, FMoD Director of Armaments,

Due to the reorientation in the field of defence and security, with a constantly changing spectrum of tasks in conflict prevention and crisis management, including the fight against international terrorism, the armed forces are facing new challenges.

An important role in protecting personnel engaged in high-risk or tedious operations is played by robots or unmanned ground vehicles (UGVs). The employment of intelligent mobile robot systems is imperative for carrying out the „dirty, dull and dangerous“ tasks and activities under threat. Unmanned systems enhance the soldiers‘ protection considerably by enabling them to operate at a safe distance from the UGV‘s dangerous job site.

Through the award of R&D contracts, the Directorate General of Armaments of the Federal Ministry of Defence supports the armed forces on their way towards using UGVs on Bundeswehr operations. The European Land Robot Trial (ELROB) is one of its successful instruments to intensify, on the one hand, cooperation between industry, the R&D community and the military users. On the other, ELROB is to point the way to short-term realisable robot systems and, in particular, to assess the current state of the art of the technologies on display.

ELROB 2008 will present robotic technologies suitable for a wide variety of applications in future Bundeswehr projects.

ELROB 2006 gave a broad overview of unmanned land robotic systems. With its many participants, this first military land robot trial gave military robotics a kick start in Europe. The ELROB 2007 trial focused on realistic scenarios and initial approaches. Again the participants showed that robotics today can already enhance the protection of personnel significantly even under hard environmental conditions.

ELROB 2008 will show the most likely and urgent military applications for UGVs. The focus this year will be on the demonstration of the autonomy/partial autonomy of the vehicles in different scenarios. With 30 participants and almost 50 exhibitors, ELROB 2008 proves again its importance to all involved.

I wish all ELROB 2008 participants success and our visitors a pleasant stay in Hammelburg.

Ellinger

Dirk Ellinger

Dear Guests,

The Infantry School celebrated its 50th anniversary in 2006.
In the course of these 50 years, the training activities, the syllabi, the training methods and our training aids have changed considerably. Of course, our underlying task „Train future infantry commanders“ has remained unchanged, yet evolving parameters and security-political fundamentals have led to drastic modifications of the syllabi and scope of our training.

The 15 years of involvement in multinational operations worldwide, the continuing technological progress and the increasingly demanding tasks of today‘s armed forces have changed the appearance of the Infantry School accordingly.

We, the members of the Infantry School, are trying to keep up with these changes and regard ourselves as a modern service provider committed to the goal of Bundeswehr transformation: The improvement of our operational capabilities. Oviously, this includes the terms of „multinationality“ and „technology“.

Multinationality has become an established part of daily life at the Infantry School. Thus, we train soldiers from friendly nations together with German soldiers on most of our courses. Special training activities are also conducted with international participation. The Infantry School has been working very closely with Swedish, French and Austrian comrades for a number of training and exercise activities.

In addition, the School maintains partnerships with other infantry schools of our allies and friends, such as the French Infantry School in Montpellier, the British Schools in Catterick and Brecon, with the Headquarters, Director of Infantry in Warminster and the Dutch Peacekeeping Operations Training Centre in Amersfoort.

The infantry‘s forward looking attitude and acceptance of technology manifests itself in the „Infanterist der Zukunft“-System that has largely been developed and tested at the Infantry School.

The infantry in particular takes great interest in the use of robotics for all tasks, because this minimizes the risk to human lives and saves troops for employment elsewhere. Thus, the reconnaissance and transport capabilities of modern robotic systems are of great interest to us infantrymen. It was not by coincidence that the first European Land Robotics Trials took place at the Infantry School in 2006, and I am pleased to welcome them again this year.
I wish you an interesting and rewarding time at our Infantry School and remain,

Josef Blotz
Brigadier General

The German Infantry School

The Hammelburg Training Area has been located on a plateau some five kilometers south of the town since 1895. Until 1918 the Royal Bavarian Army used it to train infantry, artillery and cavalry units and aviators.

After the Second World War, the cantonments served as internment and as refugee camps and as barracks for US troops.

When the Bundeswehr was formed, the Infantry School, the Grenadier Demonstration Battalion and the Garrison Administration were established here on 01 April 1956.

Today, the German Infantry School is the central training establishment for all future infantry commanders from section to battalion commander level for regular and reserve soldiers alike. The infantry includes the members of the light infantry, the mountain infantry and the airborne infantry. The air force and naval base defence forces are also specialized in dismounted operations, or in key point protection, in particular. The air force base defence forces also train their future commanders at the Infantry School, whereas the naval based defence forces generally come here to use the training facilities of the Infantry School or those of the Hammelburg Training Area.

Every year, the Infantry School trains more than 28,000 students from all nations in more than 300 courses and training activities. In addition, most of the soldiers of the Bundeswehr‘s operational contingents undergo their pre-deployment training on the Hammelburg and Wildflecken Training Areas.

During visits extending over one or more days, several thousands of visitors come to visit the School, the Infantry History Centre and the training area including our BONNLAND Training Village every year.

In addition, the German and allied infantry battalions deploying here for training in operations in urban and wooded areas receive guidance and training assistance.

The Infantry School and the transient units use the numerous ranges and battle runs with their versatile, also computer-assisted live- and dry-fire training opportunities as the basis for highly realistic training.

The Infantry School does not only administer training, but also makes major contributions to the future development of infantry doctrine and to the fielding of promising technologies for the infantry. The „Infanterist der Zukunft“, or Future Infantryman System, and the „Dismounted Battlefield Identification System“ have largely been developed and trialled at the Infantry School. In addition, the Infantry School has pioneered a new marksmanship training concept for the Bundeswehr. The Infantry School is also an essential driver for providing mission-capable equipment to the Bundeswehr troops on operational deployments. Many of the equipment items and of the protected vehicles developed and tested at the Infantry School are used already on operational deployments. Such technologies have aroused great international interest.

The Bundeswehr UN Training Centre, which is attached to the Infantry School, is responsible for the preparation of military and civilian personnel alike for deployments under international conflict prevention and crisis management efforts.

This Training Centre does not only train military commanders and civilian personnel, but above all, it prepares the operational contingents of the Bundeswehr for their deployments. The UN Training Centre also supports the units in their own preparatory training by coaching and consulting.

The Infantry School also includes one of the Army‘s three Officer Candidate Training Battalions where young officer candidates receive their basic training.

A recruit company is attached to the Directorate of Service Support. It provides all-arms basic training to recruits for subsequent employment at the Infantry School and in other units.

Since 1959 an apprentice workshop has been attached to the Infantry School in which civilian master craftsmen teach and train up to 120 apprentices in four-year courses of instruction to become certified car mechatronicians and industrial mechanics.

M-ELROB 2008
Tried and Tested Philosophy and New Challenges

For the second time the military variant of this year's European Land Robot Trials will be conducted by the German Army in cooperation with the Bundeswehr Armaments Organisation. As before, the objective of M-ELROB is to promote on a European scale the technological development of unmanned systems to be used for military purposes - in particular of unmanned ground vehicles.

As a result of the fundamental changes in world politics, the mission spectrum of the Bundeswehr today is more comprehensive and complex than it was 20 years ago. Military operations of the Bundeswehr in the Balkans, at the Horn of Africa and in Afghanistan provide visible evidence of Germany's security commitment beyond national borders.
During these operations abroad military personnel are increasingly targeted in attacks. The protection of the lives and physical integrity of the deployed soldiers are of top priority and a requirement for the accomplishment of military missions. Potential adversaries, however, are constantly adapting their tactics, techniques and procedures to our protection measures, the race between shield and sword is still on even during current operations.
By definition, unmanned robotic systems ensure maximum protection because they are exposed to the threat instead of the soldiers. The rapid technological developments of recent years have provided the basis for systems which, as unmanned platforms, perform a variety of tasks. Given some unresolved technological challenges in the development of such systems, the number of militarily used systems worldwide is low, and often their operation is still very complex.
But what is it that makes a system a robotic system? In addition to their mobility, sensor and actuator systems it is the autonomy of robotic systems which is of key importance. Seen in this light, remotely controlled systems such as, for example, industrial robots are not true robots but referred to as manipulators. The challenge of autonomy is the electronic scanning of the environment so that intelligent decision algorithms are provided with a coherent, digitised situation picture of low latency and with a high repetition rate. And this is as complicated as it sounds. In view of this challenge, efforts are being made by groups of companies, institutes and universities to develop different solutions and approaches.

Components of unmanned ground systems used for military purposes
A high degree of mobility allows the intelligent robot to move from one place to another. Depending on the terrain profile, there are different requirements in terms of speed, cross-country mobility, grade ascending and climbing capability as well as, if required, flotation. Energy supply must be maintained to ensure a sufficient period of operation. Sensors are imperative for environment scanning. The type and number of sensors depends on the requirements to be met by the system. It is above all the capability of environment detection under conditions of limited visibility and the low signature of the system that can be of crucial importance here. For transportation and/or manipulation of objects a possible payload as well as mechanical "hands" are required. The buzzword to be mentioned in this overall context is human engineering. Even if we are successful at completely automating the actuator system, the capability of manual intervention must still be provided. This is more likely to be achieved if the application

is designed in a user friendly way. Neither autonomous nor remotely controlled systems should use communication by wire. The transmission of all necessary data requires wireless communication and sufficient dimensioning . Since wireless communication is prone to being disrupted and/or intercepted, appropriate countermeasures must be taken. In addition to sufficient data encryption, the system should be autonomous enough to make its way back to re-establish contact after it was cut off. A high variability of the system can be achieved by modular design. This is the only way to easily and rapidly replace components, as required.

The challenge of autonomy

Autonomous land movements present considerably more complex challenges in terms of environment scanning than aerial movements do. Anyone involved in this field of activity knows the efforts associated with combining data from several sensors to a common reproduction of the environment as part of what is referred to as sensor data fusion. The fusion of data from several identical sensors (e.g. for covering the entire environment) is a complex task, let alone the fusion of data from different types of sensors (e.g. video and laser scanner). At increased speeds, the situation picture must be available in near real time. Moreover, the repetition rate must be high enough. If only one of these conditions is not met, the robot‘s movement cannot but be instable. Even if data fusion succeeds, the task is not yet accomplished. The situation picture still has to be interpreted. Routes, obstacles, persons (friend/foe) etc. must be identified. Complete autonomy depends on the learning ability of the system, i.e. artificial intelligence features must be provided.

The objective

As opposed to ELROB 2006, the objective of this year‘s event has changed significantly: while, against the backdrop of basic Army concepts regarding potential applications of robotic systems, the objective then was to identify the current technical performance of such systems, ELROB 2008 is conceived to serve as a catalyst for upgrading the capabilities of the Army and indeed the armed forces as a whole: The focus will be on the question whether robotic systems can effectively support our soldiers on operations in the foreseeable future. For defining the trials, the requirements of the Army‘s arms and branches regarding future applications for robotic systems were collected and evaluated first. This year‘s „Reconnaissance and Surveillance“, „Transport and Mule“, „Explosive Ordnance Disposal“ and „Site Security“ trials reflect prioritised areas for future applications of robotic systems.
This year‘s tasking emphasises the necessity of autonomous or partly autonomous capabilities, so that the human operator, for instance, should only have to monitor the robot‘s movements instead of controlling them.

The taskings

During the reconnaissance trial, the robotic systems are required to reconnoitre several targets from a distance of up to 3,000 m in a defined area after a short preparation phase only. The trials will take place by day and night. In spite of the fact that, from a military standpoint, a reconnaissance capability even or especially at night is a matter of course, it is, for all the organisers know, the first time that a night trial is conducted as part of such an event. Land robots and mini-drones have been entered for this trial.

The transport trial is composed of two independent tasks: in a convoy, supplies shall be carried by unmanned land systems over a long distance and as quickly as possible. The convoy must be made up of two or more vehicles, one of which may be manned e.g. to serve as command vehicle with the unmanned vehicles following.
In a shuttle type transport, an unmanned land system shall carry supplies between two places as often as possible.
In the explosive ordnance disposal trial, an unmanned land system shall detect mines, UXO and booby traps in the open as well as at and in vehicles and, if the system is equipped with a manipulator arm, carry out deactivation and neutralisation measures.
In the site security trial, robotic systems will be required to monitor a specific area and to report any unauthorised persons intruding. Land robots and mini-drones have been entered for this trial.

Certainly, the above taskings place higher demands on the participants than two years ago. Nevertheless, the number of participants has increased to 27 teams and 50 exhibitors from 10 European nations. ELROB 2008 covers a wide spectrum of systems, ranging from commercially available products to prototypes to pure test vehicles. The participation of several universities raises hope for valuable contributions to the field of autonomy.

Those facts once again prove that the ELROB is a highly successful and efficient tool to fertilise the needed synergetic effects of intensive co-operation between the robotic community and the user.
To close the gap between users, industry and researchers in the area of unmanned systems is one of the key goals of the event.
The armament directorate supports this process through its consistent research and development strategy in this field.

This year, the event will again be a combination of field trials and a concurrent exhibition to offer the international audience of experts from the military, industry and research communities a forum for exchanging ideas. The European Land Robot Trials 2008 are designed to adhere to their tried and tested philosophy:

- ELROB is conducted to provide an overview of the European state-of-the-art in the field of unmanned vehicles with 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!

For these reasons, ELROB - as opposed to DARPA Grand Challenge - does not consider itself a ‘fight between competitors’ with high-tech visions but an effort to show what is technically feasible today in the field of robotics, and an opportunity to promote useful technological developments in Europe and, ultimately, to establish ties among innovative and resourceful members of the community.

Participants

at

M-ELROB 2008

AirRobot

Team name / Company:	AirRobot / AirRobot GmbH & CO KG
Team leader:	Burkhard Wiggerich
Nationality:	Germany
System:	AirRobot AR100-B
Scenario:	Reconnaissance and surveillance
Contact:	Werler Str. 4-8 59755 Arnsberg Tel: +49-02932 547 740 Fax: +49-02932 547 749 E-mail: b.wiggerich@airrobot.de Website: www.airrobot.de

Team description

AirRobot GmbH & Co. KG is a global playing, mid-sized producer of professional Mini UAV Systems with Headquarter in Arnsberg-Neheim, Germany.
The self-developed high-tech system meets highest quality standards. By intensive exchange of information with our customers the products will be further developed continuously.
Distribution, technical support and after sales services are raised by a widespread network of dealers and sales offices. A team of specialists, located in Arnsberg, are supporting these activities. The business objective is to achieve customer satisfaction.
It is easy to learn how to handle the AirRobot flying platform caused by its self stabilizing electronically position control. So it is possible that the pilot can concentrate only on his mission. Different types of cameras and sensor are available. They are easy to change through a cleverly devised payload system.
Applications of AirRobot are reconnaissance, inspection, surveillance, search and rescue, as well as civil aerial view photography.

Name of vehicle

AirRobot AR70 / AR100-B / AR150

Basic data of vehicle

Height:	25cm
Height:	25 cm
Width:	70/100/150
Length:	70/100/150
Weight:	1,4 / 1,7 / 4,5 Kg
Ground clearance:	13cm
Climbing performance:	2 m/s
Propulsion:	batteries
Endurance:	30 min
Max. speed:	50Km/h
Payload:	200g/200g/1500g

Communication equipment

Type:	Digital videolink
	Digital uplink
Frequency:	2400 MHz
Possible frequency range:	from 1400 to 2400
Power:	from 500 mWatts to 2W

Sensor equipment

Vision:	OPS Optical Position System
GPS:	GPS

Allen-Vanguard Ltd

Team name / Company:	The Allen Team / Allen-Vanguard Ltd
Team leader:	Pete Benwell
Nationality:	UK
Systems:	Defender D2, Digital Vanguard
Scenario:	EOD
Contact:	Allen House Alexandra Way Ashchurch Business Park Tewkesbury Gloucestershire GL20 8TD Tel: ++44 01684 851116 Fax: ++44 01684 851101 E-mail: pbenwell@allen-vanguard.co.uk Website: www.allen-vanguard.com

Team description

The Allen Team are employees from Allen-Vanguard Ltd, who have a wide range of experience in Sales and equipment demonstrations. The Allen Team will be demonstrating two AV tele-operated Remotely Operated Vehicles (ROV); the Defender and Vanguard. Both ROVs are battery powered and controlled from a highly intuitive Console, both use digital sequence spread spectrum for their wireless communications but where necessary can be backed-up using either Ethernet of Fibre Optic Cable. It is our intention to demonstrate both ROV capabilities in the EOD/IEDD scenarios.

Name of vehicle

Defender D2

Basic data of vehicle

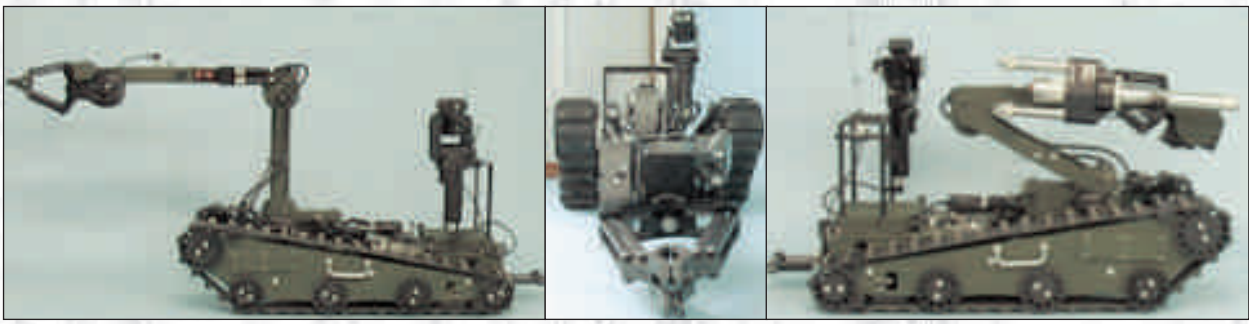
Height:	150 cm
Height:	115 cm
Width:	72.5 cm
Length:	152 cm
Weight:	330 kg
Ground clearance:	10 cm
Climbing performance:	45 degree
Wheel or track driven:	Wheel; six wheels independently driven
Propulsion:	2 x Apollo 12v DC batteries
Endurance:	24hrs
Max. speed:	2.5 km/h
Payload:	250Kg

Sensor equipment

Vision: 6 CCD Cameras as standard:
Front Drive - Wide angle “Starlight” CCD Camera
Rear Drive - Wide angle “Starlight” CCD Camera
Turret - A wide angle monochrome camera with IR illumination
Surveillance - VISCA controlled colour CCD Camera mounted on a pan & tilt unit with an x40 zoom capability
Claw - VISCA controlled colour CCD Camera mounted on a pan & tilt unit with an x40 zoom capability
Auxiliary - Bullet monochrome camera for use on the claw and other accessories
GPS: Garmin GPS-16. Average accuracy 100 cm

Name of vehicle

Digital Vanguard



Basic data of vehicle

Height:	56 cm
Width:	46 cm
Length:	104 cm
Weight:	70 Kg
Ground clearance:	5.75 cm
Climbing performance:	45 degree as standard *subject to suitable traction
Wheel or track driven:	Track as standard, can be fitted with a Wheel Kit
Propulsion:	24v battery pack
Endurance:	4 hrs
Max. speed:	2.5 Km/h
Payload:	250Kg

Sensor equipment

Vision: 3 CCD Cameras as standard
Drive - A wide angle CCD camera
Surveillance - A VISCA controlled CCD camera mounted on a Pan & Tilt unit with an x40 zoom capability.
Claw - A CCD camera suited for use with the ROVs claw
A fourth camera can be fitted this is either a dedicated disruptor camera or a CCD camera with IR illumination.

BASE TEN

Team name / Company:	RoboScout / BASE TEN SYSTEMS Electronics GmbH
Team leader:	Ferdinand Zoller
Nationality:	Germany
Systems:	Gecko TRS
Scearios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport and mule
Contact:	Am Soeldnermoos 10 85399 Hallbergmoos Tel.: +49 811 5598 230 Fax: +49 811 5598 258 fzoller@btse.de www.btse.de

Team description

The BASE TEN Engineering Team, under the leadership of Ferdinand Zoller, has been established to build a robot vehicle which is capable to fulfil military tasks such as support of tank troops, reconnaissance, combat search and rescue and other special operations. The robot belongs to the vehicle class of 3000 kg. The basic vehicle features are:

- Hybrid drive propulsion system with electrical wheel hub motors
- 4 wheel drive
- 4 wheel steering
- Sensor lever arm with reconnaissance components
  and the capability to carry various payloads.

The vehicle can be controlled via satellite communication, terrestrial communication and WLAN from a Battlefield Operation Centre connected to NetOpFü (NCW). In addition, semi-autonomous operating modes are available. The vehicle acts also as a moving relay station used by the Infanterist der Zukunft (IdZ/Infantryman of the future).
Activities started in April 2005. The modified first vehicle, the Gecko E+ Version, has participated in the ELROB 2006. Subsequent activities are targeted towards building a complete system comprising two vehicles, one remote control centre with antenna systems and payloads (tbd.) which will be ready mid 2010.
The BASE TEN team participates in the ELROB 2008 Military European Land-Robot Trial with an experimental vehicle, the so-called Gecko TRS (Technologie-Referenzsystem).

Name of vehicle

Gecko TRS

Basic data of vehicle

Height:	280 cm
Width:	232 cm
Length:	425 cm
Weight:	2990 kg
Ground Clearance:	40 cm
Average noise level:	85 dB(A) (approx.)
Climbing performance:	100 %
Wheel or track driven:	Four (4) wheel drive
Propulsion:	Diesel
Endurance:	6 h
Maximum speed:	80 km/h
Payload (on top):	200 kg
Payload (Trailer coupling):	> 1000 kg, depending on surface conditions

Sensor equipment

Wide angle camera	10	CRVC758/1,65NO 1/4“ Color CCD Fahrzeugkamera
Zoom camera	2	CCD1000H35/3,6-126 [PAL] 1/4“ CCD Color 35X Zoom Kamera
Infrared camera	2	Zeiss UCM
CCD and IR cameras, LRF	1	Adapted Zeiss Attica System
Scanner systems	2	beo Lux (two times three scanners)
INS with integrated differential GPS		IMAR NAV RQH 1002

borjet

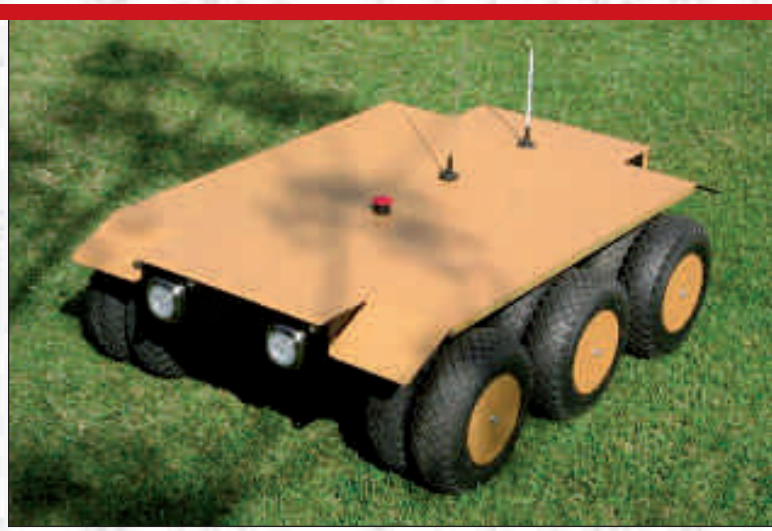
Team name / Company:	borjet
Team leader:	Franz Bormann
Nationality:	Germany
System:	P-08 (TRAXX)
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport and mule
Contact:	Mehlisstr. 9 D-88255 Baindt/Schachen Tel.: ++49-07502/940240 Fax: ++49-07502/940230 service@borjet.de www.Landroboter.de

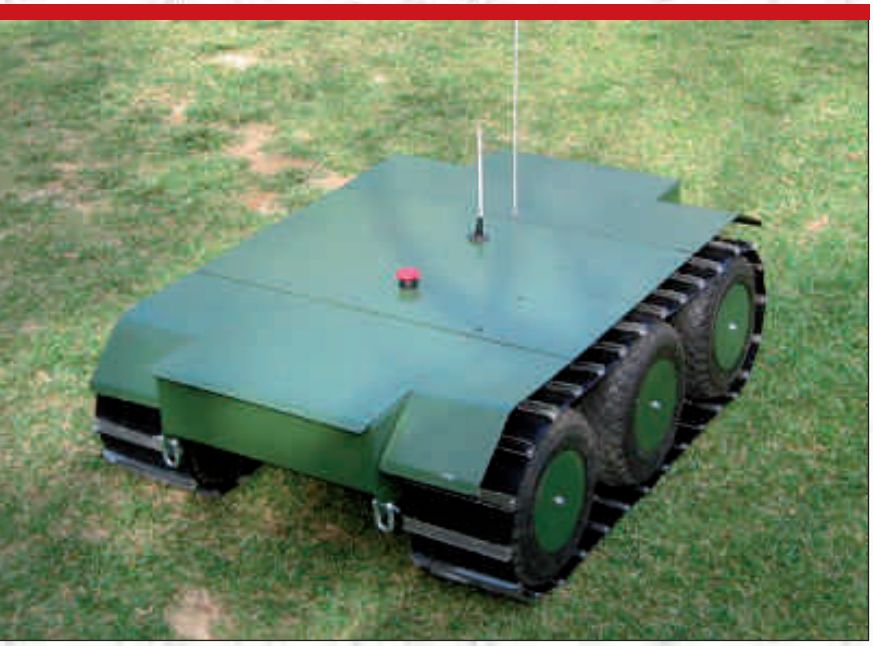
Team description

This company works in the production of model aircraft and now intends to extend its business to air and ground robots. Prototypes of both are available and land robot P-08 is now due to be presented. It is planned to provide this vehicle as the basis for whatever projects research and industry may pursue. The modular design allows to cover a host of applications at moderate expense.

Name of vehicle

P-08





Basic data of vehicle

Height:	75 cm (including antennas)/ 32 cm
Width:	75 cm
Length:	100 cm
Weight:	50 Kg (including all accessories)
Ground clearance:	10 cm
Average noise level:	50 dB(A) (approx.)
Wheel or track driven:	wheel + track
Propulsion:	batteries
Endurance:	0,5 hrs
Max. speed:	25Km/h
Payload:	100Kg

Communication equipment

Frequency:	2400 MHz
Power:	10.000 mWatts

Sensor equipment

Inertial measurement unit:	Crossbow Getit DH7

Diehl

Team name / Company:	"CANGURU" / Diehl BGT Defence GmbH & Co KG
Team leader:	Dirk Krogmann
Nationality:	Germany
System:	CANGURU
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport and mule
Contact:	Alte Nussdorfer Str. 13 D 88662 Überlingen Tel.: +49-7551-89-2811 Fax: +49-7551-89-4269 dirk.krogmann@diehl-bgt-defence.de www.diehl-bgt-defence.de

Team description

The "CANGURU" Team is the entry for both the Diehl BGT Defence (DBD) and the Fraunhofer Institute for Information and Data processing, center for application of system technologies (IITB-AST) cooperation into the ELROB2008. The team is composed of industry employees as well as research institute / faculty employees from IITB-AST under the leadership of Dirk Krogmann (Programme Manager at DBD), Thomas Kopfstedt as DBD substitute (Engineer at DBD) and Dr. Andreas Wenzel (Head of Embedded Systems at IITB-AST) as IITB-AST leader. Our vehicle is called the "CANGURU". The "CANGURU" is based on a hybrid drivetrain for long range operation capabilities as well as silent movement. The vehicle is fully digitalised comprising a CAN-bus system and actuated via a drive-by-wire system. All processing necessary for key performance (non payload processing) takes place on a small, compact board-computer using microcontroller. The vehicle incorporates measurements from GPS/INS and wheel speed odometer sensors for pose estimation also comprising ultrasonic sensors around the whole vehicle. While moving, the environment is perceived through two laser range finders, six vehicle platform cameras and a monocular vision system. A payload suite comprises an infrared camera and a 360° CCD zoom-camera. All sensors acquire environment data at rates between 5 and 100 Hertz. Map and pose information are incorporated at up to 100 Hz, enabling the "CANGURU" to avoid collisions with obstacles in real-time while advancing along the ELROB2008 route.

The development of the "CANGURU" system began in May 2006. At the time the of the initial team application, the vehicle is largely functional and has logged dozens of autonomous miles along a test course at DBD premises.

Name of vehicle

CANGURU

Basic data of vehicle

Height:	~220 cm
Width:	111 cm
Length:	215 cm
Weight:	~350 kg
Ground clearance:	20 cm
Average noise level:	80 / 55 dB(A) (fuel/batteries, approx.)
Climbing performance:	25°
Wheel or track driven:	4-Wheel Drive
Propulsion:	Hybrid (fuel, rechargeable batteries)
Endurance:	6 hrs
Max. speed:	20 km/h
Payload:	~220 kg

Communication equipment

Type 1:	Datalink Modem
Frequency:	868 MHz
Possible frequency range:	869,40 – 869,65 MHz
Power:	500 mWatts
Modulation:	Frequency Shift Keying
Number of channels:	8
Type 2:	Videolink Modem
Frequency:	2300 MHz
Possible frequency range:	2300 - 2400 MHz
Power:	1.000 mWatts
Modulation:	COFDM
Number of channels:	3
Type 3:	Datalink Modem
Frequency:	2400 MHz
Possible frequency range:	2402 – 2478 MHz
Power:	100 mWatts
Modulation:	Spread Spectrum
Number of channels:	20
Type 4 (optional backup):	Datalink WLAN802.11g
Frequency:	2400 MHz
Possible frequency range:	2400 – 2485 MHz
Power:	<100 mWatts
Modulation:	Spread Spectrum
Number of channels:	11

Sensor equipment

Vision Cameras:	7 x RGB CCD
Laser:	2 x Sick Laser LMS 291 and LMS 221
Ultrasonic:	20 x Welotec
DGPS:	Trimble AgGPS 332 OmniSTAR
IMU:	- to be specified later -
Payload:	Infrared Camera (µ-Bolometer, IndigoSystems) RGB CCD 360° Zoom Camera

Force Ware GmbH

Team name / Company:	Force Ware / Force Ware GmbH
Team leader:	Dr. Jürgen Braunstein
Nationality:	Germany
System:	KNIGHT
Scenarios:	1. Reconnaissance and surveillance 2. EOD 3. Transport 4. Mule
Contact:	Im Grund 3 72800 Eningen Tel.: ++49-7121-42 03 18 Fax: ++49-7121-42 03 19 info@forceware.de www.forceware.de

Team description

The Force Ware Team comprises of the Force Ware GmbH and WMRobots. It is their entry into the ELROB2008. The team is led by Dr. Jürgen Braunstein (Mr.) from Force Ware GmbH located in Eningen, Germany accompanied by his team mate Bob Wolstenholme (Mr.) from WMRobots located in Colmar, PA, USA. Our vehicle is called the " KNIGHT" robot. The Knight is based on a proprietary design powered by 48 V DC battery pack that can deliver 2 to 10 hours of on duty time. The robot is controlled via fibre optic cable for secure operation or optional RF radio. All processing takes place on a PC 104 stack, powered by a battery-backed, electronically controlled power system. The robot is controlled via the real time visual feedback delivered by as many as 7 on board cameras that can all have individual zoom capability. The robot has the ability to climb steps as much as 45 degrees as well as a variety of uneven surfaces and a range of surface conditions including snow via the removable tracks. The tracks can be removed to run strictly on the tires giving better life to the batteries and easier mobility on flat surfaces. The robot has 7 degrees of freedom in the manipulating arm that features infinitely variable speed of all axis simultaneously thru the use of joysticks. The arm also is 100% backlash free giving optimum precise control when making the smallest of movement commands. The robot also has 2 way audio that along with the video have permanent recording capability for post reference use. The robot also has integrated sensor software giving the robot the capability to interface directly with a variety of sensors such as chemical, radiation, X-ray, etc. The robot and control station are waterproof and can be operated in -20° C to +50 °C. Selection

Name of vehicle

Knight

Explosive & Ordnance Disposal Robot

Basic data of vehicle

Height:	102 cm
Width:	71 cm
Length:	136 cm
Weight:	275 kg (including all accessories, but no weapons)
Ground clearance:	12 cm
Climbing performance:	45 °
Wheel or track driven:	6 wheels with optional tracks
Propulsion:	batteries
Endurance:	2-10 h depending on mission and communication method
Max. speed:	4 km/h
Payload:	18 kg Manipulator arm payload

Communication equipment

Type 1:	Analogue
Type 2:	Analogue
Type 2:	Digital Frequency Hopping
Frequency 1:	2.3 - 2.5 GHz
Frequency 2:	150 MHz
Frequency 3:	902-928 MHz
Possible frequency range:	from 150 MHz to 2.5 GHz
Power 1:	5 W
Power 2:	2 W
Power 3:	100 mW or 1 W
Number of channels 1:	8
Number of channels 2:	4
Number of channels 3:	Frequency hopping patterns selection only

Sensor equipment

Vision: 2 x Sony 300:1 Zoom 640x480 cameras mounted on a custompan/tilt. With up to 5 additional

THE Fench Team

Team name / Company:	THE French Team (THALES + ECA + CNRS/LAAS)
Team leader:	Joël MORILLON (THALES)
Nationality:	France
Systems:	UGV R-TROOPER CAMELEON Spy'Arrow
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport 4. Mule 5. EOD
Contact:	Joël MORILLON – 2, avenue Gay Lussac / CS 90502 – 78995 ELANCOURT Cedex - FRANCE Tel.No: +33 (0)1 30 96 82 64 Fax No: +33 (0)1 30 96 82 50 joel-g.morillon@fr.thalesgroup.com www.thalesgroup.com www.eca.fr

Team description

French team is composed with different entities: THALES, ECA and a French robotic research centre: CNRS/LAAS

THALES has been involved in military robotics for more than 15 years. It develops technical and operational robotics demonstrators for missions in urban and open terrains. Considered missions range from observation or target acquisition to special dedicated uses (such as autonomous terrain mapping). The approach is system oriented, in order to design and build usable robotic systems, from an operational point of view. Special efforts are made to improve reliability, credibility, failure management, and so on. Many autonomous modes have been demonstrated, such as trajectory recording and replay, autonomous leader-follower, road and lane following, high speed obstacle avoidance.

ECA is the worldwide leader for its mine warfare systems and equipment. The company offers today automated systems for harsh environments as: Sub sea Mine Warfare, Systems & Equipment for Naval Forces, Robotic systems and equipment for Land Forces and Simulation & Training.

LAAS Laboratory has strong experience and is a regular contributor in field robotics. The tackled problems and the contributions concern: control architecture, autonomous navigation, environment modelling, multi-robot coordination and cooperation. The applications involved terrestrial as well as aerial unmanned vehicles. More generally, LAAS has experience in system integration, mission and task planning, motion planning and control for various robots including humanoid and mobile manipulation systems, sensor fusion, multi-robot cooperation, human-robot collaboration.

R-TROOPER (large UGV)
+ CAMELEON (Small-UGV)
+ Spy'Arrow (Mini-UAV)

Name of vehicle

UGV: R-TROOPER

Basic data of vehicle

Height:	250 cm (including antennas) / 140 cm
Width:	160 cm
Length:	300 cm
Weight:	650 kg (including all accessories)
Ground clearance:	25 cm
Average noise level:	40 dB(A) (approx.)
Climbing performance:	30 degree
Wheel or track driven:	Wheels (6)
Propulsion:	Electric motors + thermogenerator
Endurance:	8 hrs
Max. speed:	50 Km/h
Payload:	150 Kg (inside one PRM)

Communication equipment

Type:	WLAN 802.11b
Possible frequency range:	2400 - 2800
Power:	10.000 mW
Number of channels:	16

Sensor equipment

Laser:	2 x Sick Laser LMS 221
Vision:	2 x Sony FCB-EX780B cameras mounted on pan/tilt units (left+right)
	2 x Sony FCB-EX780B cameras (front+rear)
GPS:	Novatel Propak-G2 Plus
IMU	BEI Systron C-Migits 3
Power source needed:	230 Volts with 1000Watts

Name of vehicle

CAMELEON

Basic data of vehicle

Height:	19 cm
Width:	67 cm
Length:	50 cm
Weight:	26 kg (including all accessories)
Wheel or track driven:	Track
Propulsion:	Electric motors
Endurance:	1 à 2.5 h
Max. speed:	2.8 m/s

Name of vehicle

Mini-UAV: SPY'ARROW

Basic data about vehicle

Platform main capabilities:
No pilot knowledge necessary:
fully autonomous from takeoff to landing
Assisted mode and route selection by the operator to accommodate moving targets
Very light platform (<500g)
2 km radio link range
47 km/h nominal speed, 1/2h autonomy
Ready to interface many kind of sensors

Nominal onboard equipment:
Video camera with radio transmission
Onboard computer, for stabilization and mission management
GPS and attitude sensors
Radio link for operator commands and telemetry,
battery, and electric motorization

LSA

Team name / Company:	LSA/ISEP / Autonomous Systems Laboratory, Institute Superior of Engineering of Oporto.
Team leader:	José Miguel Almeida
Nationality:	Portugal
System:	LINCE
Scenarios:	1. Reconnaissance and surveillance 2. Camp Security 3. Mule
Contact:	Rua Dr. António Bernardino de Almeida, 431 4200 - 462 Porto Portugal Tel: ++351220340500 Fax: ++351228321159 lsa@lsa.isep.ipp.pt www.lsa.isep.ipp.pt

Team description

The Autonomous Systems Laboratory (LSA) is a research unit from the Porto Engineering Institute (ISEP), a school of the Porto Polytechnic Institute (IPP). Created in 2001, it has 13 permanent researchers, and integrates in its various research projects more than 20 students each year from IPP and external academic institutions, in various stages of education and different areas of knowledge. The laboratory mission is the research and development of science and technology in autonomous systems engineering and its dissemination. The research ranges from: distributed control, navigation and coordination; embedded real-time systems design; and advanced sensing and perception. Those topics are applied to field robotics, oceanographic and environmental monitoring, security and transportation.

Researchers at LSA have been involved in the last 14 years in the areas of field robotics and autonomous systems, and have designed and developed several field robotics systems like: unmanned air vehicles (UAV) for forest management, ocean and coastal monitoring (FALCOS UAV); multi-purpose autonomous surface vehicles (ASV), ROAZ and ROAZ II; Remotely Operated Vehicles (ROV) for the inspection of underwater structures; Unmanned Ground vehicles (UGV), LINCE, Runner, and the ISePorto robotic soccer team (Robocup MSL).

The lab know-how focuses in field robotics: on the design and implementation of autonomous robotic systems (marine, aerial and terrestrial), navigation algorithms, sensors and solutions, in robot control and multiple robot coordination and decision, artificial computer vision and

specific hardware design. In addition we have know-how in developing Linux based embedded robot control software and, strong and extensive field robot missions experience.

In addition the lab has a strong microelectronics and digital circuit embedded design experience with the development of various components for autonomous systems integration, namely: embedded smart vision sensor (reconfigurable hardware and IP core based design); custom designed inertial navigation system; highly integrated and network based motion control board; custom designed triple GPS navigation system for attitude determination; various embedded computational boards.

The LSA plans to bring to ELROB a team of vehicles with some cooperative capabilities. Two LINCEs vehicles (Land Intelligent Cooperative Explorer), a small electric all terrain vehicles equipped GPS, INS, Video cameras, thermal camera, a CAN bus for interfacing motor controllers boards and some sensors, an embedded CPU with Linux and running custom mission, control and navigation software. One or two UAVs, drone like, equipped with GPS, INS, custom autopilot, a CPU for vision processing, mission management and communications, a wireless adapter, and a thermal or video camera. Currently are instrumenting two electrical medium size all terrain vehicle, that should be functional for this event. The users interface run in portable rack console with sunlight monitor, embedded computer, and communications devices.

Name of vehicle

LINCE

Basic data of vehicle

Height:	65 cm (including antennas) / 43 cm
Width:	40 cm
Length:	60 cm
Weight:	15 kg (including all accessories)
Ground clearance:	13 cm
Average noise level:	10 dB(A) (approx.)
Climbing performance:	35 degree
Wheel or track driven:	Wheels
Propulsion:	batteries
Endurance:	3 hrs
Max. speed:	15 Km/h
Payload:	5-10 Kg

Communication equipment

Type:	WLAN 802.11abg
Frequency:	5000 MHz
Possible frequency range:	2400 - 5000
Power:	100 mWatts
Modulation:	DSSS, OFDM
Number of channels:	16

Sensor equipment

Vision:	1 x multi camera embedded vision system (LSA PowerVista) 2 x Pan/Tilt camera
GPS:	1 x Novatel superstar II 5Hz.
Inertial measurement unit:	1 x LSA-INS v_2.0
Traction Control System:	1 x embedded traction control system

Vehicle under development: ART

Basic data of ART

Height:	150 cm (including antennas) / 100 cm
Width:	120 cm
Length:	240 cm
Weight:	400 kg (including all accessories)
Ground clearance:	15 cm
Climbing performance:	35 degree
Wheel or track driven:	wheel
Propulsion:	batteries
Endurance:	6 hrs
Max. speed:	70 km/h
Payload:	100 kg

Sensor equipment

Vision:	1 x multi camera embedded vision system (LSA PowerVista) 2 x Pan/Tilt camera
GPS:	1 x Septentrio PolaRx2e@Dual-Frequency multi-antenna GPS/SBAS
Inertial measurement unit:	1 x LSA-INS v_2.0
Laser Scanner Sensors:	1 x SICK Laser LMS200

Vehicle under development: ARX

Basic data of ARX

Height:	150 cm (including antennas) / 110 cm
Width:	105 cm
Length:	175 cm
Weight:	200 kg (including all accessories)
Ground clearance:	25 cm
Climbing performance:	35 degree
Wheel or track driven:	wheel
Propulsion:	batteries
Endurance:	3 hrs
Max. speed:	45 Km/h
Payload:	100 kg

Sensor equipment

Vision:	1 x multi camera embedded vision system (LSA PowerVista)
GPS:	1 x Novatel superstar II 5Hz.
Inertial measurement unit:	1 x LSA-INS v_2.0
Laser Scanner Sensors:	1 x SICK Laser LMS200

Vehicle under development: Microraptor

Basic data of Microraptor

Height:	50 cm
Width:	100 cm
Length:	100 cm
Weight:	2.5 kg (including all accessories)
Wheel or track driven:	Aerial vehicle
Propulsion:	batteries
Endurance:	0.25 - 0.5 hrs
Max. speed:	30 km/h
Payload:	0.8 kg

Sensor equipment

Vision:	1 x multi camera embedded vision system (LSA PowerVista) 1 x Pan/Tilt camera
GPS:	1 x Novatel superstar II 5Hz.
Inertial measurement unit:	1 x LSA-INS v_2.0

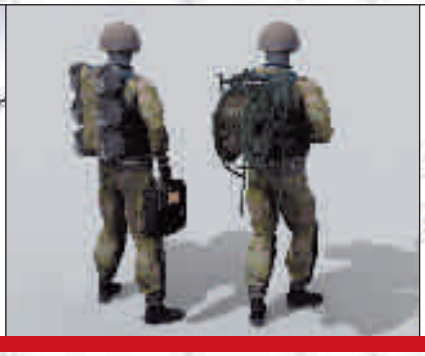
MACROSWISS S.A.

Team name / Company:	MACROSWISS / MACROSWISS S.A.
Team leader:	Cino Robin Castelli
Nationality:	Switzerland
System:	Spyrobot 4WD
Scenario:	Reconnaissance and surveillance
Contact:	Via 1° Agosto, 1 6828 – Balerna - Switzerland Tel: ++41-91 682 35 46 Fax: ++41-91 682 35 48 info@macroswiss.com www.macroswiss.com

Team description

The Macroswiss Spyrobot team is the official entry for the Reconnaissance and surveillance scenario of Macroswiss S.A.
Our vehicle is called "Spyrobot 4WD". The unit is the evolution of our previous Spyrobot prototypes and is the main changes from the previous platform are in the field of ruggedness and tossability. Another major change is in the battery system (from Lithium Ions to Lithium Polymers) and the innovative traction system.

Project Spyrobot is aimed at producing a compact, low cost, user friendly, modular, tossable, remotely-operated Unmanned Ground Vehicle for use particularly in urban conditions.
The unit must be able to relay video information from areas in which the operator does not, or cannot, go personally and must be capable of handling all the typical obstacles that are to be expected in such an environment.



QinetiQ

Team name / Company:	QinetiQ
Team leader:	Simon Christoforato
Nationality:	UK
Systems:	TALON (one of a number of possible RCVs QinetiQ will use at ELROB 2008).
Scenarios:	1. Reconnaissance and surveillance 2. Camp Security 3. Transport 4. Mule 5. EOD
Contact:	Cody Technology Park, Farnborough, Hampshire England GU14 0LX Tel: ++44 (0)1252-392000 Fax: ++44 (0) 1252-393911 KPink1@ QinetiQ.com www.QinetiQ.com

Team description

The QinetiQ team at ELROB2008 represents the tactical robotics department within the "Platform Systems Group" of "Land" division, QinetiQ, UK. The team is largely composed of scientists and research engineers from the division's battlefield robotics group, under the leadership of Dr Marcus Penny. QinetiQ is a public company formed from the privatisation of the UK MoD's military research facilities. It now provides comprehensive research, design and technical support to both military and civilian agencies. QinetiQ has been designing and building remote controlled vehicles since their inception in the mid 1970's. QinetiQ plan to bring a selection of RCVs to ELROB 2008 and partake in a number of exercises. Our primary medium sized vehicle is called "TALON". Depending on the variant this RCV can weigh between 25 and 65Kg. It is battery powered which allows operation in confines spaces. Talon is the most widely used RCV in active military conflict with over 400 being deployed into theatre with the US forces. The larger "Black Max" RCV was originally conceived as a "Route Prover" for convoy operations. It is based on a 4x4 skid steer chassis, being a Diesel / electric hybrid BLACK MAX can operate for many hours. The RCV is radio controlled, and latest version of the vehicle can support high power radio transmitters for long range CBRN type sensor operations. All systems are battery-backed, allowing the RCV to operate indoors, quietly and without production of fumes. All our vehicles can incorporate Heading, Pitch and Roll measurements, GPS, and support external environment sensor suites, as well as dextrous manipulators. A new RCV called "DRAGON RUNNER" will probably be shown for the first time in Europe at ELROB 2008.

Name of vehicle

TALON

Name of vehicle

LONG CROSS

Name of vehicle

BLACK MAX

Name of vehicle

LONG CROSS 6 Wheel

Rheinmetall Landsysteme GmbH

Team name / Company:	Uwe Eisenkolb / Rheinmetall Landsysteme GmbH
Team leader:	Uwe Eisenkolb
Nationality:	Germany
Systems:	Wiesel 2 Digital, TROBOT
Scenarios:	1. Reconnaissance and surveillance (WIESEL digital) 2. Transport (TROBOT and WIESEL 2 digital) 3. Mule (TROBOT)
Contact:	Heinrich-Ehrhardt-Str. 2 29345 Unterlüß Tel: ++49-05827-806817 Fax: ++49-05827-805213 uwe.eisenkolb@rheinmetall.com www.rheinmetall-defence.com

Team description

The Rheinmetall Defence Team is Rheinmetall Defence's entry into the ELROB2008. The team is mainly composed of employees of Rheinmetall Landsysteme GmbH. Our vehicles are:

TROBOT (Tactical ROBOT). The TROBOT is based on a Diesel-powered eight wheel commercial off-road vehicle, the ODG Centaur. It is fitted with a drive-by-wire system, several sensors and computers. The vehicle incorporates measurements from a Trimble AGPS 114 DGPS and an iMAR VRU-SSA as inertial measurement unit. While moving, the environment is perceived through one sick LMS211 laser scanner, a RTS Scandrive Duo rotating 3D laser scanner, four IFM PMD laser sensors, three PIL ultrasonic distance sensors and a pan-tilt head with video camera. The vehicle can be used manned or unmanned. In the unmanned mode it is remote controlled or autonomous. The development of the TROBOT system began in August 2005.

WIESEL 2 digital. The WIESEL digital is based on the WIESEL 2 tracked platform, developed by Rheinmetall Landsysteme GmbH. The vehicle is fitted with two operator consoles for remote driving and operating robotic vehicles like UAVs and UGVs. It is fitted with a drive-by-wire system, driving cameras and a BAA with day/night sight camera. The WIESEL 2 digital can be used manned or unmanned. In the unmanned mode it is remote controlled.

Robotics Inventions

Team name / Company:	Robotics Inventions
Team leader:	Marcin Gil
Nationality:	Poland
System:	A-Bot Standard
Scenarios :	1. Reconnaissance and surveillance 2. Camp security 3. Mule 4. EOD
Contact:	Center for Space Exploration, Bartycka 18A 00-716 Warsaw, Poland Tel: ++48-600-800-124 mgil@roboticsinventions.com www.roboticsinventions.com

Team description

Robotics Inventions company's 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 and/or repetitive tasks on human behalf. Robotics Inventions is a Research & Development company specializing in autonomous robotics and vision and sensor systems, offering consulting and subcontracting of the design and development phases of the projects; developing prototypes; creating short product series; full product design and offering products as OEMs

Robotics Inventions is going to present its corner-stone terrestrial product for Industrial, Prevention and Public sectors: A-BOT robot. The A-BOT robot is designed to be a powerful semiautonomous scouting capillary propelled mobile vehicle extensible with an additional 30kg payload suitable for urban and off-road applications, generally divided into the following types of scenarios: Scouting scenario, patrol scenario, field support scenario, intervention scenario and mixed scenario.

The Robotics Inventions A-BOT robot allows for flexible configuration of modules enabling perfect matching with requirements. The A-BOT robot platform can be configured from the following typical components: Ultrasonic sensors, infrared sensors, vision autonomous sensors, GPS sensor, vision cameras, extension port, silent power source, extended power source, autonomous module, teleoperation module, mobile teleoperator suite, teleoperator station, cargo bay.

Name of vehicle

A-BOT

Basic data of vehicle

Height:	125 cm (including antennas) / 37 cm
Width:	51 cm
Length:	101 cm
Weight:	100 kg (including all accessories)
Ground clearance:	10 cm
Average noise level:	60 dB(A) (approx.)
Climbing performance:	35 degree
Wheel or track driven:	track
Propulsion:	batteries
Endurance:	2 h
Max. speed:	15 km/h
Payload:	30 kg

Communication equipment

Type:	WLAN 802.11b	Secondary Radio Module (video)
Frequency:	2400 MHz	433 MHz
Possible frequency range:	2400 – 2800 MHz	433 - 443MHz
Power:	10 mWatts (20dbm)	1 mW
Modulation:	-	FSK
Number of channels:	13	21

Sensor equipment

Vision:	2 x Logitec Internet Camera
GPS:	Altina
Ultrasonic sensors:	6 x Parallax

S.A.S.

Team name / Company:	S.A.S. – RACCAR / Gerhard Wendl - Special Advisory Service and SIM Security & Electronic System GmbH
Team leader:	Gerhard Wendl
Nationality:	Germany
System:	Lambda01
Scenarios:	1. Reconnaissance and surveillance 2. Camp Security
Contact:	Heubergstrasse 18 D-83026 Rosenheim Tel: ++49 8031 22 36 36-2 Mobil: ++49 175 202 6004 saswendl@vodafone.de

Team description

The team RACAR is the contribution of the companies Gerhard Wendl Special Advisory Service and SIM Security & Electronic System GmbH to the ELROB 2008 and consists of members of the companies involved in the project development.

The abbreviation RACAR, chosen as project name, indicates Reconnaissance and Combat Applications Robot and results from the tactical alignment of the vehicle for special military or police high risk missions. At the interpretation of the RACAR, model Lambda01, the following tactical aspects enjoyed preference: In-/outdoor capability, all-terrain performance, resistance against unauthorized manipulation, ballistic protection, range or mission duration, one man handling, reconnaissance potential and suitability as a weapon platform.

Lambda01 is based on a track drive steel chassis with suspension and is operable in-/out-door by means of a hand-held remote and video control device up to approx. 150/1000 m. The operation duration by permanent driving and reconnaissance activity is 6 hours at least. The speed capability with the standard gear ratio is up to 10 km/hour. The climb ability of Lambda01 implies driving on typical staircases as well. 02/2007 became RACAR's development started with the construction of a prototype.

Siralab Robotics S.r.l.

Team name / Company:	Siralab / Siralab Robotics S.r.l.
Team leader:	Giorgio Belloni
Nationality:	Italy
System:	SR-H3
Scenario:	Camp security
Contact:	Via Pentima Bassa 21, 05100 TERNI (ITALY) Tel: ++39-(0)744 1926010 Fax: ++39-(0)75-585 3654 www.siralab.com giorgio.belloni@siralab.com

Team description

The Siralab Team is a Siralab Robotics S.r.l. entry into the ELROB2008. The Team is composed of roboticians (university researchers), electronic engineers and technicians. Siralab Robotics S.r.l. is a SpinOff company of the University of Perugia. Our vehicle is called "SR-H3" and is a mini UAV (Unmanned Aerial Vehicle). It is an electrically powered, fixed wing tail-less aircraft with 1kg payload capacity. Payload can be: a photocamera or a gimbal stabilized videocamera or a thermocamera. The vehicle is controlled by our Autopilot SR-H3000. The vehicle incorporates measurements from GPS, IMU, Pitot probe, Altimeter and others. The aircraft is continuously monitored and controlled by Ground Control Station wich can send to him waypoints, path, and others commands. The operator also can directly controll the installed payload. UAV Range is about 15 km and autonomy is 1 h. Vehicle applications are: rapid reconnaissance, automatic patrolling, aerial photography and video, aerial termography, national security, dangerous areas reconnaissance (radiation risk, toxic gas, explosions or contagions), atmospheric and ambiental parameter monitoring, military tactical missions, lost research and many others.

Smith Engineering GB Ltd

Team name / Company:	Moonbuggy / Smith Engineering GB Ltd
Team leader:	Rodney Smith
Nationality:	UK
Systems:	Moonbuggy
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport 4. Mule 5. EOD
Contact:	Solway Industrial Estate Maryport, Cumbria, CA15 8NF Tel: ++44 1900 815831 Fax: ++44 1900 815553 r.smith@moonbuggy.com www.moonbuggy.com

Team description

Smith Engineering is a family run business of 29 years. MoonBuggy started development as a robotic platform 5 years ago and is the UK's only privately funded large diesel UGV in commercial production. Our longest serving platform is currently deployed at a UK Nuclear site as part of its first response emergency team. A 415 volt tethered decommissioning robot has just been completed for the UK Atomic Energy Authority.

Name of vehicle

Moonbuggy

Basic data of vehicle

Height:	140 cm (including antennas) / 103 cm
Width:	126 cm
Length:	180 cm
Weight:	750 kg (including all accessories)
Ground clearance:	18 cm
Average noise level:	70 dB(A) (approx.)
Climbing performance:	45 degree
Wheel or track driven:	Wheel
Propulsion:	Diesel
Endurance:	4 hrs
Max. speed:	25 km/h
Payload:	250 kg

Communication equipment

Type:	Command / Video
Frequency:	434 MHz / 1.3 GHz
Possible frequency range:	Fixed
Power:	10 mWatts / 2000 mWatts
Modulation:	FSK / FM
Number of channels:	16

Sensor equipment

GPS:	Garmin
Vision:	3 x navigation 120 deg view cameras 1 x Forward Vision MIC-300 Pan/Tilt/Zoom (optional Thermal imager)
Radiation:	RDS 200 Geiger counter

Internal Engine management and feedback

telerob

Team name / Company:	telerob / telerob Gesellschaft für Fernhantierungstechnik mbH
Team leader:	Dr. Andreas Ciossek
Nationality:	Germany
Systems:	teleMAX
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. EOD
Contact:	Vogelsangstrasse 8 73760 Ostfildern Tel: ++49-0711-34102-115 Fax: ++49-0711-34102-555 ciossek@telerob.de www.telerob.de

Team description

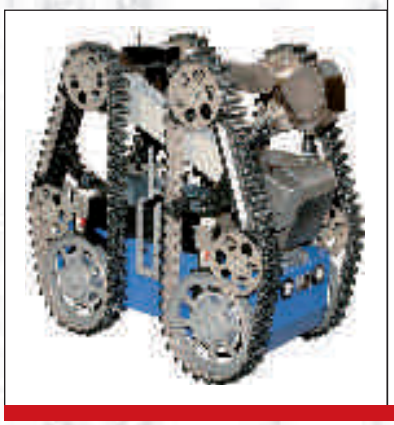
"To develop machines, equipment and systems that protect or replace human beings in situations where their presence would be either impossible or place them at great risk". This is the motto, motivation and mission of telerob Gesellschaft für Fernhantierungstechnik mbH. Whether it's one of our Master- 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.

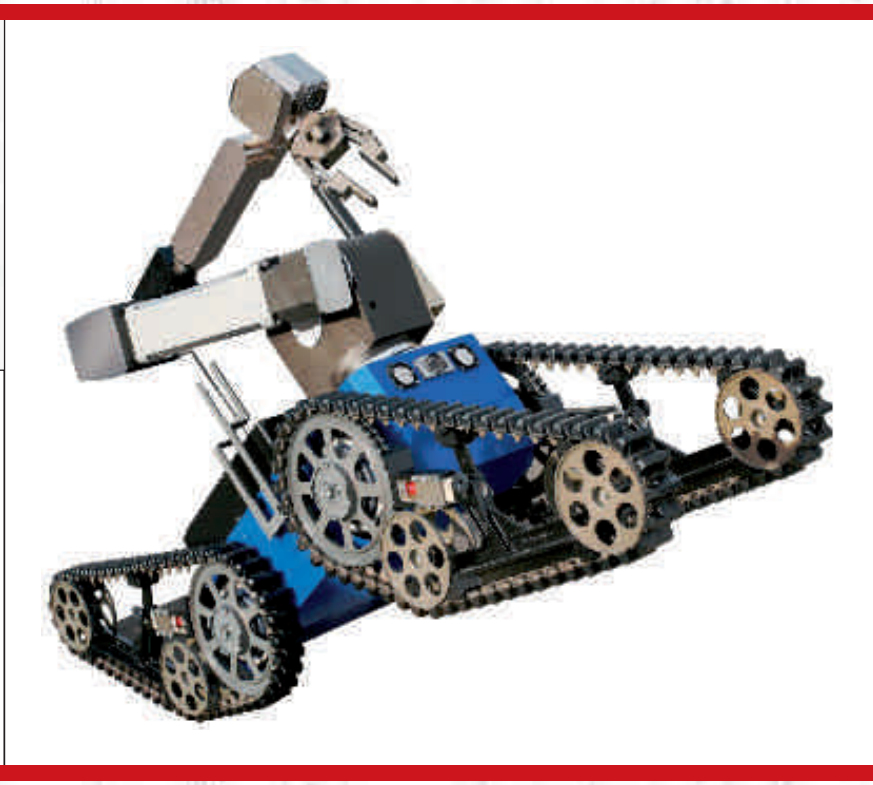
The telerob range of products encompasses EOD robots (tEODor and teleMAX), completely equipped bomb disposal vehicles (TEL600), bomb disposal equipment, non-magnetic special tools (NOMATOOLS), as well as manipulators for servicing, maintaining and dismantling nuclear facilities (EMSM).

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.

Name of vehicle

teleMAX





Basic data of vehicle

Dimensions if the vehicle is in stowing position:

Height:	75 cm
Width:	40 cm
Length:	80 cm

Maximum dimensions of the vehicle:

Height:	2600 cm maximum vertical reach position
Length:	160 cm flipper horizontally extended
Weight:	79,4 kg base system
Ground clearance:	depends on configuration
Climbing performance:	45 degree
Wheel or track driven:	4 tracks
Propulsion:	battery
Endurance:	up to 4 hrs
Max. speed:	up to 5 km/h
Payload:	10 kg

Communication equipment

Data communication link 1:

Type:	Radio
Frequency:	434 MHz
Possible frequency range:	433 - 435 MHz
Power:	up to 1000 mWatts
Number of channels:	80

Data communication link 2 (optional):

Type:	Fibre optical

Video feedback:

Type:	Radio
Frequency:	2353 MHz
Possible frequency range:	2353 - 2381 MHz
Power:	5000 mWatts
Number of channels:	5

Sensor 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 Further optional cameras
GPS:	Garmin 16-HVS. Average accuracy 15m.
Radiation:	Thermo Electron RadEye-PRD or other.
Gas:	Dräger Xam7000 or other.

TNO

Team name / Company:	EyeRobot / TNO Defence, Security, and Safety
Team leader:	J.C. van den Heuvel
Nationality:	Netherlands
System:	EyeRobot
Scenarios:	1. Camp security 2. Reconnaissance
Contact:	Oude Waalsdorperweg 63 2597 AK The Hague Tel: ++31 70 374 0453 Fax: ++31 70 374 0654 johan.vandenheuvel@tno.nl www.tno.nl

Team description

The EyeRobot Team is TNO's entry into the ELROB2008. The team is largely composed of employees from TNO and the Royal Netherlands Army. The EyeRobot was developed by a consortium of companies in the Netherlands under the projectmanagement of TNO and supported by the Netherlands Ministry of Defence as a research project.

Our vehicle is called the "EyeRobot". It is a battery powered vehicle based on a platform from Robosoft, the RobuROC4. The four wheel platform is a skid steer robot. The two modes of operation and the payload are developed by the EyeRobot team. The EyeRobot can be operated by remote control, and in TelePresence mode.

The all electric vehicle has a Li-ion battery pack of Saft and brushless motors. The sensors are mounted on a Sagebrush model20 servo controlled Pan/tilt unit. The sensor suite consists of Stereo camera's, Tele zoom camera, Laser ranger finder, 3D audio and optional multi-spectral and Thermal infrared camera.

The platform is controlled from the navigation PC, and the payload from the Payload PC, the 3D audio has a separate computer. Together with the Robosoft platform PC the total number of PC's is four. For positioning the platform is equipped with wheel encoders, an Omnistar dGPS, and a Xsens IMU.

The EyeRobot system has two wireless links, a 5.4GHz Smartbridge COFDM link with high bandwidth for video and audio, and a Satel 400Mhz RS232 link with 10 km range capacity for control of the system.

The development of the EyeRobot system started 1st January 2004. The experience of the partners was based on the RoboJeep and the "Generaal" platforms and the Cateyes project. During the project the RobuROC4 platform was specified and the payload integrated on the platform. The Navigation PC controls the platform through TCP/IP connection.

Name of vehicle

EyeRobot

Basic data of vehicle

Height:	190 cm (including antennas) / 150 cm
Width:	81 cm
Length:	132 cm
Weight:	210 kg (including all accessories)
Ground clearance:	17 cm
Average noise level:	50 dB(A) (approx.)
Climbing performance:	25 degree
Wheel or track driven:	wheel
Propulsion:	Li-ion batteries
Endurance:	2500 Wh (about 5-6 hrs)
Max. speed:	10 km/h
Payload:	capacity 30 kg (current payload on top RobuROC4 is 70 kg)

Communication equipment

Type:	WLAN 802.11i
Frequency:	5400 MHz
Possible frequency range:	5400 - 5800
Power:	500 mWatts
Modulation:	COFDM
Number of channels:	16
Type:	Half duplex radio modem
Frequency:	400 MHz
Possible frequency range:	380 - 470 MHz
Power:	10.000 mWatts
Number of channels:	80

Sensors equipment

Laser:	LaserOptronix LDF600-rs232
Vision:	2 x JAI cvs 3200 NTSC camera's, Matrox Meteor II frame grabber 2 x JAI CV A11 camera's for DROID, Matrox frame grabber Duncantech 3CCD multi-spectral (Red, Green, Near-infrared) Radiance HS thermal infrared camera
Audio:	2 x 3D audio array, RME hammerfall
Video server:	Axis 241 video server
Pan/Tilt:	Sagebrush model 20 servo
GPS:	Omnistar 7114 LR12 DGPS with satellite correction signal
Inertial measurement unit:	Xsense MT9

University of Bremen

Team name / Company:	Jacobs Robot Team / Jacobs University Bremen
Team leader:	Andreas Birk
Nationality:	Germany
Systems:	Rugbot
Scenarios:	1. Reconnaissance and surveillance 2. EOD 3. Camp security
Contact:	Campus Ring 1 28759 Bremen Tel.: ++49-421-200 3113 Fax: ++49-421-200 3103 a.birk@iu-bremen.de www.robotics.iu-bremen.de

Team description

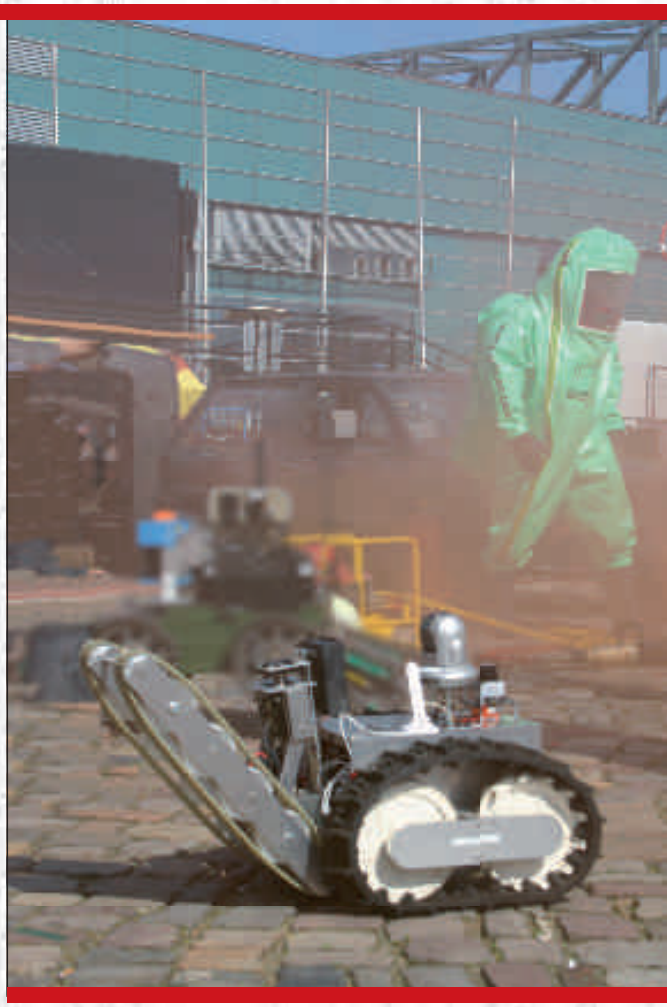
The Jacobs team consists of students and scientists from the robotics research group of Prof. Dr. Andreas Birk at the Jacobs University Bremen (Jacobs). The team is engaged since 2001 in the area of rescue robotics, where the challenges that are presented in the three different scenarios of ELROB are quite similar.

The main type of robots used by the group is the so-called "Rugbot" type of robot. The name Rugbot is derived from "rugged robot". The systems are complete in-house developments based on the so-called Cube-System, a collection of hardware and software components for fast robot prototyping that was developed over the last decade through several research projects under the guidance of Andreas Birk.

Rugbots are tracked vehicles that are light-weight (about 35 kg) and have a small footprint (approximately 50 cm x 50 cm). They are very agile and fast on open terrain. An active flipper mechanism allows Rugbots to negotiate stairs and rubble piles. Their small footprint is highly beneficial in indoor scenarios. They have significant on-board computation power and they can be equipped with a large variety of sensors. The standard payload includes a laser-scanner, ultrasound sensors, four cameras, one thermo camera, and rate gyros. The onboard software is capable of mapping, detection of humans and fully autonomous control. Teleoperation is in varying degrees is also supported. The on-board batteries allow for 2.5 hours of continuous operation. At the moment, six Rugbots are in operation at Jacobs.

Name of vehicle

EyeRobot



A Jacobs robot at the Rescue Robot Fieldtest 2006 in Bremen, Germany. The robot supports a firebrigade in the situation assessment in a hazmat rescue drill. The scenario consists of a traffic accident involving a truck transporting hazardous material and several passenger cars.

A Jacobs land robot cooperating with an Airrobot aerial robot at the European Land Robotics Trials (ELROB) 2007 in Monte Ceneri, Switzerland. In this technology evaluation event, the aerial robot has to search for hazard areas like seats of fire in a forest, which the land robot then has to reach.

Two Jacobs robots support first responders in the situation assessment after a simulated terrorist attack with NBC substances at a large public event. The two robots are supervised by only a single operator. The robots can operate fully autonomously and they coordinate their joined exploration of the area.

An intelligent mobile robot developed by the Jacobs Robotics Group. The system is designed for Safety, Security, and Rescue Robotics (SSRR) and it is capable of assisting a human operator in tele-operation as well as of working in fully autonomous mode e.g., to cooperate with several systems in a joint mission without permanent human supervision. The picture shows the robot in the Jacobs Test Arena, a special evaluation and training facility developed and operated in coorperation with the US National Institute of Standards an Technology (NIST).

Communication equipment

Type:	WLAN 802.11g (Lancom Airlancer)
Frequency:	2400 MHz
Possible frequency range:	2400 MHz
Power:	100 mW
Modulation:	OFDM
Number of channels:	11

Sensor equipment

Laser:	LMS 200 (1 robot), URG-04LX (4 robots)
Vision:	1x Panasonic KX-HCM280 PanTiltZoom camera 4 x NxUltra, 1x Flir A10
GPS:	Trimble Lassen IQ

University of Hannover

Team name / Company:	RTS / Leibniz Universität Hannover
Team leader:	Prof. Dr.-Ing. Bernardo Wagner
Nationality:	Germany
System:	RTS-HANNA
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport and mule
Contact:	Appelstraße 9a 30167 Hannover Tel: ++49-511-762-5515 Fax: ++49-511-762-4012 wagner@rts.uni-hannover.de www.rts.uni-hannover.de

Team Description

The Institute for Systems Engineering (ISE) deals with the modelling, simulation, analysis and realisation of hardware and software architectures of complex and technical systems. The Real Time Systems Group (RTS) is part of the Institute for Systems Engineering. Head of the RTS is Prof. Dr.-Ing. Bernardo Wagner. The RTS focuses its work on the fields of distributed automation systems and mobile service robots. Such systems have to interact with real surroundings in a correct, reliable and secure way and furthermore with deterministic time response, that is in real time.

For M-ELROB 2008 the RTS is using is new outdoor platform RTS-HANNA. The robot is based on a Kawasaki Mule 3010 side-by-side vehicle. Equipped with a drive-by-wire retrofit kit from PARAVAN GmbH, this vehicle is fully controllable via computer. The four-wheel drive with differential-lock allows operation in urban as well as in heavy non-urban terrain. The maximum speed of the vehicle is 40Km/h and the payload 600Kg. RTS-HANNA is equipped with various sensors for teleoperation, semi-autonomous operation and fully autonomous operation. Main sensor is a pair of 3D laser range scanner used for environmental perception. In addition, multiple cameras, including an infrared camera, Differential-GPS and inertial sensor are used for vehicle control. The navigation algorithms used on our robot are based on sensor data fusion of laser, inertial and DGPS data. Our focus lies on the incorporation of 3D sensor data

into robot tasks like autonomous obstacle avoidance, autonomous object recognition and localization.
Based on the sensor- and navigation-system the RTS is going to present new concepts for fully autonomous operation and semi-autonomous operation at long distances via a communication channel of limited bandwidth. In this context RTS-HANNA is utilized as a demonstrator for robotic technology that can be adopted to any steer-by-wire platform.

Name of vehicle

RTS-HANNA

Basic data of vehicle

Height:	300 cm (including antennas) / 245 cm
Width:	144 cm
Length:	285 cm
Weight:	800 kg (including all accessories)
Ground clearance:	17 cm
Average noise level:	70 dB(A) (approx.)
Climbing performance:	45 degree
Wheel or track driven:	4-wheel, all-wheel drive
Propulsion:	Diesel engine
Endurance:	>8 hrs
Max. speed:	40 km/h
Payload:	600 kg

Communication equipment

Type:	WLAN 802.11a
Frequency:	5000 MHz
Power:	100 mWatts
Number of channels:	5
Type:	Radio Modem
Frequency:	434 MHz
Power:	10 Watt
Number of channels:	80

Sensor equipment

3D Laser:	2 x RTS ScanDriveDuo
Vision:	1x XenICs Xport-395 IR camera
	1 x Axis 213PTZ
GPS:	Trimble AgGPS 114
Inertial measurement unit:	Perform Tech GU 3023

University of Heidelberg

Team name / Company: HeidelCar / Heidelberg University of Applied Sciences
Team leader: Prof. Dr. Achim Gottscheber
Nationality: Germany
System: HeidelCar
Scenario: Mule

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achim.gottscheber@fh-heidelberg.de
www.elrob.fh-heidelberg.de

Team description

The HeidelCar Team is taking part in the Event ELROB. The team is composed of members of the SRH Hochschule Heidelberg, especially of the following departments: Electrical Engineering, Mechanical Engineering, Computer Sciences and Industrial Engineering. Our vehicle is called HeidelCar and is a commercial car that was modified primarily with existing commercial technology for navigation and operation. All processing takes place in modules of industrial embedded computers. The vehicle incorporates measurements units such as GPS, ultrasonic sensors, acceleration sensors, laser sensors, and cameras for navigation. All sensors acquire environment data at rates between 10 Hz and 1 MHz. The development of our HeidelCar started in October 2005.

Name of vehicle

HeidelCar

HeidelCar during ELROB 2006

Basic data of vehicle

Height:	2000 cm (including antennas) / 1931 cm
Width:	2007 cm
Length:	4212 cm
Weight:	2850 kg (including all accessories)
Ground clearance:	20,5 cm
Average noise level:	100 dB(A) (approx.)
Climbing performance:	100%
Wheel or track driven:	wheel
Propulsion:	fuel
Endurance:	24 hrs
Max. speed:	180 Km/h
Payload:	585 kg

Communication equipment

Type:	WLAN 802.11g
Frequency:	2400 MHz
Possible frequency range:	2400 - 2800
Power:	1.000 mWatts
Modulation:	Zorg
Number of channels:	16

Sensor equipment

Laser:	distance sensor, IR-Laser 905 nm
Vision:	Webcam
GPS:	DGPS. Average accuracy 4 cm.
Ultra sonic:	ultra sonic sensor
Acceleration:	3-axis accelerometer

University of Kaiserslautern

Team name / Company:	RAVON / University of Kaiserslautern
Team leader:	Prof. Dr. Karsten Berns
Nationality:	Germany
Systems:	RAVON (Robust Autonomous Vehicle for Off-road Navigation)
Course:	1. Reconnaissance and surveillance 2. Mule
Contact:	Gottlieb-Daimler-Straße, Building 48 D-67663 Kaiserslautern Tel: +49 631 205 2579 Fax: +49 631 205 2640 elrob@informatik.uni-kl.de http://rrlab.informatik.uni-kl.de

Team Description

Team RAVON is part of the Robotics Research Lab (RRLab) at the University of Kaiserslautern. The work group was founded in April 2003. Today, 15 research assistants work under the leadership of Prof. Dr. Karsten Berns.

The off-road platform RAVON (Robust Autonomous Vehicle for Offroad Navigation – http://agrosy.informatik.uni-kl.de/en/robots/ravon/) developed in the RRLab weighs about 650kg and has the size of a city car. The robot features an all-wheel-drive with four independent motors each of which furnishes 3000 watts enabling the vehicle to climb slopes of up to 45 degrees (at 3m/s). The front and rear axis can be controlled separately via linear motors to allow for advanced manoeuvres like parallel steering or tight radii.

As main sensor systems for obstacle detection, three 2D Sick (http://www.sick.de/de/de.html) laser scanners and two custom-built stereo camera heads have been mounted. One of the laser scanners can be panned to gather 3D distance data.

For localisation purposes, an inertial measurement unit, a magnetic field sensor, and a GPS receiver have been integrated with the vehicle's odometry. Equipped with three industrial PCs, the robot is able to move fully autonomously.

The robot's behaviour-based control system is implemented based on the open source C++ control software framework MCA2-KL (Modular Controller Architecture 2 (Kaiserslautern Branch) – see http://rrlib.cs.uni-kl.de/) which is being developed in our working group.

The development of RAVON was started in the year 2004. Currently, the vehicle realises several behaviours guiding it through rough terrain on different test courses.

Name of vehicle

RAVON

Basic data of vehicle

Height:	180 cm (highest point: GPS antenna)
Width:	140 cm
Length:	240 cm
Weight:	650 kg (Including all accessories)
Ground clearance:	28 cm
Climbing performance:	100% (45°) at 7km/h
Wheel or track driven:	wheel driven
Propulsion:	Optima Spiral Cell Batteries
Endurance:	4 h
Max. speed:	10 km/h
Payload:	unknown (Carrying a payload of 30 kg for the mule scenario is possible.)

Communication equipment

Type:	WLAN 802.11g Cisco Aeronet 340
Frequency:	2400 MHz
Possible frequency range:	2400 - 2483.5 MHz
Power:	max. 500 mW
Modulation:	OFDM
Number of channels:	13

Communication equipment

Type:	emergency stop radio link SVS SHT-7
Frequency:	433 MHz
Power:	max. 10 mW
Number of channels:	3
Type:	IK Elektronik Freeconnect Mini + BDA25B Amplifier
Frequency:	2.4 GHz Data Transceiver
Possible frequency range:	2400 - 2483.5 MHz
Power:	max. 500 mW
Modulation:	FSK
Number of channels:	8
Type:	Remote Control Logitech Cordless Rumblepad 2
Frequency:	2400 MHz
Possible frequency range:	2400 - 2483.5 MHz
Power: max.	10 mW
Modulation:	Frequency Hopping Spread Spectrum
Number of channels:	1

Sensor equipment

Laser:	2x Sick LMS 291; 1x Sick S 300
Vision:	Stereo system using 2 PTGrey Dragonfly cameras connected via Firewire (IEEE1394); Stereo system using 2 PTGrey Scorpion high resolution colour cameras connected via Firewire
GPS:	NAVCOM (John Deere Company) Star Fire 2 DGPS with Green Star correction signal via L2 frequency
Inertial measurement unit:	custom-built
Magnetic field sensor:	custom-built
Encoders:	one per wheel and steering unit
Infrared sensors:	Sharp IR-sensors; used to measure position of bumpers (needed for tactile creep)

University of Linköping

Team name / Company:	preRunners / University of Linköping
Team leader:	Jonas Nygårds
Nationality:	Sweden
Systems:	MoDuLiTH / testCarrier
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport 4. Mule
Contact:	Division of Fluid and Mechanical Engineering Systems Department of Mechanical Engineering Linköping University SE-581 83 Linköping, Tel.: ++46 13 281789 Fax: ++46 13 130414 robotics@ikp.liu.se jonny@ikp.liu.se www.flumes.ikp.liu.se/research/auto_en.xf

Team description

The preRunners Team is composed around the larger research project preRunners supported by FMV (Swedish Defence Materiel Administration) & Vinnova (Swedish Governmental Agency for Innovation Systems) with additional team members from FOI (Swedish Defence Research Agency) and Lulea University of Technology, Mobile Robotics Sweden and Danaher Motion Särö AB. The project is based on experience in autonomous robots at both Lulå and Linköping university since the 1990:s. The history of the group can be sampled at the old webpages: http://www.sm.luth.se/csee/ra/, http://idefix.ikp.liu.se/rames/ (very old "web-timecapsule " from the late 1990`s) and the industry partners: http://www.mobile-robotics.com/.

The team is largely composed of faculty and students from Linköping University Department of Mechanical Engineering, under the leadership of Jonas Nygårds and Jan-Ove Palmberg (Professor and director of the Fluid and Mechanical Engineering Systems lab) with support from FOI, Luleå University and the industry partners.

Our vehicle is called MoDuLiTH/A. The MoDuLiTH was developed as a rapid product demonstrator in a student project spring 2007 it is a modular electric vehicle configurable in 2+1 1+2 or 2+2 wheel configurations (http://www.ikp.liu.se/machine/news/images/ModuLiTH.pdf). The design for making the MoDuLiTH autonomous (MoDuLiTH /A) was prepared in a student project fall 2007

and is currently implemented on the vehicle (however not visible on the pictures). The goal of this spring rapid product demonstrator project is to develop the control station, adapt MoDuLiTH/A to the rules of ELROB and perform extensive field-test of the system. Based on the success of several previous projects we are confident that the vehicle will be fieldable at the ELROB08 even though it is not finished at the moment. The sensor processing and control laws are developed in parallel in the ordinary preRunners project, on the development vehicle (testCarrier).The testCarrier has been operative since spring 2007 giving valuable experience with the control system. Based on the testCarrier results and our experience since the 1990:s at both Lulå and Linköping university, we predict the transfer process to the MoDuLiTH/A to be heavily taxing on the rapid product demonstrator student group but well within their reach. Examples of previous student projects for instance autonomous parking are presented at: http://www.ikp.liu.se/evolve/.

Name of vehicle

MoDuLiTH

Basic data of vehicle

Height:	350 cm (including antennas) / 110 cm
Width:	100 cm
Length:	240 cm
Weight:	350 kg (including all accessories)
Ground clearance:	20 cm
Average noise level:	70 dB(A) (approx.)
Climbing performance:	20 degree
Wheel or track driven:	wheel
Propulsion:	batteries
Endurance:	3 hrs
Max. speed:	50 km/h
Payload:	100 kg (200 kg possible)

Communication equipment

Type:	WLAN 802.11g
Frequency:	2400 MHz
Possible	frequency range: from 2400 to 2800
Power:	10.000 mWatts
Number of channels:	16
Type:	3G mobile

Sensor equipment

Laser:	5 x Sick Laser LMS 200
Vision:	TBD probably 1 pair firewire cameras
GPS:	Novatel Allstar & Superstar std DGPS accuracy
Inertial measurement unit:	Xsens Mti

University of the Bundeswehr Munich

Team name / Company:	UBM – MuCAR / University of the Bundeswehr Munich
Team leader:	Prof. Dr.-Ing. Hans-Joachim "Joe" Wünsche
Nationality:	Germany
System:	MuCAR-3
Scenarios:	1. Transport 2. Mule
Contact:	LRT 13 TAS 85577 Neubiberg Tel: ++49-(0)89 – 6004 – 3588 Fax: ++49-(0)89 – 6004 – 3074 joe.wuensche@unibw.de www.unibw.de/lrt13/tas

Team description

Team MuCAR develops and operates MuCAR-3, and is headed by Prof. Dr.-Ing. H.-J. Wuensche, professor for "Autonomous Systems Technology" and successor of Prof. Dr.-Ing. Ernst D. Dickmanns at the University of the Bundeswehr Munich (UBM). Our vehicle is named "MuCAR-3", as this is the third generation of our **M**unich **C**ognitive, **A**utonomous **R**obot Cars. The first generation vehicle was "VaMoRs", which demonstrated fully autonomous driving on a not yet opened German Autobahn at its maximum speed of 96 km/h 20 years ago in 1987, covering a distance of 20 km. The second generation vehicle "VaMP" established further records in 1995, when it drove from Munich to Denmark and back for a distance of almost 1800 km, of which about 1660 km were driven fully autonomous at speeds up 180 km/h. Both vehicles have retired to museums. The new vehicle was chosen to be a good vehicle both for participating in traffic on public roads as well as for off-road driving. MuCAR-3 is based on a stock VW Touareg with a V6 TDI engine, modified to allow computer control of steering, brake, throttle and automatic gearbox. Full body skid plates allow testing in rough terrain. Apart from inertial sensors we continue to focus on vision as a main sensor for perception, as this sensor provides most of the information humans need for driving. In addition we use a high definition 360 deg. Laser Scanner mounted on the roof of the vehicle. This sensor helps to cope with special applications such as off-road driving, until vision systems can fully cope with those scenarios as well.

The main vision sensors are 3 forward looking cameras placed on a two-axis platform inside the vehicle. The arrangement resembles the human vision system, with a tele-camera as "fovea" and 2 slightly outward pointed wide angle cameras for peripheral vision. All cameras are mounted on a yaw axis platform to allow for active control of the horizontal viewing direction, with the tele-camera mounted such, that its

narrow field of view of 4 deg is inertially stabilized by looking through a fast moving mirror counteracting disturbances coming from the road (much like we humans are able to focus and stabilize our attention even on rough roads), while it can also be directed towards special areas of interest.

Name of vehicle

MuCAR-3

Basic data of vehicle

Height:	240 cm (with Laserscanner on roof) / 205 cm
Width:	193 cm
Length:	480 cm
Weight:	2800 kg (including all accessories)
Ground clearance:	up to 30cm
Average noise level:	81 dB(A) (approx.)
Climbing performance:	45 degree
Wheel or track driven:	4 wheel drive
Propulsion:	fuel (diesel) (Volkswagen 3.0 ltr V6 TDI engine)
Endurance:	8 hrs
Max. speed:	205 km/h
Payload:	250 kg

Communication equipment

Wireless Radio Modem: optional, for use with a local D-GPS base station

Sensor equipment

Vision:	3 x CMOS cameras with wide-angle & tele-lens mounted on custom build 2 axis platform inside the vehicle
Lidar:	High definition 3D Lidar System mounted on vehicle roof
INS:	Full 6 DOF IMU system with integrated D-GPS System
MEMS Gyros:	1 for inertial camera pitch axis stabilisation

University of Oulu

Team name / Company:	University of Oulu
Team leader:	Juha Röning
Nationality:	Finland
System:	Mörri
Scenarios:	1. Reconnaissance and surveillance 2. Camp Security 3. Mule
Contact:	Intelligent Systems Group Department of Electrical and Information Engineering P.O.Box 4500 FIN-90014 University of Oulu Finland Tel: ++358-8-553 1011 Fax: ++358-8-553 2612 celrob@ee.oulu.fi www.ee.oulu.fi/research/isg/projects/CELROB

Team description

The Oulu Robotics Group Team (ORG) is Oulu University's entry into the ELROB2008. The team is composed of faculty and students from of Electrical and Information Engineering, under the leadership of Juha Röning (Professor) and Antti Tikanmäki (Researcher). Our vehicle is called the "Mörri". Mörri is a six wheel solid base robot with very strong motors. The robot has been designed in order to operate in extreme conditions and weathers and with heavy load to carry.

The vehicle is actuated via a robust wireless connection. The vehicle contains several sensors to measure movements and surrounding environment. This includes, laser scanner, two cameras, inclinometer and GPS. All sensors take a part on estimation of current state of the robot in the environment. Several autonomous features have been included on-board computer to ease the operation. This includes collision avoidance, route execution, and obstacle analysis and data fusion. Our vehicle is semi-autonomous and human operator's role is to give guidelines to vehicle as it travels on the environment.

Name of vehicle

Mörri

Basic data of vehicle

Height:	60 cm
Width:	50 cm
Length:	90 cm
Weight:	50 - 60 kg (including all accessories)
Ground clearance:	7 cm
Average noise level:	30 dB(A) (approx.)
Climbing performance:	60 degree
Wheel or track driven:	wheel
Propulsion:	batteries
Endurance:	~6 hrs max.
Speed:	40 km/h
Payload:	150 kg

Communication equipment 2.1 Video link

Type:	Analog video link
Frequency:	2380 MHz
Possible frequency range:	2370 - 2390 MHz
Power:	10 Watts
Modulation:	FM
Number of channels:	1

Communication Link

Type:	Radio Modem, Satelline 3ASd
Frequency:	869,4125 MHz
Possible frequency range:	2380 - MHz
Power:	0.5 Watts
Number of channels:	1

Backup Communication Link

Type:	WLAN 802.11g, (with router nodes)
Frequency:	2.4 GHz
Possible frequency range:	2380 - MHz
Power:	1 mWatts
OFDM Number of channels:	16

Backup Communication Link 2

Type:	HSDPA/UMTS /EDGE/GPRS modem
Number of channels:	2

Sensor equipment

Laser:	2 x Hokuyo URG-04LX laser scanner 1 x Noptel LCM2-30 laser range finder 1 x Sick LMS 291 laser scanner
Vision:	2 x Point Gray Flea2 FL2-08S2 cameras mounted on a PTU 1 x thermal imaging camera Flea
GPS:	GlobalSat BU-353 DGPS.
Inertial measurement unit:	XSens MTi

University of Siegen

Teamname / Company:	AMOR / University of Siegen
Team leader:	Prof. Dr. Klaus-Dieter Kuhnert
Nationality:	Germany
System:	AMOR
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport 4. Mule
Contact:	Hoelderlinstrasse 3 57076 Siegen Tel: ++49-271 740 3317 Fax: ++49-271 740 4421 kuhnert@fb12.uni-siegen.de

Team description

The team was founded to create a platform for research in autonomous driving in the outdoors. The aim is to build a robot, which is capable to drive through heavy terrain typical for the central European landscape. The main emphasis is put on the security and the expandability of the system to allow several groups of co-workers to work with the robot at the same time. The sensors of the robot are focused on inertia and laser line scanners in combination with other depth-image generating systems, like PMD cameras and stereo CCD cameras. The robot can be provided with a global map of his surroundings to find a optimal path to a coordinate, given in longitude and latitude.

Name of vehicle

AMOR

Basic data of vehicle

Height:	170 cm (including antennas) / 150 cm
Width:	110 cm
Length:	220 cm
Weight:	400 kg (including all accessories)
Ground clearance:	24,5 cm
Average noise level:	77,2 dB(A) (Vehicle specs.)
Climbing performance:	45 degree
Wheel or track driven:	wheel 4x4
Propulsion:	fuel
Endurance:	~6 hrs
Max. speed:	90 km/h
Payload:	60 kg

Communication equipment

Type:	WLAN 802.11 Pre-N
Frequency:	2400 MHz
Number of channels:	11

Sensor equipment

Laser:	3 x Sick Laser LMS 221
Vision:	2 x CCD camera, intelligent camera
GPS:	SIRFIII GPS mouse, DGPS
Radar:	small power Doppler radar Siemens KMY-24
Inertial measurement unit:	custom inertia senor array
Ultrasonic:	5 x Polaroid ultrasonic sensors
Movement:	2 x fast speed CMOS cameras, Tachogenerator
Orientation:	2 x electronic compass

University of Würzburg

Team name / Company: Universität Würzburg,
Steinbeis Transferzentrum ARS,
Zentrum für Telematik

Team leader: Prof. Dr. Schilling

Nationality: Germany

Contact: Steinbeis Transferzentrum ARS
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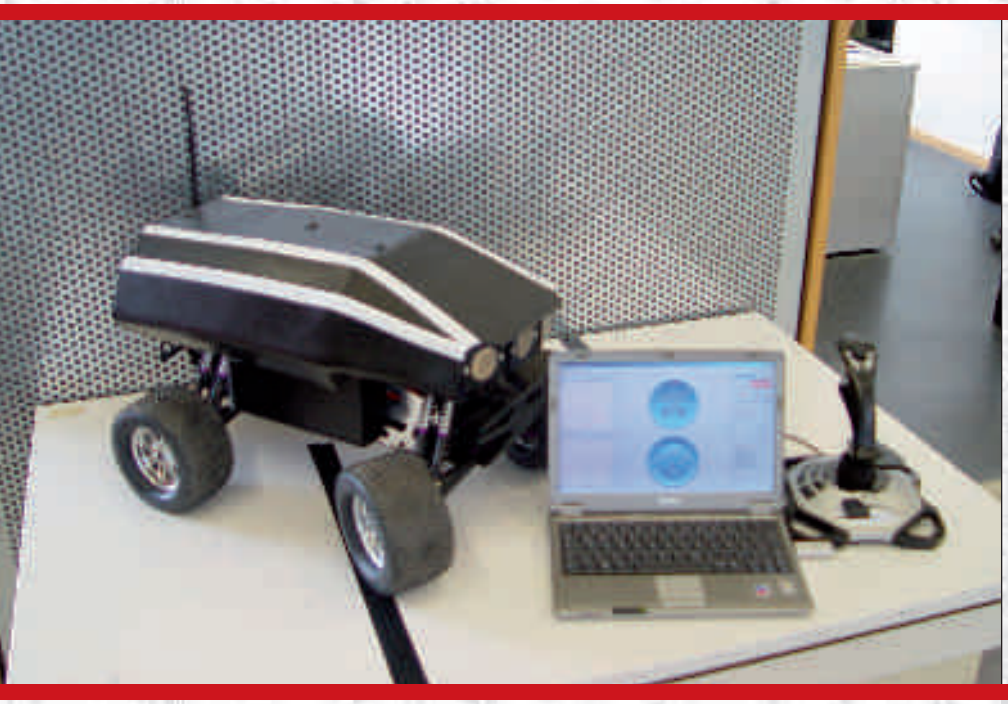
Team description

The Julius-Maximilians University Würzburg was first founded in 1402. It enrolls today more than 20000 students in 10 faculties and hosts well known research institutions. Thirteen Nobel Prize winners worked there, among them Wilhelm Roentgen, who discovered the X-rays in Würzburg.

The Steinbeis Center for Applied Robotics and Software Technologies (ARS) addresses since 1992 advanced robotics, sensorics and control solutions in industrial applications. The MERLIN vehicles have been developed as a product since 1992 and are offered in various tracked and wheeled versions appropriate for harsh working environments on the market.

The Center for Telematics is an independent research institute with focus on telerobotic aspects. It supplies advanced solutions for remote control, drive assistance systems and user interfaces.

Name of vehicle



Outdoor MERLIN™

(**M**obile **E**xperimental **R**obots for **L**ocomotion and **I**ntelligent **N**avigation) in tracked and wheeled versions

The Outdoor MERLIN rover and the control station

Basic data of vehicle

Height:	45 cm
Width:	50 cm
Length:	60 cm
Weight:	15 kg
Ground clearance:	10 cm
Average noise level:	low
Climbing performance:	35°
Wheel or track driven:	wheel
Propulsion:	electric motor
Endurance:	3 h
Max. speed:	50 km/h
Payload:	5 kg

Communication equipment

Type:	WLAN 802.11b
Frequency:	2400 MHz
Possible frequency range:	
Power:	100 mW
Number of channels:	13

Sensor equipment

GPS:	Haicom
Ultrasonic:	4 US-Sensors
Infrared:	2 IR-Sensors
Gyroscope:	1 solid state gyro
Vision:	1 Network Camera

The operation of the MERLIN system is supported by autonomous functions (including obstacle detection and avoidance, autonomous return to base if the radio link is lost) and an advanced driver support system, providing advice to the operator in handling complex situations.

The Outdoor MERLIN and the team from Würzburg were the winners of the "urban scenario" competition at C-ELROB 2007

Exhibitions

at

M-ELROB 2008

AIM INFRAROT-MODULE GmbH

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Booth No.:	5

Team description

AIM is manufacturer of high performance modules for modern infrared systems and world-wide market leader of high performance infrared technology. AIM develops and manufactures infrared detectors and modules for thermal imaging and guidance systems. With appr. 330 employees the company is situated in Heilbronn with many years of experience also in international programmes.

Areas of interest

Thermal imaging modules and cameras based on 2nd and 3rd generation detectors, Read-out of integrated circuits for visible and infrared arrays, coolers with integrated electronics and video processing with automatic image correction algorithms. By combining all required core capabilities under one roof, AIM is a merchant supplier for standard and customer-specific infrared modules and cameras for e.g. observation platforms.

AIRBORNE INDUSTRIES

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Nationality:	Germany
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Booth No:	19

Team description

Airborne Industries is specialized in development and production of tethered-unmanned airborne vehicles. The Airborne Industries Team has over three decades experience in the design of aerostats of all sizes in a variety of profiles and designs. Extended loitering times and very low cost make T-UAV deployment a fast and effective solution for border control communications relay and perimeter security in a wide variety of situations. Larger aerostats have been used for parachutist training for many years and continue to be used by special forces around the world in a range of roles.

Areas of interest

- T-UAV Systems
- UAV Systems
- Audio & Video transmission, relay, broadcast and presentation
- Radar Systems
- Ground Handling Systems & Control Systems for UAVs
- Border protection, camp security, mass event surveillance

Autoflug GmbH

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Booth No:	5

Team description

Autoflug Steuerungs- und SensorTechnik GmbH is located close to Stuttgart and is a 100% subsidiary of the Autoflug group in Hamburg. Apart of gyro systems and harnesses AST designs and develops optical fibre data transmission systems. Applications are missiles, UAVs and AUVs and UGVs. The optical fibre link allows to transmit a higher data rate than a radio link, is not jam able and works also at sites were a radio link would not work (e.g. inside buildings, caves). Several kilometres of distance can be realised via a pay-out dispenser system which has been proved in AUVs and UAVs applications. Additional reinforcement of the optical fibre provides an up to 10 times higher break force which is useful in harsh environmental conditions. Autoflug fibre optic pay-out systems are operated in missiles, AUVs for mine detection and Micro UAVs currently. For more information please contact: V.Schulze@autoflug.de

Areas of interest

High bandwidth data communication link with a fibre optical pay-out system developed for missiles, AUVs and UAVs could be also applicable for GUVs.

BFI Optilas GmbH

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Nationality:	Germany
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Booth No:	3

Team description

BFi OPTiLAS provides a selection of advanced imaging solution for security & surveillance, military, industrial, machine vision, metrology, maintenance, scientific and life science applications.



The product portfolio includes:
Full range of infrared thermal imagers and OEM components for UAV and UGS security and industrial night-vision and thermo-vision systems, high-speed video, progressive scan cameras, cooled digital CCD camera, image processing software, lenses, and lighting.

The product portfolio covers a variety of applications such as:
Machine vision, Process control, UAV and UGS, Infantryman of the future, Medical Imaging, Search & Rescue, Marine protection, Fire fighting -Security surveillance, Long range surveillance, Night vision, Thermography analysis, Border control, Preventive maintenance, Law enforcement and Electrical inspection.

CT-Video GmbH

Company:	CT-Video GmbH
Nationality:	Germany
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Booth No:	7

Team description

CT-Video GmbH was founded 1999 in Lutherstadt Eisleben, Germany and develops, produces and distributes analog and digital special solutions for wireless video audio and data communication.
The main field of activity are mobile, digital COFDM solutions, which are adapted to the special customer requirements; but also standard solutions are part of the diversified CT-Video product range. The systems are developed in-house and in close cooperation with the user.
CT-Video has not only a wide experience of engineering, but also a broad know how of the differing areas of application in the sectors authorities, automotive industry, fire departments, nuclear technology, etc. This guarantees the development of perfect functioning systems – also in very sensitive and security-relevant areas and difficult usage conditions.

Areas of Interest

- Mobile radio solutions for the analog and digital transmission of video and audio data (including COFDM modulation)
- Camera technology including wireless and wired control
- Recording technology for video, audio and data signals
- Electric power supply components for a mobile use

ECA

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Booth No:	15

For more information see page 33-36 (THE French Team)

Team description

ECA is the worldwide leader for its mine warfare systems and equipment.
The company offers today automated systems for harsh environments as:

- Sub sea Mine Warfare
- Systems & Equipment for Naval Forces
- Robotics systems and equipment for Land Forces
- Simulation & Training

EMT

Company:	EMT Ingenieurgesellschaft Dipl.-Ing. Hartmut Euer mbH
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Booth No:	8

Team description

EMT currently works on four different places with 150 staff members in the field of UAV. EMT products are the UAV's LUNA, ALADIN and Fancopter.

Areas of interest

Development of future UAV'S.

Name of system

Fancopter

Basic data of system

Height:	44 cm
Width:	max. 73 cm radius
Weight:	1.5 kg (including payload)
Propulsion:	electric motor
Endurance:	max. 25 minutes in flight max. 2.7 h when perching
Max. speed:	40 km/h
Payload:	max. 300 g

Communication equipment

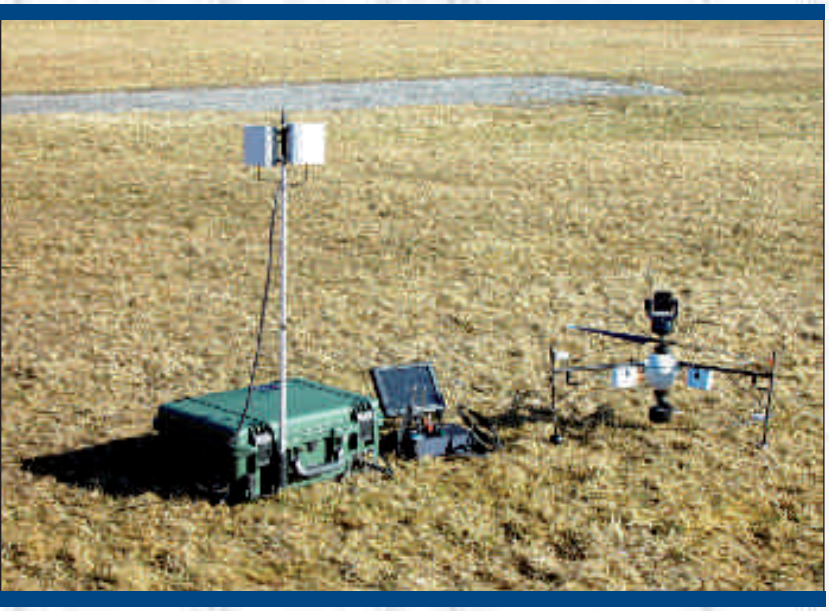
Type:
1. Video down – link transmitter:
Possible frequency range: 16 frequencies in the range 2.310 – 2.480 GHz
Power: 400 mw
2. Telemetry up – link receiver:
Number of channels: 2 in the range 300 – 420 MHz

Sensor equipment

Easy changeable sensors with payload bus system
with selection via software on a stabilised platform for

- daylight
- twilight,
- night/IR,
- digital photo,
- US – sensor for terrain following,
- in preparation microphone and gas sensors.

GPS accuracy plus/minus 2.5 – 20 m only outside buildings.
Video analysis (Optical Flow) accuracy few cm also inside of buildings, high computing power necessary.
Number of micro controllers: 7



FES GmbH

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Nationality: Germany

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Booth No: 16

Team description

The technicians, mechanics and engineers of FES GmbH are experts in the fields of chassis and body design, prototyping, road trials, technical documentation and interior equipment. Our engineering services in the field of simultaneous engineering include the complete chain from predevelopment through to start of production of new products.

FGAN - FKIE

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Web: www.fgan.de

Booth No : 35

Team description

The FGAN employs currently 600 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).

There is a broad spectrum of single research topics. We deal among others with the development of modern target tracking procedures in a network of different sensors, with the selection and design of communication systems, with problems of information dissemination in radio networks – also over long distances - with the reconnaissance of location and property of transmission devices, with the condensed processing (fusion) and consistent distribution of data in complex Communication and Information Systems (CIS) up to the design and implementation of intelligent user interfaces.

Premises and challenge of our work is the fast progress of information technology which offers a huge potential to improve systems.

Single steps of our approach are to identify those potentials, to develop methods and procedures to transfer this into applications, and to conduct feasibility studies and cost estimates based on experimental work.

The robotics group within the FGAN has more than twenty years of experience in research and technology of unmanned mobile systems. Our key competence is in the development and evaluation of complex human-robot systems. One particular application area we are working at is the improvement of RSTA missions carried out using heterogeneous multi-robot systems consisting of UGVs and UAVs.

The interaction with such multi-robot systems is a highly complex task for the operator, because already a single system has several different sensors and actuators available, which have to be controlled.

Our approach to deal with these intricacies is to develop intelligent assistance functions on all level of functionality, from low level navigation of single robots to higher levels like multi-robot planning. We do this on the one hand to increase the level of autonomy of the systems, and on the other hand to highly improve the situational awareness of the operators. Examples for such assistance functions are autonomous navigation algorithms like collision avoidance techniques for dynamic environments and methods for providing condensed and optimised information to the operator.

Our aim is to develop innovative tools for human robot interaction and co-operation. Therefore, we continuously transfer newly developed results into experimental systems and system demonstrators in collaboration with the Combat Development Branches of the Bundeswehr service schools.

Areas of interest

A special high potential activity which we present at this exhibition is the iterative evolutionary design of a modular unmanned CBRNE (Chemical Biological Radiological Nuclear Explosive) reconnaissance system. The detection of CBRN(E) hazards within the scope of NBC reconnaissance is an important function to ensure the NBC defence capability in the armed forces throughout the entire mission spectrum.
Within the professional qualification for NBC reconnaissance, operational NBC reconnaissance in an area of operations has the following tasks on the spot:

- detection and preliminary identification of CBRN(E) hazards,
- detection and monitoring of contamination,
- sample taking.

The protection of own forces is of special importance during missions and routine duty. Survivability and protection for the purpose of successful prevention of hazards for the life and health of Bundeswehr members is an indispensable basic requirement for mission accomplishment, and at the same time expression of the overall care responsibility of the employer for the members of the Bundeswehr.
Personnel for NBC reconnaissance and sample taking are exposed to a permanent contamination hazard. The equipment of the NBC Defence Corps of the Army for mobile NBC reconnaissance does not meet the requirements, which are associated with

- operations in urban terrain,
- mobility of the units to be supported, and
- feasible protection of employed personnel.

In order to minimize the employment of personnel „on the spot“ in particular during NBC reconnaissance and to reduce the risks to personnel, a high level of automation and robotisation is the main focus for the further development of NBC defence capabilities.
The primary objective of this activity therefore rests on the rapid realization of a robust, reliable, and flexible mobile system. For this purpose, during the first phase recourse is taken to already existing and fielded state-of-the art components, both for the platform and the sensor system. For the mobile platform, a vehicle which is already gas and water-tight will be procured and advanced. To increase its mobility, depending on the terrain it can be either tracked or wheeled. In addition, this platform can be used with a diesel-electric drive so that long operating time and operating range can be realized. The system will include numerous assistant functions, up to partial autonomy. For the sensor system, the focus will first be on radiological and chemical sensors. In a second phase, the system will be complemented by an additional vehicle with manipulator and an unmanned aerial system. During this step, the sensor system will be expanded by the E-sensor.
In addition to the aspect of networking and cooperation of this mobile multi-ro-

bot system there are numerous questions regarding the command and control of such highly complex man-machine systems.
Within the scope of this activity, the two R & D topics of „robotics and unmanned systems“ and „NBC protection and defence “ are thus merged synergetically.

As a result, with this experimental system the only mobile unmanned CRNE reconnaissance system, which has been systematically developed with the German military, will be available to the user. The system will be presented on the M-ELROB 2008 in a first configuration level.

Name of system

Bw CNRE-Experimentalsystem

Communication equipment

Type:	Data Modem / SATEL
Frequency:	444,55MHz
Power:	5W
Modulation:	FSK
Number of channels:	1
Type:	COFDM for Video and Data / VTQ ORCA
Frequency:	375MHz (Funk oder LWL)
Possible frequency range:	200-390MHz
Power:	10W
Modulation:	QPSK

Basic data of system

Height:	150cm
Width:	120cm
Length:	180cm
Weight:	320kg
Ground clearance:	30cm
Average noise level:	electric propulsion is almost noiseless
Climbing performance:	40deg
Wheel or track driven:	6x6 wheel or tracks
Propulsion:	electric/diesel hybrid
Endurance:	several hours
Max. speed:	20km/h
Payload:	150kg

Sensor equipment

Vision:	Panasonic WV-CS850 dome-camera (day/night vision)
GPS:	TopCon Legacy E+ (DGPS/Glonass/Galileo receiver)
Sensors:	MDS-l+ (ThermoFischer – RN sensor)
	identiFINDER (ICX – RN sensor)
	MultiRAEPlus (RAE Systems – C sensor)
	LCD 3.3 (Smith Detection – C sensor)

IABG mbH

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Booth No :	11

Team description

IABG is a leading services and consultancy company active across Europe. We focus mainly on technology-intensive sectors. We plan, implement and operate. We offer our customers solutions in these business areas

- Defence& Security
- Information & Communication
- Transport & Environment
- Aeronautics
- Space

Areas of interest

In our main business area "Defence & Security" modelling and simulation (M&S) becomes a more and more important method and tool. Complex new processes and systems can no longer be represented without simulation. Conducting experiments, refining solutions to problems, configuring components or prototype tests no longer are conceivable without M&S.

IABG-Lichtenau applies M&S to the field of Robotics. By order of BWB U34.1 a simulation model of the real Tactical Robotics system demonstrator TROBOT realized by RLS is developed and presented at ELROB in a basic version. One main feature of this simulation is its interface to distributed simulation in operational scenarios.

i-sft GmbH

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Booth No: 20

Team description

i-sft GmbH with their headquarters in Gundersheim, Germany, develop and manufacture TFT-displays for industrial applications. i-sft is widely known today as the leading European manufacturer of innovative TFT-displays for non-consumer applications.

The initial idea of i-sft (industrial solutions flatpanel technology) originates from a project group under the guidance of the Siemens AG, whose task it was to develop an innovative display for operation in the new ICE 3 high-speed trains. The result was a TFT-display module with an exceptional brightness, good resistance against shock and vibration and a significantly enhanced temperature range. This innovative technology raised the life-time expectancy to new and unknown values.

During the course of the spin-off in early 2004 another dynamic development followed: Now completely independent, i-sft strategically embedded itself into a flexible global network of small and middle-sized partner companies, best suited to support the individual wishes of an international clientele. The success of some 350 display specialists inside the global network is based on the group´s strong competence strategy in light and display technology.

Due to their rapid expansion i-sft decided to give up the former premises and re-locate to a much larger facility in Gundersheim. The modern infrastructure of the new location offers best possible development and manufacturing opportunities including spacious clean-rooms (class 100) and the most modern test and measurement equipment.

The display modules produced in Gundersheim are destined for applications all over the world, especially in countries with extreme climates. Areas of operation become apparent when the environment is demanding and the system must remain highly reliable. The i-sft application portfolio ranges from outdoor ATMs to avio-

nic and military applications; from locomotive systems to mining machinery. In short, i-sft steps in when the application is too demanding for standard displays.

Now with a growing reputation in international markets along with the extension of the portfolio, i-sft is looking at further growth. Using a strong global partner network i-sft is able to handle even large projects which otherwise would be too much to accomplish alone. This way i-sft is increasingly establishing itself as the number one European manufacturer of displays for non-consumer applications.
Backbone of i-sft is without a doubt the comprehensive technology know-how that covers everything from raw materials to components right up to system knowledge. Together with partner companies i-sft persues an active development strategy that upholds the networks know-how advantage.

Due to the innovative approach used by i-sft, the products technically differentiate themselves from those of the competitors significantly. These attributes surface especially when the conditions become highly demanding. Outstanding features of i-sft displays are:
High brightness linked with a wide dimming range
Extended temperature range
Resistance to shock and vibration
Long-life expectancy and excellent reliability
High efficiency resulting in low power input and minimal heat expansion
Another earmark of the i-sft display modules is their availability extending over a ten year period. The customer driven developments result in Best-of-Bench solutions ensuring every project is individually optimized based on the best Total Cost of Ownership.

Areas of interest

Robotics with focus on
man-machine interface,
Armoured vehicles,
Marine applications,
Avionics

Name of system

iRobot

iRobot and PackBot are registered trademarks of iRobot Corporation

Isomorph srl

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Nationality: Italy

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Web: www.isomorph.it

Booth No: 1

Team description

Isomorph has developed a new kind of information processing (linear computing). It allows to recognise also complex objects (like human beings) in a natural (complex) environment. The method results in a computer architecture, which seems to be similar to the human brain (as studied by Rizzolatti et al.). It results in a more unified view of the concept of "information" (for more details: http://www.isomorph.it/science/duino2007).
Recently IBM has developed a new kind of microprocessor (CELL), which is very well suited for our programs (since it has an almost linear architecture). Installed on the CELL, our programs can identify human beings in a natural environment within typically 0.2 seconds, reconstruct the position in space and describe some basic actions performed by the reconstructed person. Some examples can be found in www.isomorph.it/solutions/information-technology/pattern-recognition/watch-the-world-through-a-robotic-brain and www.isomorph.it/solutions/information-technology/pattern-recognition/weapons-alarm. A theoretical discussion can be found in www.letters.isomorph.it/available-articles

Areas of interest

First applications of our technique have been successfully implemented in industrial quality control. We next would like to develop an autonomous robotic system.

Name of sytem

robotic brain

A real person in real space is identified by the robotic brain.
An avatar is created at the corresponding position in virtual space.

At the time being the robotic brain obtains information about the position of the person in space in all three dimensions (the system is stereoscopic) and the relative position of the arms.

Note, that the person is not carrying any sensors or other equipment, all information is obtained from two simple video cameras.

MBDA / LFK

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Nationality: Germany

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Web: www.mbda.net

Booth No : 24

Team description

LFK GmbH and its associated subsidiaries are an integrated part of MBDA, with an annual turnover of 3bn Euros and 10.000 employees the largest manufacturer of Guided Missile Systems worldwide.

As the market leader in Germany, LFK and its subsidiaries build the forth column within MBDA, in addition to MBDA's French, British and Italian one.
Of MBDA's 10.000 employees, 1.250 are based in Germany at the Unterschleissheim (550), Schrobenhausen (450), Aschau (120) and Ulm plants (70). Together with joint-venture companies and subcontractors they design, develop and manufacture guided missile systems for aircraft armament (Taurus KEPD 350 for Tornado, Eurofighter Typhoon, Gripen and F18), air defence (Meads, Patriot, Stinger,
LFK NG), helicopter armament (PARS 3 LR for Tiger), ships (RAM, ESSM) as well as for „Battlefield Engagement" (Milan ADT). Guided Missile Systems consist of firing parts and launchers, missiles and peripheral equipment (e.g. logistic tools).
In addition, LFK and its subsidiaries design, develop and manufacture subsystems and key components for guided missile systems (e.g. warheads, guidance control and navigation systems). They also provide complete logistic support for the systems.
Funded through own as well as public sources, LFK as well as its subsidiaries develop their technological competence further, e.g. in the domain of air defence (SysFla/LFK NG), to make sure they can offer their customers the guided missile systems required to fulfil the challenging tasks of the future.
Subsidiaries and Joint Ventures of LFK are: Bayern-Chemie, TDW, Comlog, Ramsys, Taurus Systems, euroMeads/ Meads International, GLVS, Parsys, Euromissile and EMDG

Areas of interest

Robotics research with focus on man-machine interface.

microdrones GmbH

Company:	microdrones GmbH
Nationality:	Germany
Contact:	info@microdrones.com
Booth No:	33

Team description

The company microdrones GmbH was founded in October 2005 by the four shareholders Udo Juerss, Thorsten Kanand, Jan Wendel and Daniel Schuebeler.

All founders have been busy with development of aerial vehicles for a number of years. The innovative fusion of our core expertise is our formula for success.

Our company objective is the development and production of rotary wing based VTOL MAV´s (VTOL = Vertical Take Off and Landing, MAV = Micro Aerial Vehicle).
Our first product, the MD4-200 has been available since April 2006. Within the first 16 month more than 250 units have been sold - mainly inside of Europe.

It is used in many different applications: Aerial photography, Archeology, Surveillance, Plant inspection, Fire and Rescue service, Border control, Police, Special Forces, Army.
With future products we will introduce even much more sophisticated control- and communication technologies.
Our company name together with our slogan „your eye in the sky“ is self-explanatory and directly meets our product applications.
One of our future aims will be the expansion of our worldwide reseller network and production locations. This demonstrates our commitment to the highest quality products and a reliable service.
We are a completely independent company.

Name of system

md4-200

Basic data of system

Height:	198.5
Width:	598.0
Length:	598.0
Weight: approx.	800g
Average noise level:	<65dBa
Climbing performance:	depends on payload
Propulsion:	Electric brushless
Endurance:	20min
Max. speed:	approx. 40km/h
Payload:	200g

Communication equipment

Type:	Security Link or COFDM / RC-Signal / GSM (optional)
Frequency:	2.3-2,4Ghz & 35Mhz
Power:	100mW
Modulation:	PPM
Number of channels:	RC (1), Downlink(1)

Sensor equipment

Daylight, Dawn, Nightvision camera system (Live-Picture and HQ-Storage)
GPS, Magnetometer, 3Axis Gyroscope, Accelerometer, Baro-Altimeter

MineWolf Systems AG

Company:	MineWolf Systems AG
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Booth No:	22

Team description

MineWolf Systems is the leading provider of state-of-the-art mechanical landmine clearance technologies and services. Our flagship product, the „MineWolf", has set new standards in terms of reliability and efficiency and has shown unprecedented results in projects worldwide. More than 15 million square meters of mine-contaminated land in Europe, Africa and the Middle East have been effectively cleared using the MineWolf technology.
It is our mission to provide safe, reliable, fast and cost-efficient mechanical demining solutions to our customers worldwide. With this goal in mind, we provide our clients in the military, commercial and humanitarian sector a wide range of products and services to clear all types of landmines in a highly effective and cost-efficient manner:

- The MineWolf is best suited for large projects clearing up to 30,000 m2 per day.
- The Mini MineWolf fulfils all requirements for smaller tasks and quick deployments in remote areas.
- The MineWolf Bagger clears difficult areas where manual work is dangerous and tedious.

Areas of interest

Remote control application in demining and surveillance.
Robotics research with focus on man-machine interface.

Name of sytem

Mini MineWolf

The Mini MineWolf is a purpose-built remote-controlled vehicle for landmine clearance. Its light-weight construction and compact dimensions have been designed for ease of transportation via truck, ship or air. The machine with workshop and tiller fits into an ISO 20 foot container. It destroys small AP mines while resisting AT mine detonations of up to 10kg TNT. A key feature of the system is the patented tiller working tool which is designed to strike the ground in a predefined 4 cm pattern to a depth of up to 25 cm. Alternatively a conventional flail attachment may be interchanged for high-risk environments or very rocky terrain.

Mini MineWolf: remote controlled mechanical demining machine

Basic data of system

Dimensions (l x w x h):

Prime Mover without Attachment	3860 x 1700 x 2219 mm
Prime Mover with Tiller	5561 x 1860 x 2219 mm
Prime Mover with Flail	5130 x 2292 x 2219 mm

Ground clearance:

Minimum (up to undercarriage)	140 mm
Maximum (up to chassis)	400 mm

Weight:

Prime mover w/o tiller (incl. fuel)	6.1 tons
Prime mover with tiller (incl. fuel)	8.0 tons
Prime mover with flail (incl. fuel)	8.0 tons

Engine:

Type	6 cylinder in-line, 4 stroke, turbo charged, intercooling Model Deutz BF61013FC
Performance	176 kW (240HP) at 2100 rpm

Tiller:

Rotor rotation	500 – 800 rpm
Diameter	830 mm
Power transmission	Direct drive with turbo clutch
Height control	Adjustable hoisting gear
Number of Chisels	40 (hardened steel)

ND SatCom Defence GmbH

Company:	ND SatCom Defence GmbH
Nationality:	Germany
Contact:	ND SatCom Defence GmbH P.O. Box D-88039 Friedrichshafen Tel.: +49 7545 939 0 Fax.: +49 7545 939 8700 Email: info@defence.ndsatcom.com Web: www.defence.ndsatcom.com
Booth No:	17

Team description

ND SatCom Defence GmbH plays a leading role in the European military satellite communications industry. As a subsidiary of ND SatCom GmbH, ND SatCom Defence offers all core competencies and qualifications required for the turnkey delivery and logistic support of military SatCom systems. ND SatCom Defence builds on more than 25 years of experience in the design, development and implementation of SatCom systems for the military and other organizations in the area of national and international security. The company provides comprehensive, tailor made communication network ground segment solutions to military, governmental and peace-keeping organizations worldwide. ND SatCom is a wholly owned subsidiary of SES ASTRA in Luxembourg.

Areas of interest

The ND SatCom Defence solutions portfolio includes:

- System Solutions
- Fixed Ground Terminals
- Mobile & Transportable Terminals
- Network Management Systems
- Components

Name of system

SatCom

SatCom on the move terminal on top of the Gecko robot and the 90cm Satcom on the move terminal

OmniSTAR B.V.

Company:	OmniSTAR B.V.
Nationality:	Netherlands
Contact:	OmniSTAR B.V. Dillenburgsingel 69 2263 HW Leidschendam Tel.: +31 70 317 0900 Fax.: +31 70 317 0919 Email: info@omnistar.nl Web: www.omnistar.nl
Booth No:	8

By courtesy of Stanford University and EMT

Team description

Being a Member of the Fugro Group, OmniSTAR is world leader in providing high accuracy DGNSS correction data via satellite channels. With approximately 100 reference stations, 6 high power satellites and 2 global Network Control Centres, OmniSTAR delivers consistent and highly reliable positioning services worldwide, 24 hours a day, 365 days a year.
OmniSTAR's HP/XP services were developed to satisfy the need for high accuracy positioning solutions. OmniSTAR-HP/XP is the latest dual frequency GNSS augmentation solution in the OmniSTAR family of High Performance services. It delivers decimetre accuracy using 2 independent positioning technologies: network and precise orbits & clocks.
If you wish to receive more information about OmniSTAR's hardware and services, do not hesitate to visit our stand during the ELROB event.

Areas of interest

- GIS-mapping.
- Use of precision DGPS/DGNSS for military operations.
- Unmanned autonomous/remotely controlled landbased and airborne vehicles (UAV's).

Robowatch Technologies GmbH

Company:	Robowatch Technologies GmbH
Nationality:	Germany
Contact:	Robowatch Technologies GmbH Dr. Jens Hanke Pankstr. 8 – 10, Haus C D-13127 Berlin Tel.: +49 30 4749 8860 Fax.: +49 30 4749 8866 Email: info@robowatch.de Web: www.robowatch.de
Booth No:	21

Team description

Robowatch Technologies GmbH is one of the leading service robotics - companies and provider of Autonomous Unmanned Ground Vehicles - AUGVs - that warn persons in good time when they get into dangerous situations, support surveillance of hazardous zones and extensive areas, and optimise reconnaissance for purposes of disaster control and civil protection.

These autonomously navigating, unmanned ground vehicle systems raise the effectivity and enhance protection of members of the armed forces and special assignment teams during highly risky or fatiguing operations. For this purpose, robotic systems are available for reconnaissance, detection of chemical, radioactive and nuclear (CBRN) hazards, as well as defusing and transportation of explosive devices. If needed they can also be remotely controlled. Apart from Robowatch's system development services, the company concentrates on autonomous control of conventional mission vehicles and UGVs, so significantly extending their range of applications.

Areas of interest

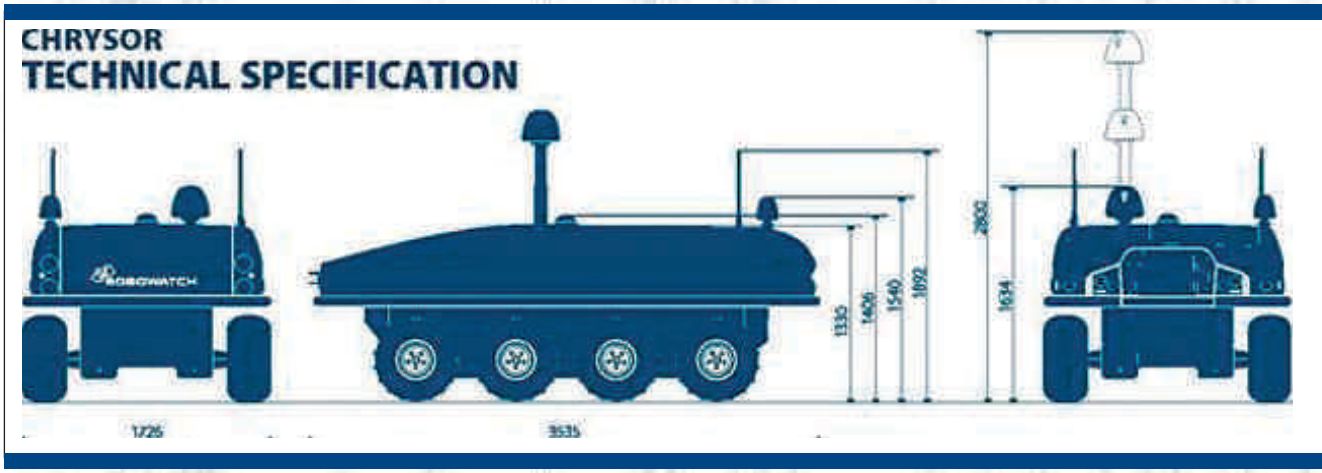
- Vehicle-independent route planning processes for autonomous vehicle control
- Sensorfusion and visualization tools
- Operation and communication concepts (Human-robot interaction)
- UGV and UAV interaction

Name of system

CHRYSOR

Basic data of system

Width/Length/Height:	1726 mm/3535 mm/1634 mm
Empty weight:	950 kg
Operating time:	9,5 h (= 400 km distance)
Silent modus:	12 h (Detection without driving operation)
Speed:	45 km/h (Turbodiesel)
Propulsion unit:	DM 950 DT (Daihatsu Turbodiesel)
Type:	Three-Cylinder 4-stroke turbo diesell, liquid cooled
Piston displacement:	952 cm³ (58 cu in)
Torque:	74 Nm bei 2400 1/min
Power output:	23,1 kW (31,4 PS) bei 3600 1/min
Braking system:	Hydraulic disc brakes, mechanical hand brake
Steering:	Hydrostatic steering system



Basic data of system (continued)

Electrical system:	12 Volt, 60 Ampere generator, 950 CCA Battery, 24V on-board power supply, additional 100 A generator, 60 Ah Lithium battery, spark plug monitoring and sensor for measuring water in fuel
Micorelectronics and sensors:	2 x Onboard AMD Opteron F2000 Prozessor, 2 GB SDRAM, Compact flash storage, Temperature sensor, Gyroscope, Inertial measurement system
Vehicle controls:	Steering wheel with integrated instrument panel (including speedometer, fuel and temperature gauges, signal lamps, starter switch), brake and gas pedal, integrated actuators for unmanned driving (mechanical linkages, motors and controllers for automatic steering, braking and acceleration), AdHoc WLAN communication system
Sensors for registering vehicle surroundings and remote vehicle control:	DGPS receiver (precision of 1 m), 3D laser scanner (Capture angel 120° horizontal, 90° vertical), 3 x high-sensitivity accelerometers for three-axis spatial direction, Odometer, Distance sensors, 10 x Cameras, Pan-tilt thermal camera and CCD-zoom camera (x312) system with image stabilization
Optional tracked drive:	Customized and easily mountable RC60 track system for off-road mobility
Weight:	950 kg unloaded, 1633 kg permissible all-up weight when loaded
Maximum payload:	680 kg
Maximum towing load:	907 kg towing capacity
Seating:	1 driver‘s seat for manned operation
Fuel consumption:	48 l diesel tank capacity for approx. 9,5 h operating time
Speed:	When manned 45 km/h (optionally with permit to drive on public roads), unmanned 15 km/h
Mission environment:	All-weather and off-road (-40 °C to +65 °C; -40 °F to 149 °F)
Shipping weight:	950 kg net
Shipping possibilities:	Truck, trailer, cargo aircraft, helicopter

Communication equipment

Type:	WLAN
Frequency:	2437MHz
Possible frequency range:	2412MHz – 2484MHz
Power:	max 4W
Modulation:	802.11g
Number of channels:	14

Sensor equipment

1. Pan-and-tilt camera sytem
2. Telescopic arm
3. CCD-zoom camera with image stabilization
4. Thermal imaging camera
5. DGPS antenna
6. AdHoc WLAN antenna
7. Cameras for 360° panoramic views
8. Access to driver's cabin
9. 3D laser for navigation
10. Xenon spotlights

TELEFUNKEN Radio

Team name / Company:	Telefunken Racoms / TELEFUNKEN Radio Communication Systems GmbH & Co.KG
Nationality:	Germany
Systems:	Guardium-UGV, VIPER
Contact:	Eberhard-Finckh-Strasse 55, 89075 Ulm Tel: ++49 (0)731 1553 - 240 eFax: ++49 (0)731 1553 - 10240 Mobile: ++49 (0)171 5600644 bernhard.kram@tfk-racoms.com www.tfk-racoms.com
Booth No:	9

Team description

Telefunken Racoms is a subsidiary of Elbit Systems Ltd which is a leading company in the field of defense systems for Air, Sea and Land platforms. The Elbit Systems group together with it‘s world wide subsidiaries has developed and introduced a big variety of robotic and unmanned vehicles. At ELROB 2008 Telefunken Racoms will present 2 of it‘s Unmanned Ground Vehicles: The VIPeR and the Guardium. The VIPeR is a dismounted soldier device extending the field of view or performing other tasks that are to dangerous to be done by the soldiers. The VIPeR features intuitive operating methodology and intelligent, semi-autonomous capabilities. The Guardium-UGV (G-UGV) system is an autonomous system that provides costumer tailored cost-effective unmanned security solutions for day and night surveillance and reconnaissance missions in open and urban terrains. The G-UGV provides 24/7, all weather, all terrain dynamic patrolling with the ability to be integrated into any C4ISR Systems.

Name of system

Guardium

Basic data of system

Height:	220 cm (including antennas) / 197 cm
Width:	177 cm
Length:	300 cm
Weight:	1410 kg (including all accessories)
Wheel or track driven:	wheel
Propulsion:	fuel
Max. speed:	60 km/h
Payload:	300 kg

Communication equipment

Type: Wide Band Communication Network to support service between platforms and control station

Sensor equipment

Laser:	2 x Sick Laser
Vision:	1 x PTZ day/night CCD camera 2 x day/night camera + near IR led illuminators 1 x 360 degrees panoramic vision system + near IR led illuminators
GPS:	GPS + DGPS + INS
Radar:	Forward Looking Radar

Name of system

VIPER

Basic data of system

Height:	40 cm (including antennas) / 25 cm
Width:	45 cm
Length:	50 cm
Weight:	12 kg (including all accessories)
Ground clearance:	10 cm
Average noise level:	Very Low
Climbing performance:	55 degree
Wheel or track driven:	Track & Wheel
Propulsion:	batteries
Endurance:	4 hrs
Max. speed:	8 km/h
Payload:	8 kg

Communication equipment

Type:	COFDM
Frequency:	2400 MHz & 800 MHz
Possible frequency range:	from 2400 to 2500
Power:	1 Watt
Modulation:	QPSK
Number of channels:	1 Full duplex

Sensor equipment

Vision:	Different Commercial TV cameras
GPS:	Trimble
Inertial measurement unit:	Yes

The VIPER is designed to carry different sensors:
Cameras, NBC detectors, Tear gas dispenser etc.

THALES Defence Deutschland GmbH

Company: THALES Defence Deutschland GmbH
Nationality: Germany

Contact: THALES Defence Deutschland GmbH
Land & Joint Systems
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Web: www.thalesgroup.com/germany

Booth No : 16

Team description

With operations in 50 countries and 68,000 employees, Thales is a world leader in Mission-critical information systems for the Aerospace, Defence and Security markets. Building on proven capabilities in large and complex software systems, Thales steps up to the security challenges of its customers in an increasingly interconnected, technology-driven world.

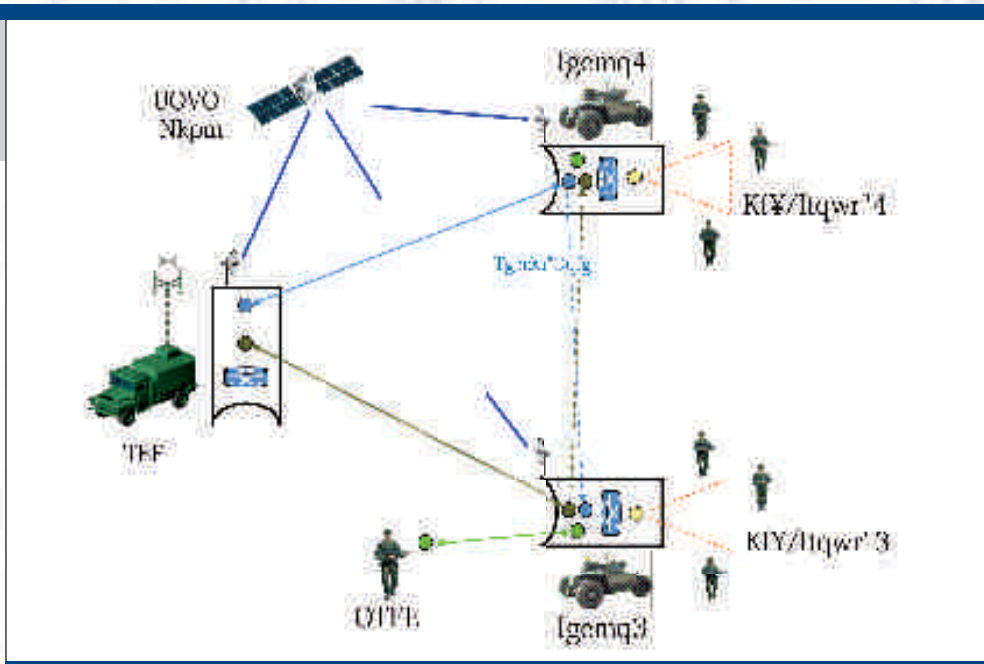
Civil and military systems benefit from many of the same technologies and innovations. Developing these dual technologies has been a long tradition for Thales, with its global network of 22,000 high-level researchers. Leveraging a global presence and spanning the entire value chain, from prime contracting to equipment, Thales plays a pivotal role in making the world a safer place.

Name of system

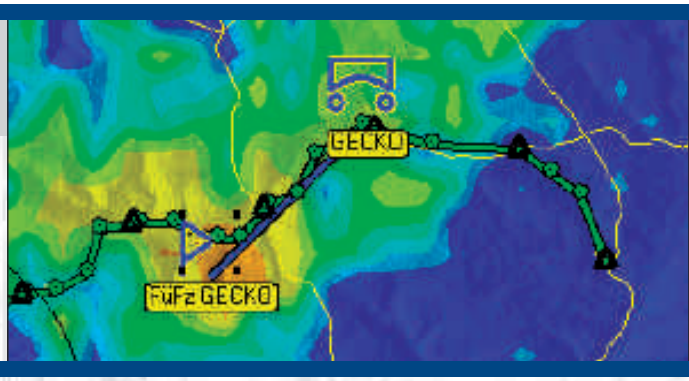
Communication System RoboCom

RoboCom is a robust COFDM high speed UGV data link, especially designed for demanding non – Line of Sight Multipath propagation scenarios. The IP based network enables QOS based control data, video transmissions and payload data. In difficult radio propagation areas the automatic relay function via terrestrial or satellite link increases the usable radio link range. The Frequency range is 170 to 1000 MHz in sub bands, e. g. the 225 to 400 MHz UHF military sub band with a transmit power of 1 W avg. (10 W peak) which results in a typical range of 4 km in a rural environment. Automatically tuned co site filters assure the coexistence of transmitters and receivers as well as other communication equipment on the vehicle even in dense RF environments.

RoboCom Communication network



Range calculation for UGV "GECKO"



Name of system

Radio propagation calculation tool KESS

An essential part of the control station is the radio propagation calculation tool KESS. KESS allows the calculation of the radio coverage for the control and data link to the remote controlled robot vehicle. By this the most favourable locations for the control station as well as possible "dead spots" for the radio link can be estimated without time consuming or dangerous tests in the deployment area. KESS determines where an relay stations should ideally be placed – by indicating optimal sites and simply displacing the relay station on-screen using the mouse.

KESS is an innovative tool for situation depiction, analysis, evaluation, simulation and assessment in geographical and radio engineering terms within any optionally definable area. The software makes use of new, three-dimensional techniques for modeling radio wave propagation. KESS is easy and intuitive to use and calls for no knowledge of programming languages, operating systems or similar. KESS is an integrated tool concerning all kinds of radio planning and allows system integration in all C4I, BMIS and Electronic Warfare systems.

THALES Optronics

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Nationality: France

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www.thalesgroup.com
www.eca.fr
www.laas.fr

Booth No : 15

For more information see page 33-36 (THE French Team)

Team description

THALES has been involved in military robotics for more than 15 years. It develops technical and operational robotics demonstrators for missions in urban and open terrains. Considered missions range from observation or target acquisition to special dedicated uses (such as autonomous terrain mapping). The approach is system oriented, in order to design and build usable robotic systems, from an operational point of view. Special efforts are made to improve reliability, credibility, failure management, and so on. Many autonomous modes have been demonstrated, such as trajectory recording and replay, autonomous leader-follower, road and lane following, high speed obstacle avoidance.

TSL/FSHT

Company: TSL/FSHT, Aachen, BerWEntwg EinsLog H / Technik LandSys
Nationality: Germany

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52060 Aachen
Lützow-Kaserne
Trierer Str. 445
Tel.: + 49 241 3720-5500
Fax.: + 49 214 –3720-5109
Email: michaelzeising@bundeswehr.org
Booth No: 29

Team description

College for Land-systems Engineering and Army School for Engineering (TSL/FSHT) presents their DEMONSTRATOR TELEMAINTENANCE with support of the companies RLS and ESG. The exhibitor wants to demonstrate his ideas of a system Telemaintenance for land systems and underline particularly the necessity with the Demonstrator Telemaintenance to use this method to the support of the material preservation in use.

As far as Army mission logistics is concerned, the maintenance forces are faced with the challenge to provide logistic support in theater to an increasing number of diverse, highly complex weapon systems with a limited amount of technically qualified personnel.

Telemaintenance shall founded technically and trained repairman gave full particulars knowledge of system for everyone Products, so that the repair can be arranged for over a long distance.

Essential elements of the system Telemaintenance are prognosis, diagnosis, monitoring and repair. Also become high-technologies how virtual reality (VR), augmented reality (AR) and modern, mobile network technology components of the system Telemaintenance.

Into exemplary scenario trade the operator, the system-maintenance-specialist (SysInstFw) of the unit and the repairman (InstFw)of the light- repair-unit with experts of the Bundeswehr and the defence industry which support and teach the repair under use of equipment data, Interactive electronic technical documentation (IETD) and expert knowledge out of a support center.

Name of sytem

Demonstrator Telemaintenance (Overview)

Basic data of system

Height:	1900 mm
Width:	1820 mm
Length:	3769 mm
Weight:	3600 kg
Ground clearance:	302 mm
Climbing performance:	60%
Wheel or track driven:	track driven
Propulsion:	4 Zylinder TDI (110 PS)
Max. speed:	70 km/h
Payload:	800 kg

Demonstrator-Fahrzeug Digital - Wiesel 2

Communication equipment

Type:	SEM 80/90
Frequency:	46 Mhz
Possible frequency range:	30,0 bis 79,975 MHz
Power:	10 W

UlrichC

Company: UlrichC
Nationality: Germany

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UlrichC
Am Stiegelberg 9a
D-76448 Durmersheim
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Email: christian.ulrich@ulrichc.de
Web: www.ulrichc.de

Booth No: 7

Team description

UlrichC researches and develops mobile robot systems. The main emphasis of the development lays on PC-based outdoor robot vehicles which can be controlled via internet. Furthermore, UlrichC offers free chain- and wheel- chassis constructions that are specialized for robots and manipulators.

Areas of interest

Information for purposeful development of robots with security-tasks.

Name of system

CYOUTOO

Basic data of system

Height:	80 cm
Width:	47 cm
Length:	65 cm
Weight:	45 Kg
Ground clearance:	7,5 cm
Average noise level:	35 db(A)
Climbing performance:	40%
Wheel or track driven:	Tracks
Propulsion:	200 W
Endurance:	4 Std
Max. speed:	5 Km/h
Payload:	25 Kg

Communication equipment

Type:	WLAN
Possible frequency range:	2,400 - 2,4835 GHz
Power:	100 mW
Number of channels:	13
Type:	Radio link
Frequency:	868,19 Mhz
Possible frequency range:	868..870 MHz
Modulation:	10dBm
Number of channels:	11
Type:	Other
	Cables, GPRS and direct Keypad

Sensor equipment

Vision:	moving CCD-camera lux 1 / 3,5 - 8 mm lens
GPS:	Chipset SiRF Star III
Other:	PIR-Sensors for person detection
	1x Front US-Sensor; 2x Front IR-Sensors

University of Koblenz-Landau

Company: resko@UniKoblenz / University of Koblenz-Landau
Nationality: Germany

Contact: Active Vision Group
Univerity of Koblenz-Landau
Universitätsstr. 1
D-56070 Koblenz
Tel. +49-(0)261 / 287 - 2783
pellenz@uni-koblenz.de

Booth No: 31

Note: We will not compete in the ELROB competition, but we will show our robot in an extra RoboCup Rescue arena

Team description

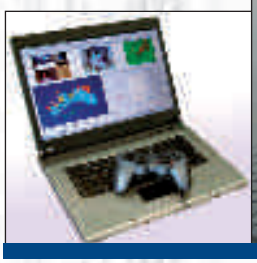
The team resko@UniKoblenz is a team of researchers and students from the University of Koblenz-Landau, Germany. Our mobile rescue system called "Robbie X" was developed during the last three years. Five practical courses were held in which the robot was built and its software developed. The robot was successfully used in the RoboCup rescue competitions 2006 and 2007.

Areas of interest

Sensor data fusion, map building, SLAM, autonomy

Name of system

Robbie X



Basic data about the system

Height:	80 cm
Width:	50 cm
Length:	65 cm
Weight:	35 kg
Ground clearance:	6 cm
Average noise level:	about 55 dB(A)
Climbing performance:	up to 15 degrees
Wheel or track driven:	four-wheel-drive
Propulsion:	electrical direct-current motors
Endurance:	45 min.
Max. speed:	1.2 m/s
Payload:	0 kg (sensors only)

Communication equipment

Type:	WLAN (IEEEE 802.11a/b/g; only a is used)
Frequency:	5 GHz band
Possible frequency range:	see IEEE 802.11a
Power:	22 mW
Modulation:	see IEEE 802.11a
Number of channels:	see IEEE 802.11a

Sensor equipment

Vision:	2x high resolution Sony color camera (DFW-X700 + DFW-X710) 1x Fire-i Webcam
Thermal sensor:	1x self-made low-cost thermal sensor (based on two TPA 81)
Sonar:	16x sonar sensors
Laser scanner:	1x Hokuyo URG04-LX (4 m range, 240° FOV, 0.36° resolution)

VAN BRUMMELEN MACHINEFABRIEK B.V.

Company: VAN BRUMMELEN MACHINEFABRIEK B.V.
Nationality: Netherlands

Contact: VAN BRUMMELEN MACHINEFABRIEK B.V.
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Web: www.mfvanbrummelen.nl

Booth No: 4

Team description

At Van Brummelen Machinefabriek b.v. are working 85 employees. VBM is specialized in developing, designing, engineering and manufacturing special equipment and machinery for one-offs and small series. Strenght of the company lies in manufacturing special machinery and constructions and/or exactly according to customer specifications. Van Brummelen b.v. exist of the following departments: Engineering, R&D, Machining and Welding & Construction.

Areas of interest

Research of Fuel Cell powered long range reconnaissance robotplatforms.

Name of the sytem

Cheatah VTE-3500 HMBFP

Basic data about system

Height:	350mm - 400mm
Width:	650mm
Length:	1150mm
Weight:	285kg
Ground clearance:	110mm
Average noise level:	< 55dB(A)
Climbing performance:	100%
Wheel or track driven:	Track
Propulsion:	Electrical (Gell Batteries or Fuel Cell)
Endurance:	25km
Max. speed:	10km/h
Payload:	90kg

Communication equipment

Type:	TeleRadio 60TX-06SOL
Frequency:	433,92MHz
Power:	10mW - 100mW
Modulation:	FM
Number of channels:	6

VTQ Videotronik GmbH

Company:	VTQ Videotronik GmbH
Nationality:	Germany
Contact:	VTQ Videotronik GmbH Rainer Böttcher Grüne Strasse 2 D-06268 Querfurt Tel.: +49 34771 51-71 Fax.: +49 34771 22044 Email: r.boettcher@vtq.de Web: www.vtq.de
Booth No:	20

Team description

VTQ Videotronik GmbH is a developer and manufacturer of wireless systems transmitting video, audio and data signals.The devices are working in frequencies ranging from 200MHz to 24GHz. State of the art technologies like COFDM ensure an interference free transmission of the signals. VTQs own R&D department and its very advanced and flexible assembling line enable the company to develop all kind of customised products on request. Since decades VTQ maintains a close relationship to military and government authorities. For many projects of these autorities special R&D work has been done.

Areas of interest

Wireless systems transmitting video, audio and data signals

Exhibitions/Participants

at

M-ELROB 2008

AirRobot

Team name / Company:	AirRobot / AirRobot GmbH & CO KG
Team leader:	Burkhard Wiggerich
Nationality:	Germany
System:	AirRobot AR100-B
Scenario:	Reconnaissance and surveillance
Contact:	Werler Str. 4-8 59755 Arnsberg Tel: +49-02932 547 740 Fax: +49-02932 547 749 E-mail: b.wiggerich@airrobot.de Website: www.airrobot.de

For more information look at page 18

Allen-Vanguard Ltd

Team name / Company:	The Allen Team / Allen-Vanguard Ltd
Team leader:	Pete Benwell
Nationality:	UK
Systems:	Defender D2, Digital Vanguard
Scenario:	EOD
Contact:	Allen House Alexandra Way Ashchurch Business Park Tewkesbury Gloucestershire GL20 8TD Tel: ++44 01684 851116 Fax: ++44 01684 851101 E-mail: pbenwell@allen-vanguard.co.uk Website: www.allen-vanguard.com

For more information look at page 20

BASE TEN

Team name / Company:	RoboScout / BASE TEN SYSTEMS Electronics GmbH
Team leader:	Ferdinand Zoller
Nationality:	Germany
Systems:	Gecko TRS
Scearios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport and mule
Contact:	Am Soeldnermoos 10 85399 Hallbergmoos Tel.: +49 811 5598 230 Fax: +49 811 5598 258 fzoller@btse.de www.btse.de

For more information look at page 23

borjet

Team name / Company:	borjet
Team leader:	Franz Bormann
Nationality:	Germany
System:	P-08 (TRAXX)
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport and mule
Contact:	Mehlisstr. 9 D-88255 Baindt/Schachen Tel.: ++49-07502/940240 Fax: ++49-07502/940230 service@borjet.de www.Landroboter.de

For more information look at page 25

Diehl

Team name / Company:	"CANGURU" / Diehl BGT Defence GmbH & Co KG
Team leader:	Dirk Krogmann
Nationality:	Germany
System:	CANGURU
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport and mule
Contact:	Alte Nussdorfer Str. 13 D 88662 Überlingen Tel.: +49-7551-89-2811 Fax: +49-7551-89-4269 dirk.krogmann@diehl-bgt-defence.de www.diehl-bgt-defence.de

For more information look at page 27

Force Ware GmbH

Team name / Company:	Force Ware / Force Ware GmbH
Team leader:	Dr. Jürgen Braunstein
Nationality:	Germany
System:	KNIGHT
Scenarios:	1. Reconnaissance and surveillance 2. EOD 3. Transport 4. Mule
Contact:	Im Grund 3 72800 Eningen Tel.: ++49-7121-42 03 18 Fax: ++49-7121-42 03 19 info@forceware.de www.forceware.de

For more information look at page 30

LSA

Team name / Company:	LSA/ISEP / Autonomous Systems Laboratory, Institute Superior of Engineering of Oporto.
Team leader:	José Miguel Almeida
Nationality:	Portugal
System:	LINCE
Scenarios:	1. Reconnaissance and surveillance 2. Camp Security 3. Mule
Contact:	Rua Dr. António Bernardino de Almeida, 431 4200 - 462 Porto Portugal Tel: ++351220340500 Fax: ++351228321159 lsa@lsa.isep.ipp.pt www.lsa.isep.ipp.pt

For more information look at page 37

MACROSWISS S.A.

Team name / Company:	MACROSWISS / MACROSWISS S.A.
Team leader:	Cino Robin Castelli
Nationality:	Switzerland
System:	Spyrobot 4WD
Scenario:	Reconnaissance and surveillance
Contact:	Via 1° Agosto, 1 6828 – Balerna - Switzerland Tel: ++41-91 682 35 46 Fax: ++41-91 682 35 48 info@macroswiss.com www.macroswiss.com

For more information look at page 37

QinetiQ

Team name / Company:	QinetiQ
Team leader:	Simon Christoforato
Nationality:	UK
Systems:	TALON (one of a number of possible RCVs QinetiQ will use at ELROB 2008).
Scenarios:	1. Reconnaissance and surveillance 2. Camp Security 3. Transport 4. Mule 5. EOD
Contact:	Cody Technology Park, Farnborough, Hampshire England GU14 0LX Tel: ++44 (0)1252-392000 Fax: ++44 (0) 1252-393911 KPink1@ QinetiQ.com www.QinetiQ.com

For more information look at page 43

Rheinmetall Landsysteme GmbH

Team name / Company:	Uwe Eisenkolb / Rheinmetall Landsysteme GmbH
Team leader:	Uwe Eisenkolb
Nationality:	Germany
Systems:	Wiesel 2 Digital, TROBOT
Scenarios:	1. Reconnaissance and surveillance (WIESEL digital) 2. Transport (TROBOT and WIESEL 2 digital) 3. Mule (TROBOT)
Contact:	Heinrich-Ehrhardt-Str. 2 29345 Unterlüß Tel: ++49-05827-806817 Fax: ++49-05827-805213 uwe.eisenkolb@rheinmetall.com www.rheinmetall-defence.com

For more information look at page 45

Robotics Inventions

Team name / Company:	Robotics Inventions
Team leader:	Marcin Gil
Nationality:	Poland
System:	A-Bot Standard
Scenarios :	1. Reconnaissance and surveillance 2. Camp security 3. Mule 4. EOD
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For more information look at page 46

S.A.S.

Team name / Company:	S.A.S. – RACCAR / Gerhard Wendl - Special Advisory Service and SIM Security & Electronic System GmbH
Team leader:	Gerhard Wendl
Nationality:	Germany
System:	Lambda01
Scenarios:	1. Reconnaissance and surveillance 2. Camp Security
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For more information look at page 48

Siralab Robotics S.r.l.

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Team leader:	Giorgio Belloni
Nationality:	Italy
System:	SR-H3
Scenario:	Camp security
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For more information look at page 49

Smith Engineering GB Ltd

Team name / Company:	Moonbuggy / Smith Engineering GB Ltd
Team leader:	Rodney Smith
Nationality:	UK
Systems:	Moonbuggy
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport 4. Mule 5. EOD
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For more information look at page 50

telerob

Team name / Company:	telerob / telerob Gesellschaft für Fernhantierungstechnik mbH
Team leader:	Dr. Andreas Ciossek
Nationality:	Germany
Systems:	teleMAX
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. EOD
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For more information look at page 52

TNO

Team name / Company:	EyeRobot / TNO Defence, Security, and Safety
Team leader:	J.C. van den Heuvel
Nationality:	Netherlands
System:	EyeRobot
Scenarios:	1. Camp security 2. Reconnaissance
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For more information look at page 55

University of Bremen

Team name / Company:	Jacobs Robot Team / Jacobs University Bremen
Team leader:	Andreas Birk
Nationality:	Germany
Systems:	Rugbot
Scenarios:	1. Reconnaissance and surveillance 2. EOD 3. Camp security
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For more information look at page 58

University of Hannover

Team name / Company:	RTS / Leibniz Universität Hannover
Team leader:	Prof. Dr.-Ing. Bernardo Wagner
Nationality:	Germany
System:	RTS-HANNA
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport and mule
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University of Heidelberg

Team name / Company:	HeidelCar / Heidelberg University of Applied Sciences
Team leader:	Prof. Dr. Achim Gottscheber
Nationality:	Germany
System:	HeidelCar
Scenario:	Mule
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For more information look at page 64

University of Kaiserslautern

Team name / Company:	RAVON / University of Kaiserslautern
Team leader:	Prof. Dr. Karsten Berns
Nationality:	Germany
Systems:	RAVON (Robust Autonomous Vehicle for Off-road Navigation)
Course:	1. Reconnaissance and surveillance 2. Mule
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University of Linköping

Team name / Company:	preRunners / University of Linköping
Team leader:	Jonas Nygårds
Nationality:	Sweden
Systems:	MoDuLiTH / testCarrier
Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport 4. Mule
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University of the Bundeswehr Munich

Team name / Company:	UBM – MuCAR / University of the Bundeswehr Munich
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System:	MuCAR-3
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For more information look at page 72

University of Siegen

Teamname / Company:	AMOR / University of Siegen
Team leader:	Prof. Dr. Klaus-Dieter Kuhnert
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Scenarios:	1. Reconnaissance and surveillance 2. Camp security 3. Transport 4. Mule
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For more information look at page 77

University of Würzburg

Team name / Company:	Universität Würzburg, Steinbeis Transferzentrum ARS, Zentrum für Telematik
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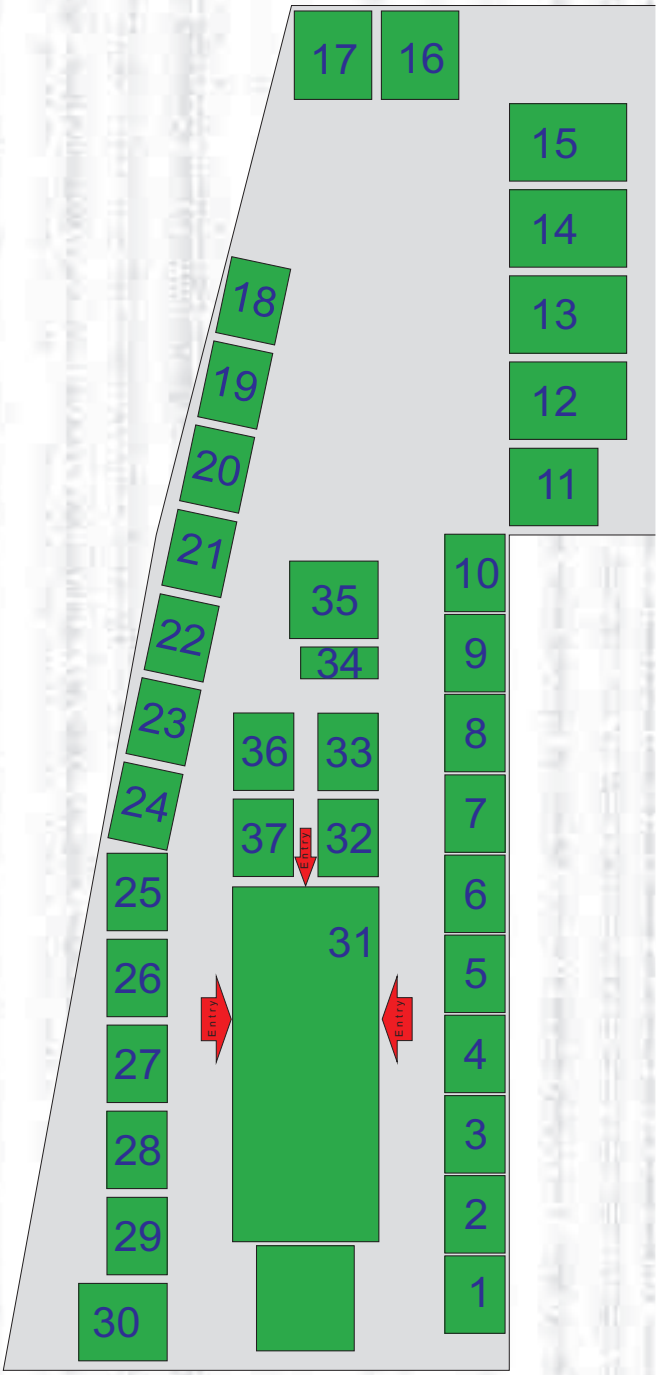
For more information look at page 79

General Informations

regarding

M-ELROB 2008

Static Display Area



1 - Isomorph S.r.l.
- Siralab Robotics S.r.l.
2 - borjet aeromodels Deutschland
- Force Ware GmbH
3 - Robotics Inventions
- BFI Optilas GmbH
4 - Van Brummelen Machinefabriek B.V.
5 - AIM INFRAROT-MODULE GmbH
- Autoflug Steuerungs- und SensorTechnik GmbH
6 - TNO Defense, Security and Safety
7 - CT-Video GmbH
- UlrichC
8 - OmniSTAR B.V.
- EMT Ingenieurgesellschaft
9 - Telefunken Radio Communication Systems GmbH & Co. KG
10 - QinetiQ
- Moonbuggy Ltd
11 - IABG mbH
12 - Rheinmetall Landsysteme GmbH
13 - Diehl BGT Defence GmbH & Co.KG
14 - University of the Bundeswehr Munich
15 - ECA S.A.
- THALES Optronics
16 - FES GmbH
- THALES Defence Deutschland GmbH Land & Joint Systems
17 - BASE TEN SYSTEMS Electronics GmbH
- ND SatCom Defence GmbH
18 - telerob Gesellschaft für Fernhantierungs-technik mbH
19 - Airborne Industries
20 - VTQ Videotronik GmbH
- i-sft GmbH
21 - Robowatch Technologies GmbH
22 - MineWolf Systems AG
23 - Macroswiss Sa
24 - MBDA/LFK
25 - Allen Vanguard
26 - University of Applied Sciences of Heidelberg
27 - Industrial Research Institute for Automations and Measurements (PIAP)
28 - Special Advisory Service (SAS)
29 - TSH Aachen
30 - TSH Aachen
31 - University of Koblenz-Landau
32 - University of Kaiserslautern
33 - University of Siegen
- microdrones GmbH
34 - Leibniz University of Hannover
35 - Research Establishment for Applied Science (FGAN-FKIE)
36 - Julius Maximilians University of Würzburg
- Institute Superior of Engineering of Oporto (LSA/ISEP)
37 - AirRobot GmbH & Co. KG
- Jacobs University of Bremen

M-ELROB Area


Infantry School
Hammelburg ==>
Gauaschach ==>
P
P
Inprocessing Point
Press & Info Centre
General-Heusinger Barracks
Entrance
Dynamic Show Area
Static Display Area
EOD
ELROB Inn
Directing Staff
Spectator´s Area Camp Security
Spectator´s Area Reconnaissance Trial
N

Schedule

Monday, 30 June 2008

by 1200 hrs	Arrival of visitors at the reporting point
1230 hrs	Opening addresses by Lieutenant General Budde, Chief of Staff, Army, and Ministerialdirektor Ellinger, Director General of Armaments
followed by:	Open air presentation of participating systems as well as of the static display
in the evening:	Reception for invited guests

Tuesday, 1 July 2008

0800 - 1700 hrs	Reconnaissance trial at daytime

Wednesday, 2 July 2008

0800 - 1700 hrs	Transport / EOD trials
2200 - 0500 hrs	Reconnaissance trial at night

Thursday, 3 July 2008

0800 - 1700 hrs	Site security trial
followed by:	Farewell function

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