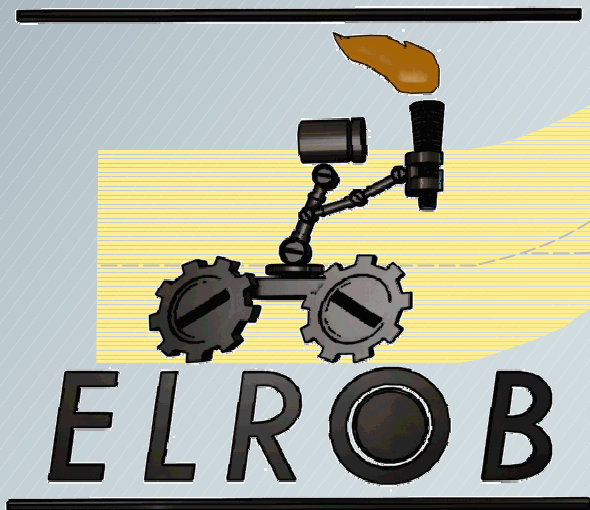


# M - ELROB 2010

The European Robot Trial

Additional Institutions



INFANTRY SCHOOL

HAMMELBURG

GERMANY

17. – 20. May 2010



**Bundeswehr**



## ELP GmbH European Logistic Partners

### Ground robots

Company: ELP GmbH European Logistic Partners  
Contact information: Mollenkotten 151  
42279 Wuppertal  
Germany  
Tel.: +49-202 698940  
Fax.: +49-202 6989410  
E-mail: [elp@elp-gmbh.de](mailto:elp@elp-gmbh.de)  
Website: [www.elp-gmbh.de](http://www.elp-gmbh.de)

- Static Display

Since establishment in 1989, ELP GmbH has been involved with the needs of military and police bomb disposal units and their very special equipment.

At first the focus was set mainly in the field of remote controlled manipulation equipment such as hook and line sets and remote controlled vehicles.

Portable x-ray equipment, ballistic protective devices and drugs- and explosives detection instruments were soon incorporated into our offered range of products.

Being closely involved in the conception and design of such equipment as well as developing our own designs and patents, we now provide state of the art products for the very special needs and requirements found in this area of safety and security minded applications.

By offering training as well as technical support, workshop maintenance and repair facilities, we stride to maintain the high standard of expectations of our long time customers.

ELP GmbH has been marketing the PackBotEOD in German-speaking Europe since 2002. Following an elaborate evaluation by the Bundeswehr, the first PackBotEOD Systems have been deployed in 2006.

### System name: PackBotEOD



*PackBotEOD*



## PackBotEOD

ELP GmbH European Logistic Partners

### Basic data

Height (max):	2500 cm (total height from ground to top, incl. antennas etc.)
Height (min):	1500cm (Total height from ground to top of the vehicle)
Width:	90 cm
Length:	150 cm
Weight:	28 kg (including batteries)
Turning diameter:	65 cm
Ground clearance:	13 cm

### Mobility

Climbing performance:	75 %
Wheel or track driven:	track
Propulsion:	batteries
Endurance:	8 - 10 hrs
Max. speed:	7 km/h
Payload:	35 kg
Locomotion:	2 tracks
Steering:	skid
Tether:	fibre optic
Control:	Remote teleportation, line-of-sight
Manipulator:	yes
Stairs:	40 degrees
Incline:	38 degrees



### Communication equipment

Type:	WLAN 802.11b
Frequency:	2400 MHz
Power:	100 m W
Number of channels:	6

### Sensor equipment

Vision:	4 Colour Cameras, 1 of them 300 x zoom low level
GPS:	optional

### Platform main capabilities

The PackBot EOD is one of four possible configurations of the commercially available PackBot Chassis manufactured by iRobot Inc., Bedford, USA.

The Chassis is powered by either an iRobot-manufactured NiCad-Battery, which also fits into the Portable Command Console (PCC), or alternatively by the BB-2590 Li-Ion Battery and compatible types. Its tracks and unique flipper design ensure high maneuverability even over rough terrain while at the same time ensuring robustness. The chassis itself (as well as the Scout- and Explorer configurations) can be dropped onto a solid concrete surface from a height of approximately 3 meters without sustaining damage.

The chassis is rated for submersion in water of up to 3 m, the EOD manipulator arm can be submerged up to 1.25 m. The complete RCV weighs only about 25 kg and can thus easily be deployed by a single operator. Being designed as a modular payload-carrier, the chassis provides several interfaces for external payloads. Some of these serve as manipulators, others carry external sensors (Explosives-, Chem-/Bio-, radiation-detection) and yet others serve to provide the PackBot with autonomous capabilities (Sensing: LIDAR, LADAR, Stereo-Vision, GPS, etc., additional computing power). The PackBot chassis demonstrated at ELROB is a "smart" remote-operated chassis without autonomy.

## Palfinger Europe GmbH

### Ground Robots

Company: Palfinger Europe GmbH  
Contact information: F.-W.-Scherer-Straße 24  
A 5101 Bergheim-Salzburg  
AUSTRIA  
Tel.: +43-(0)662 4684 2182  
Fax.: +43-(0)662 4684 2491  
E-mail: [govsales@palfinger.com](mailto:govsales@palfinger.com)  
Website: [www.palfinger.com](http://www.palfinger.com)

- Static Display
- Open Display

Wherever high demands are placed on the loading, unloading and transfer of goods, PALFINGER products offer high-tech solutions for seamless loading and transport logistics. Like no other manufacturer, PALFINGER offers proven logistics systems from a single source, such as:

- Transportable, remote controlled forklifts (Field loaders) from 1.5 up to 2.5 to
- Hydraulic truck loading cranes from 0.8 up to 150 mt
- Hookloader / PLS systems from 3 up to 26 mt

They impress by virtue of their superior application engineering which precisely match your specific requirements profile. Service and assistance through global dealer network in 130 countries with 4.000 service outlets.

### System name: **CRAYLER FLG 140**



*CRAYLER FLG 140 with a CH 53 during a field test*



## CRAYLER FLG 140

### Air-Transportable all Terrain Field Loader Company

Palfinger Europe GmbH

#### Basic data

Height (max):	3540 mm (with extended mast)
Height (min):	965 mm (folded position)
Width:	1820 mm
Length:	3690 mm (folding forks with 1100 mm included)
Weight:	2200 kg (folding forks included)
Capacity:	1300 kg @ 600 mm
Side shift:	+/- 150 mm
Radio Remote Control:	up to 300 m
Drive system:	4x4 all-wheel-drive
Lifting height:	2810 mm
Turning circle radius:	3640 mm
Average noise level:	84 dB(A)

#### Mobility

Climbing performance:	27 %
Wheel or track driven:	wheel
Propulsion:	fuel - DIESEL
Max. speed:	6 km/h (preset)
Control:	Radio Remote Control

#### Communication equipment

Type:	Hetronic
Frequency:	CS 434

#### Platform main capabilities

- Excellent ground clearance thru 3D-guide pivot
- 4-wheel driven for any type of terrain
- Gradability up to 27 %
- Manoeuvred precisely by means of a radio remote control (up to 300 meter range)
- Can be deployed in sensitive areas and operated out of a protected vehicle
- Save loading/unloading of helicopters
- Ideal for aid and disaster missions of any kind



CRAYLER FLG 140, Palfinger Europe GmbH

## University of Applied Sciences Offenburg

### Aerial robots

Organization: Hochschule Offenburg  
Contact information: Prof. Dr. Werner Schröder  
Badstr.24  
77652 Offenburg  
Germany  
Tel.: +49-781/205-271 (-311)  
Fax.: +49-781/205-214  
E-mail: [w.schroeder@fh-offenburg.de](mailto:w.schroeder@fh-offenburg.de)  
Website: [www.fh-offenburg.de](http://www.fh-offenburg.de)

- Static Display

The Hochschule Offenburg is a university of applied research with about 3000 students. In the department of electrical engineering, we have developed a small attitude and heading reference system (AHRS), a GPS-augmented inertial navigator and a flight control system for small helicopters together with a ground station. The system has been successfully tested on an electrically driven stunt helicopter under a whole range of weather conditions including more than 50 km/h wind load and ice-build-up on frame and blades. The system will be further optimized and applied in a large range of different applications.

### System name: Autonomous Helicopter



*Autonomous Helicopter in flight with camera equipment underslung (Video in Youtube, look for „minihelicopter“ and „Offenburg“)*



# Autonomous Helicopter

University of Applied Sciences Offenburg

## Basic data (all for current airframe)

Rotor diameter:	135 cm
Height (min):	41 cm
Width:	30 cm approx.
Length:	116 cm
Weight:	3 kg approx. without payload
Average noise level:	electric drive
Others:	no Bell-Hiller mechanics



## Mobility (all for current airframe)

Climbing performance:	>10 m/s
Propulsion:	brushless electric motor
Endurance:	>20 min, depending on accumulator
Max. speed:	> 100 km/h
Payload:	up to 3 kg, depending on accumulator (for current airframe)

Steering:	roll/pitch/collective pitch/heading
Tether:	currently none, but possible
Control:	waypoint-mode, either programmed or by remote control

## Communication equipment

Type:	Digital videolink(s) / several Digital up-/downlinks
Frequency:	2.4 Ghz/5.8 GHz
Power:	conforming to EU regulations
Number of channels:	spread spectrum for digital up/down/ 8 channels for videolink
Other:	remote control via two independent channels with receiver voting

## Sensor equipment

Vision:	video camera(s), video goggles with main flight data
GPS:	ublox, others possible like carrier phase GPS (RTK)
Other sensors:	MEMS-Gyros and -accels, pressure sensor, rotor rate sensor, temperature sensors, current sensors, voltage sensors, magnetometer, acoustic distance sensors, optical distance sensors

## Platform main capabilities

- all-weather, especially strong wind and ice-built-up conditions
- very manoeuvrable and fast
- very easy handling under full computer control
- steering via waypoint-mode, either programmed or by remote control
- payload up to own empty weight
- can be equipped with carrier phase GPS (RTK)
- system can be adapted to almost any small scale helicopter
- video goggles with main flight data displayed, no further ground station required
- lots of built-in safety like in-flight system restart, autorotation and simple mechanics
- small package, even smaller for long-range transport
- start-up time out of transport box: 5s (warm), GPS-lock-time (cold)
- quiet and low radar and thermal signature

## AUTOFLUG Steuerungs- und SensorTechnik GmbH

### Fibre-optic-based data transfer system

Company: AUTOFLUG Steuerungs- und SensorTechnik GmbH  
Contact information: Neue Str. 95  
D-73230 Kirchheim  
Phone: +49 (0) 7021 89 2900 Fax: +49 (0) 4101 307-110  
eMail: [vertrieb.sales@autoflug.de](mailto:vertrieb.sales@autoflug.de)  
Internet: <http://www.autoflug.de>

- Static Display

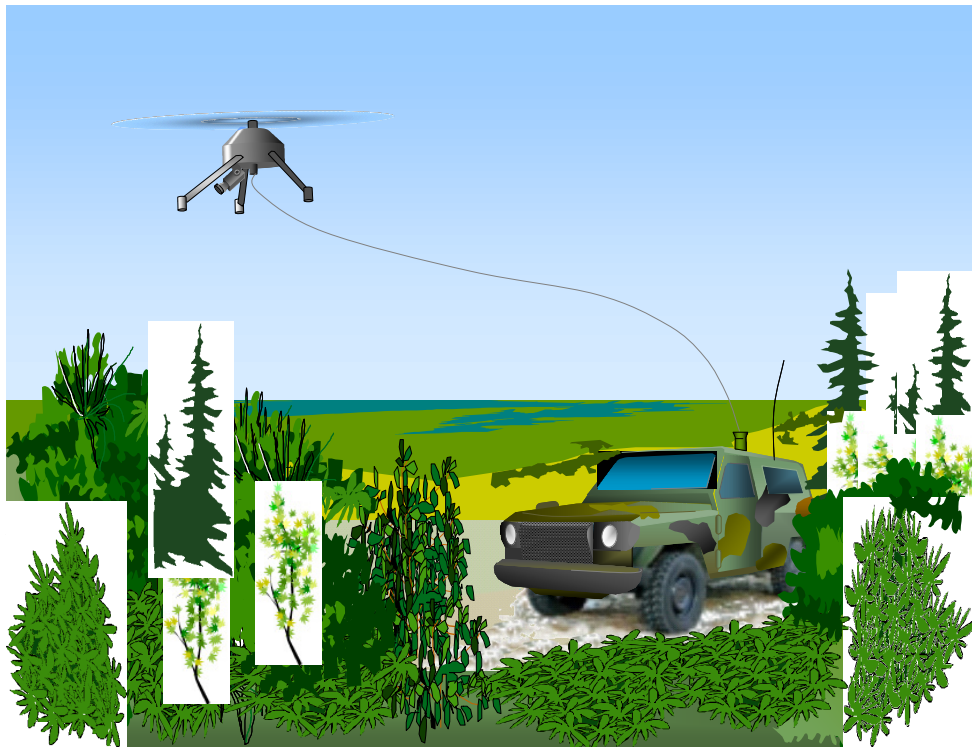
AUTOFLUG offers a wide range of products and services in the fields of safety and rescue technology and measuring and control systems.

AUTOFLUG develops, manufactures and maintains mechanical and fibre optic gyroscopes and gyroscope platforms employed in flight and altitude control systems and in the stabilisation of weapons and optical systems in aircraft, guided missiles and armoured land vehicles.

Design and development of special fibre optic cables for video data transmission systems started in the early 90's. Since then AUTOFLUG has developed and delivered fibre optic cable dispenser systems for missiles, micro-drones and land vehicles. The fibre optic systems are used for transmission of video, audio and high data rate control signals.

Drawing on many years of experience, AUTOFLUG also develops, manufactures and maintains fuel system components, such as fuel level sensors (capacitive, ultrasonic and optical), as well as a range of additional components and subsystems that are incorporated in both armoured land vehicles and aircraft.

### System name: Fibre Optic Payout Dispenser System



*Micro Drone and vehicle with Fibre optic cable*



# Fibre Optic Payout Dispenser System

AUTOFLUG Steuerungs- und SensorTechnik GmbH

## Techniques and specific Performance

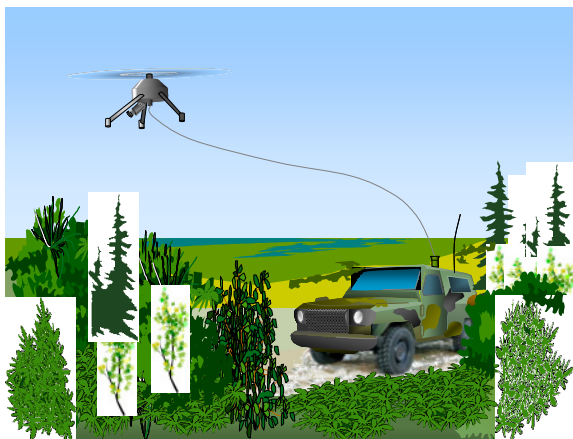
AUTOFLUG has the capability to design and develop products according to customer requirements with the following techniques:

- Single- or multi mode fibre
- Unique fibre reinforcement
- Pre-twisted fibre
- Dispenser systems for underwater and air application
- Combined dispenser systems with length up to several 10.000 m
- Dispenser with different winding techniques
- Minimized size and weight

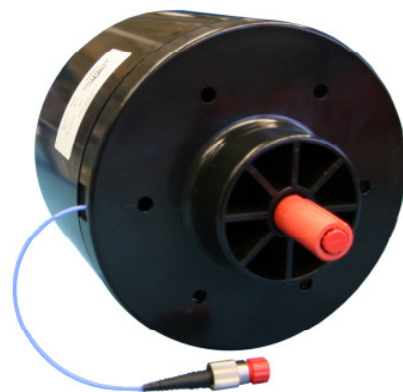
AUTOFLUG's fibre reinforcement technology provides an optimized protection for optical fibres without any limitations to flexibility or optical characteristics. An improved bobbin stability will be realized by our special fibre adhesive coating still providing an excellent payout performance. With an overall diameter of less than 500 micron with a signal attenuation of less than 0.4 dB per kilometer and a weight of less than 0.215 g per meter the AUTOFLUG reinforced optical fibre is by far the best balanced solution between performance and protection.

## Basic Technical Data AUTOFLUG reinforced optical cable

Fibre length	up to several 10.000 m
Diameter incl. reinforcement	0,260—0,500 mm
Weight incl. reinforcement	0,060—0,2100 g per meter
Signal attenuation@1310 nm	< 0.40 dB per km
Signal attenuation optional connector	< 0.2 dB each connector
Tensile strength	up to 250 N



*Micro Drone and vehicle with Fibre optic cable*



*Payout Dispenser System with optic connectors*

## Defence R&D Canada / Simon Fraser University

### Simulations

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Tel.: +1 403-544-4732  
Fax.: +1 403-544-4704  
Email: [Greg.Broten@forces.gc.ca](mailto:Greg.Broten@forces.gc.ca),  
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Web: [www.suffield.drdc-rddc.gc.ca](http://www.suffield.drdc-rddc.gc.ca)

- Static Display

The Autonomous Intelligent Systems Section, within Defence R&D Canada, researches and develops both unmanned ground and unmanned air vehicles. The section is composed of approximately 20 scientists, engineers and technologists.



## **Simulations**

Defence R&D Canada / Simon Fraser University

### **Platform main capabilities**

The simulation of autonomous sustain and resupply capabilities.

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## eurosimtec GmbH

### UAV-SIMULATION

Company: eurosimtec GmbH  
Contact information: Saarwerdenstrasse 8a  
56663 Musterberg  
Germany  
Tel.: +49-211 301856-0  
Fax.: +49-211 301856-29  
E-mail: [info@eurosimtec.de](mailto:info@eurosimtec.de)  
Website: [www.eurosimtec.de](http://www.eurosimtec.de)

- Static Display

eurosimtec develops complex real-time simulation solutions for national and international companies, public clients and leading research and technology institutes. All solutions are developed rapidly and specific for each customer.

The results excel with their high training value, user-friendliness, simulated realism and the reliable software and hardware.

**System name:**  
**UAS-TS (Unmanned Aerial System - Training Simulation)**



*UAS-TS (Workstation for the instructor)*



# UAS-TS (Unmanned Arial System - Training Simulation)

## SIMULATION

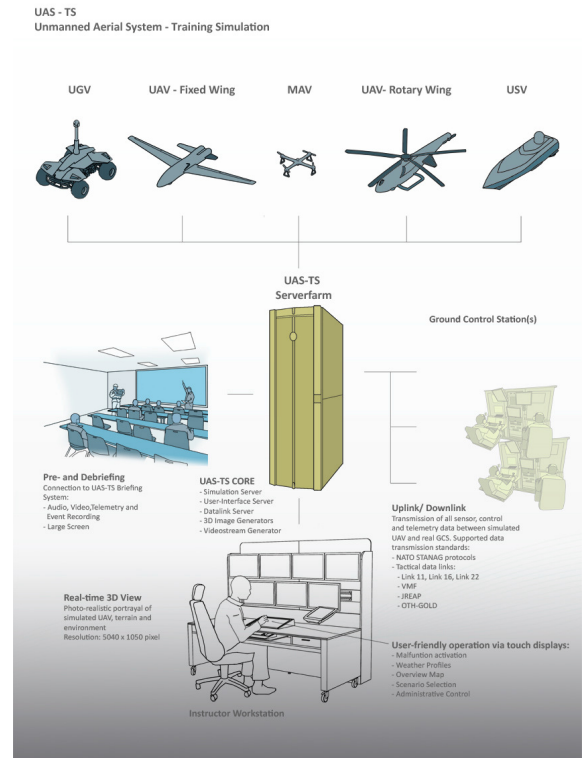
eurosimtec GmbH

## Introduction

Modern UAV systems are exceedingly varied, highly complex and often include sensitive technology. With the increasing use of UAVs by personnel from a range of backgrounds and experience, this can put a considerable strain on the training of UAV crews. The need for a dedicated and flexible training tool is therefore immediately apparent. Ideally, such a tool should be able to cover all aspects of UAV operation and allow a didactic and skill-oriented education. With such a goal in mind, we have developed the 3D UAV training solution UAS-TS in collaboration with the German Armed Forces. The first system was successfully installed at the Training Centre of the German Armed Forces in Munster [1] in November 2009. Initially, the system is being employed to instruct new crews of the tactical UAV system LUNA [2], especially as a preparation for deployment in the Kunduz area, Afghanistan.

## System Setup

The UAS-TS setup mainly consists of a workstation for the instructor, giving him a wide-angle view of the virtual 3D environment and displaying the UAV status. Control of the simulation and the mission scenario is mostly done via a large and intuitive touch display. To keep administrative workload low, there is a secondary touch display dedicated to control and monitor the hard and software. The trainees are instructed using an actual ground control station (GCS), which directly connects to UAS-TS. The simulation acts as a drop-in replacement for the actual UAV, providing the control and telemetry data link and the synthetically created video feed from the simulated UAV cameras. The connection is flexible and conforms to standard



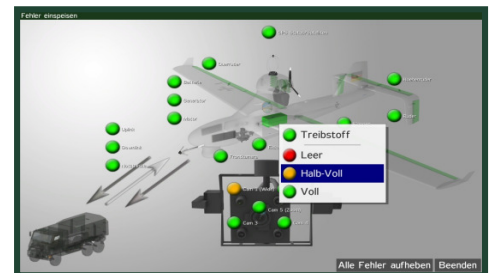
### 3D Visualisation and Terrain

The use of commercial-of-the-shelf (COTS) products in the development of UAS-TS allows high visual quality at a fraction of the usual development time and cost. This approach was combined with the adherence to industry standards, which made it possible to rapidly create highly detailed vehicle models and the virtual 3D terrain from the available source data. Such visual fidelity is extremely important in UAV simulations as it is necessary to successfully train the operation of the UAV sensory equipment. The authentic visuals also help the trainees (and the instructor) to get accommodated with the simulation more easily.



## UAV System Malfunctions

An important aspect in the training of a UAV crew is the preparation for possible technical malfunctions. Reactions to and behaviour in the occurrence of such errors can be trained and improved upon. UAS-TS enables the instructor to introduce simulated technical errors, such as mechanical and electrical failures within the UAV, its sensors or a breakdown of the radio link with the GCS. The malfunctions can be activated with various degrees of severity and their effects are realistically simulated.



## Summary

We have reported on the development of the UAV training simulation UAS-TS and its commissioning at the Training Centre of the German Armed Forces at Munster [1]. The simulation is flexible and can be applied to other unmanned systems. It features a realistic virtual 3D environment, including computer generated forces, which can be adapted to simulate any terrain and mission scenario.

## KB Videosystems GmbH

### Communication Systems

Company: KB Videosystems GmbH  
Contact information: Lindenstraße 23  
06268 Querfurt  
Germany  
Tel.: +49-34771 717052  
Fax.: +49-34771 23597  
E-mail: [info@kb-videosystems.com](mailto:info@kb-videosystems.com)  
Website: [www.kb-videosystems.com](http://www.kb-videosystems.com)

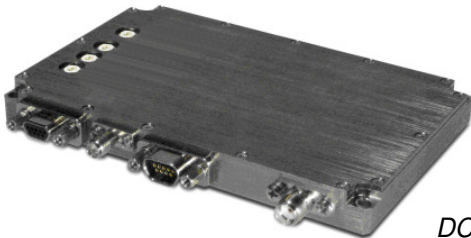
- Static Display

We are a young start-up with ambitious goals. Our team members have many years of experience with professional video equipment, dealing with industrial consumers as well as customers in law enforcement and military. Our products are designed to withstand harsh environments and are ideal for law enforcement, surveillance, UAV, UGV, military, and other applications requiring high quality products in a compact, rugged package.

We are providing systems for digital COFDM transmission, optical communication and high speed UMTS as well as different thermal imaging camera solutions."

**System name:**

- COFDM DCO Series
- Optical Communication Systems
- Thermal Imaging



*DCO TX 100 / 250mW (RF)*



*Rapid Fire R10 Optical Communication System*



*KB TI 384 OF*



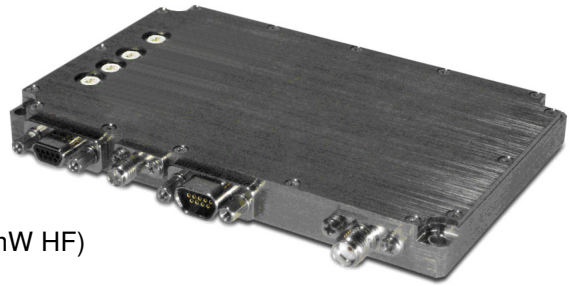
## DCO TX 100 / 250mW (RF)

### COFDM DCO Series

KB Videosystems Gmbh

#### Features:

- Small and compact size
- Light weight
- Low consumption – high efficiency (4.5W / 100mW HF)
- Simple operation
- Transmission of Video (PAL/NTSC), Audio (Stereo) and RS232 (max. 115,2Kbit)
- Narrow bandwidths (2,5MHz / 1,25MHz)
- 256 Bit AES encryption as standard
- High receiver sensitivity
- Great variety of available frequencies
- Robust construction and high quality (J-STD-001D Class 3 assembly, Medical/Aerospace)
- Extreme temperature range (-20 °C bis +70 °C )
- Voltage range suitable for LiPo technology (11V – 16V DC)



## Rapid Fire R10 Optical Communication System

### Optical Communication Systems

KB Videosystems Gmbh

#### Features:

- Most secure communication technology on the market
- Low danger of wiretapping and discovery of the device
- Bi-directional Data, Voice, and Video
- Point-to-point LAN extension
- 100% eye-safe IR LED communications
- Wide field-of-view (same as 7 x 50 binoculars)
- Perfect for emergency and temporary communications
- Handheld or tripod mounted for ease of use

Best alternative to cables



## KB TI 384 OF

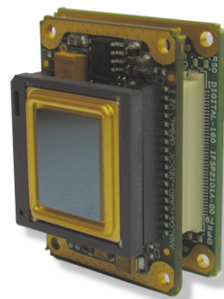
### Thermal Imaging

KB Videosystems Gmbh

#### Features:

- Uncooled or cooled cameras
- Compact size and low weight
- Excellent energy efficiency
- Excellent cost efficiency
- NETD value of < 50 °mK (at F/1).
- Different models and interfaces available
- Dual FOV
- Excellent Picture quality at day and night, even in unfavorable visibility conditions
- Rugged construction

Extended temperature range (-40 °C to +60 °C )



## **Mechatronic – Moduls GmbH**

### **Mechanical Components**

Company: Mechatronic – Moduls GmbH  
Mechanikkomponenten für Elektroniksysteme und Apparatebau  
Contact information: Oberndorfer Str. 1  
83527 Haag i. Oberbayern (near Munich)  
Germany  
Tel.: +49 (0) 8072 371 200  
Fax.: +49 (0) 8072 371 222  
E-mail: [info@mechatronic-hess.de](mailto:info@mechatronic-hess.de)  
Website: [www.mechatronic-hess.de](http://www.mechatronic-hess.de)

- Static Display

The main areas of our product lines are mechanical components of electronic systems and apparatus construction. This leads from prototyping up to serial production of various high qualified parts and systems.

Qualified employees, modern techniques and proven experience are the basis of the perfect realisation of our customers' conception.

Our B2B – components are in worldwide use.

Mechatronic – Moduls GmbH is certified against DIN EN ISO 9001:2000

### **System name:**

### **Custom body of the LVS Module of the RoboScout Gecko**



*Custom body of LVS Module*



## Custom body of the LVS Module of the RoboScout Gecko

### Mechanical Components

Mechatronic – Moduls GmbH

#### Platform main capabilities

This custom body carries the sensors which BASE10 integrates into the Light – Video – Scanner ( LVS ) - Modul of GECKO



*Custom body of LVS Module -manufactured by MECHATRONIC - MODULS*

## RTI Real-Time Innovations

### Software

Company: RTI Real-Time Innovations  
Contact information: 399 Silbury Boulevard Central Milton  
Keynes, MK9 2HL  
United Kingdom  
Tel: +44 (0) 1908 303 685  
Email: [info@rti.com](mailto:info@rti.com)  
Web: <http://www.rti.com>

- Static Display

RTI was founded in 1991 by researchers from a Stanford University robotics research laboratory. Real-Time Innovations (RTI) provides the integration infrastructure for hundreds of real-time and significantly reduces integration time, cost and risk with proven products and deep expertise in real-time systems.

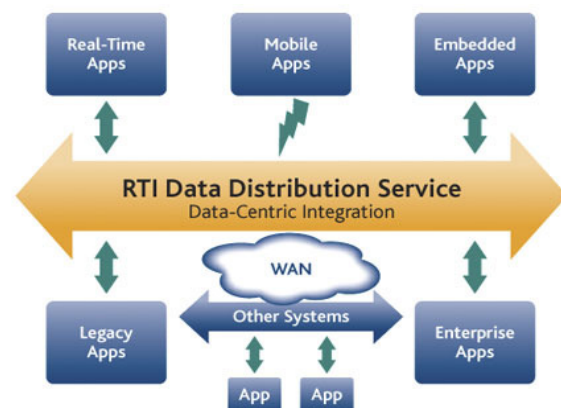
Customers of RTI in EMEA include Base10, EADS, MBDA, BAE, QinetiQ, SAAB, INDRA, Rheinmetall, Ultra Electronics, PLATH, VW, ESO and IAV.

RTI Data Distribution Service is an integration platform for real-time systems. Based on a serverless software bus, it allows real-time applications to communicate with each other and with enterprise and legacy applications. RTI Data Distribution Service features a unique combination of high performance and broad standards support. It provides integrators of demanding applications with an alternative to custom integration that is both off-the-shelf and supports an open architecture

### System name: RTI is used in RoboScout Control Centre for the Gecko unmanned ground vehicle



*RoboScout Control Centre with Gecko unmanned ground vehicle*



## RTI is used in RoboScout Control Centre for the Gecko unmanned ground vehicle

### Software

#### RTI Real-Time Innovations

##### The Problem

RoboScout is a proof of concept system designed to meet evolving application requirements from the German Federal MoD. Ideas and issues for future deployments of UGVs are continuously developing as feedback from research and battlefield deployments advances the Army's thinking for UGV utilization. It therefore became a design goal that the UGV system design be highly modular in order to enable rapid change and evolution. The RCC design had to be as modular as the UGV, so that additional control interfaces and/or information feedback sub-systems could be easily integrated in to match the function and capability of the UGV. Future system scalability requirements were therefore unknown at the start of the design process and would need to continuously be extended in the development process. However, added to this challenge was the requirement that many of the RCC applications had to exhibit highly reliable and often real-time characteristics.

This was particularly important when communicating through the RCC to the data link connected to the UGV for critical functions such as steering and pedal control. Adding compute systems to the RCC was one way to ensure that each new control application would receive the resources it needed to execute locally. However, ultimately the challenge was that critical control data had to be reliably marshalled, within real-time constraints, to and from these sub-systems through a multimedia data link to the UGV. Determining an integration solution that simultaneously met the demands of the overall system for scalability, reliability and real-time performance became a central design issue for the RCC of the RoboScout system.

##### The Solution

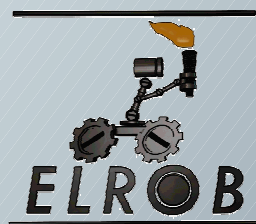
The data-centric design approach supported by RTI Data Distribution Service was a key enabler for developing this scalable RCC design. As new capabilities are added to the vehicle, they need to access information or share it with existing modules in the RCC. This requires a continuous re-integration exercise. With a data-centric design supported by the publish-subscribe messaging model, no re-write of existing modules is needed to share information with the new RCC module.

##### The Impact

RTI Data Distribution Service made it possible for the RCC to integrate highly modular software applications for all its key functions: steering, brake and acceleration control; dashboard; map view; video controller for up to twelve video feeds; and localized supporting applications such as logging, data-link protocol converter and system start-up control. New applications can be started and stopped dynamically in the RCC, which is ideal in a concept design where new features and ideas are being continuously developed and tested. RTI Data Distribution Service fattened the integration complexity curve and enabled BASE10 to develop an extremely flexible modular design without incurring massive time and/or cost penalties.



*RoboScout Control Centre*



**M - ELROB 2010**