ELROB - ISMCR 2018

21th International Symposium on Measurement and Control in Robotics
26-27 September 2018 – International CBRNE Institute, MONS, Belgium

ROBOTICS FOR THE CHANGING WORLD

CATALOGUE

BEMEKO

www.imeko.org – TC 17

European Society for Defense	Hainaut Sécurité	Belgian Royal Higher Institute of Defense	Climbing and Walking Robots Association	

The ELROB Competition, coupled with the ISMCR Symposium is organised by:

The International CBRNE Institute

The ICI's aim is to enhance CBRNE risk mitigation at regional, national and international levels, in particular through its two Knowledge Centres (CBRN&E).
The ICI engages in a wide range of CBRNE-related activities including developing and supporting academic and policy-related research, organising conferences, seminars and workshops, as well as professional development programmes for responders by means of courses and master classes.
The ICI was established in partnership with the municipality of Les Bons Villers, Belgium. The Royal Decree incorporating the ICI, as an independent International Non-Profit Organization, was granted on 30 August 2013. It was officially inaugurated on 5 October 2013 by Ms Agnes Marcaillou (Director of the United Nations Mine Action Service (UNMAS)), Mr Wart (Mayor Les Bons Villers), MrMattmann & Mr Rothbacher (co-directors of HZS).

The Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE

The Cognitive Mobile Systems Department of the Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE is actively researching in the area of unmanned systems for more than 20 years. Our main expertise is the development and evaluation of complex human-robot systems. The main focus is on RSTA and CBRNE-reconnaissance missions using heterogeneous multi-robot systems. Working with such multi-robot systems is a competitive task for the operator. Even a single robot utilizes several different sensors and provides a high degree of mobility, which all need to be controlled by the operator.
CMS approaches this challenge through intelligent assistance functions. The operator is supported by these assistance functionalities on all levels, ranging from navigating a single robot to complex planning problems of multi-robot systems. Our key skill is the development of innovative tools for human-robot interaction and cooperation. For this purpose new developments are constantly integrated in experimental systems and evaluated in co-operation with security authorities and organizations as well as the military.

Military ELROB 2018 – Lens-Bauffe Belgium

Welcome to the military ELROB 2018 in Belgium. This year's event is already the tenth edition of the European Land Robot Trials. Over the years, the trials have established themselves as Europe's leading outdoor robotics event.

After exceedingly successful ELROB events in Hammelburg (Germany), Thun (Switzerland), Warsaw (Poland), and Eggendorf (Austria) this seventh presentation of the military version of ELROB takes place at the RPA Hainaut Sécurité site in Lens and is kindly co-organized by the International CBRNE Institute (ICI), Les Bons Villers. Bringing together potential end-users, members of the robotics research community and industry representatives, ELROB once more demonstrates the successful cooperation between the European countries.

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

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

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

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

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

With kind regards

F. Schneider

Dr Frank E. Schneider

Deputy Head of the Cognitive Mobile Systems Department (CMS)
Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE
frank.schneider@fkie.fraunhofer.de
Military ELROB 2018 – Lens, Belgium

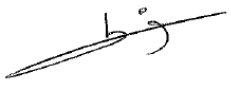
ELROB'2018 - EUROPEAN LAND-ROBOTS TRIALS
ISMCR'2018 – International Symposium on
Measurement and Control in Robotics botics

From 24 to 27 September 2018, on the 'HAINAUT Security' site, located in BAUFFE (Mons, close to CHIEVRE airport and CASTEAU NATO headquarters), is held the annual competitions to demonstrate the capabilities of mobile robots in realistic scenarios. In 2011, this competition, devoted exclusively on Research and Development, brought together six European teams focusing on applications related to civilian security missions, on the site of the Belgian Defense Demining Service, in a wooded area. In 2016, the Austrian Ministry of Defense, supported by the NATO EOD Center of Excellence, managed the ELROB tests entrusted to twelve European teams, focusing on the essential military applications: recognition of potential dangers in urban sites, transport conveying of equipment, search and rescue of victims, detection of explosive devices and mine neutralization.
2018 sees the execution of these same scenarios to which has been added the detection of improvised explosive devices (terrorist threat) and the evacuation of victims, scenarios favored by Defense experts gathered in research groups of the Organization 'Science and Technology' of NATO.
In an edition of 4 July 2018, under the pen of Sarah Frere, the daily 'La Libre Belgique' stressed the importance of legislating for the prohibition of 'autonomous weapons', referring to the opinion of Scientists, proposals of ECOLO-GROEN and the precedent which was, at the initiative of Belgium, the prohibition of the use of anti-personnel mines and the OTTAWA Convention. The simplistic title 'Robot Killer' of this 'paper'(as it was at the time of the Ottawa Convention - 1997 - the qualification of 'Mine-clearing Robot ') distorts the interest of research in Mobile Robotics whose technological evolution allows already assisting human operators (including the military) when performing risky tasks in dangerous environments: as a frequent example, the intervention of the EOD[1] robot of the Belgian Defense Explosives Removal Service during frequent calls on suspicious sites (last intervention noticed, that of STOCKEL, related to the arrest of suspected terrorists, in possession of vehicle carrying explosive TATP).
It was in 1982 at the initiative of the G7 at an economic summit held in Versailles that the International Advanced Robotics Program (IARP) was adopted, the objective of which clearly stated the need for international cooperation in order to develop the robotics to assist human operators in hazardous tasks in dangerous environments. Alongside 16 member countries of this program, Belgium joined the program and entrusted its representation to the Royal Military Academy (RMA) in 2001. The RMA decided to coordinate two working groups, one devoted to robotics for humanitarian demining, the second one devoted to robotics assisting at risk operations. These two groups launched several European projects funded by the European commission, including the VIEW-FINDER project providing assistance to fire departments in toxic areas, the project TIRAMISU planning to develop a coherent set of tools for humanitarian demining including autonomous devices for the detection of mines, and the project ICARUS, combining drones, marine and land-based robotic devices for the search and rescue of victims ,. Some demining robots are currently adapted to the detection of improvised explosive devices, in particular at the initiative of the Italian Defense Department financing the IDS company in the development of a vehicle called MINERVA, equipped with a matrix of ground penetration radars (GPR) and other sensors to detect and identify explosives.
The RMA, for its part, adapted a SEDEE[2] robot, endowing it with a matrix of metal sensors developed by the German firm VALLON GmbH
The ELROB'2018 competition presented 16 teams of which five (NIC Instruments Ltd-UK, TELEROB GmbH-GE, BROKK Ltd.-SE, ELP GmbH-GE, TAUT-AT) will be tested on explosive device detection capabilities and seven competitors tested on rescue capabilities for victims (TELEROB GmbH-GE, Fraunhofer & TNO-GE-NL, BISG-FI, TAUT, BROKK and ELP, AVRORA-RU)
The aim of these competitions is to promote the best advances in technology and to strengthen cooperation in

[1] Explosive Ordnance Disposal
[2] Service belge d'enlèvement et de destruction d'engins explosifs (EOD) www.mil.be/dovo

research.
The events has been doubled this year by the organization of the 21st International Symposium on Robotics (ISMCR'2018[3]) under the auspices of the International Confederation IMEKO, and more particularly its technical committee (TC17) coordinator of research in robotics, chaired by Japan, of which Belgium is an active member in charge of the organization of this symposium.
No reasoned research of the 'killer robot' type is seriously considered in 'terrestrial' robotics.

But what about aerial robotics, drones? The Royal Military Academy is currently coordinating a new Horizon project called SAFE CHORE whose objective is the detection of 'dangerous' drones as part of border surveillance.
And it is obvious that many projects aim to use drones (still known under the name RPAS[4]) in the framework of (NATO, among others) missions of recognition, surveillance and acquisition of objectives ... it is precisely this last type of missions which could 'appearing to the qualification of' killers' if the objective is the enemy and the acquisition its neutralization ...
However, priority is given to monitoring and reconnaissance missions and to the specific examination of suspect areas or areas affected by CBRN-type contaminations: the recent example of measures to confirm the use or location of chemical weapons in Syria, as well as the use of drones for the detection of mine-infested areas in Croatia confirm the interest of these machines.
It is now utopian to legislate on the prohibition of 'combat' or 'combat support' drones, as investments in this area are very much involved while the role of drones alongside fighter planes is already essential: the conflicts affected by the intensive use of bombing (and precise targeting by some drones) are unfortunately, since the Second World War, pests in terms of civilian casualties: the Balkans yesterday, Afghanistan, Syria, Yemen, between others, emphasize this damage
The United States are obviously very involved in the development of drones of different categories (ROVER system, PREDATOR, MQ-5B HUNTER ...) but the European countries like France, Germany, Italy and Great Britain also have invested and also invest in drones in the arms industry, supported by NATO, the European Defense Agency or even the European Commission (oriented towards the civil security of the European area).
These investments are in billions and today pose many problems in terms of intrinsic safety of the vehicles used (their autonomy, control-or loss of control-possible interference with air traffic, reliability of communications, etc.). and in the field of ethics (protection of privacy, for example, but also interdependence between man and machine ... .
The current proliferation of video games' (or even serials and science fiction) taking the use sophisticated weapons of combat 'affect the younger generations and deserve preventive and perhaps paramount legislation, the' killings accidents' multiply today....
The ISMCR'2018 International Symposium details some of the topics discussed above. ELROB'2018, meanwhile, illustrates the progress of terrestrial robotics.
Perhaps we can conclude with these reflections of Axel KAHN, eminent researcher of international renown in Ethics: "With robots, men have undoubtedly taken an important step in their powers to master nature and to conquer the world. Universe ...but will these tools l not evolve towards a form of empowerment that weakens this control and lead to dehumanization? .We are not already close to control by an interactive device (Internet, virtual world of the Web) ... The world of tomorrow depends on all of us. With the help of robots, why not? The human singularity of our animality allows it, it does not guarantee it. "



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[3] See program on www.ici-belgium.be/events and www.elrob.org
[4] RPAS Remotely Piloted Aircraft Systems

The Royal Higher Institute for Defence

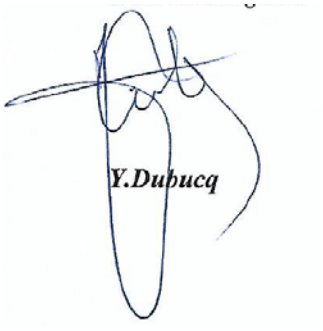
The Royal Higher Institute for Defence (RHID) is the reference body or think tank of the Belgian Ministry of Defence in the field of security and Defence.
In order to fully accomplish its mission, the RHID has set the objectives of focusing the attention - by identifying research and discussion topics, and themes of interest - as well as deepening and disseminating knowledge.
It is also responsible for managing the multiannual programme for scientific and technological research, including the security and Defence studies, as well as the scientific research of the Royal Army and Military History Museum.
Scientific & Technological Research is organized in 3 main domains to cover the whole spectrum of ongoing and future scientific research: Data Acquisition and Processing (OAP), Mobility, Systems and Protection (MSP), Human Factors and Medicine (HFM).
Through national and international partnerships, the RHID has developed an extensive network to exchange ideas and experiences.
Triple Helix, also known as Golden Triangle, which actively involves the 3 main actors (industry, the academic world and the administration) is the preferential approach followed by RHID to conduct scientific and technological research. This way, the best balance is to be achieved between outsourcing and in-house expertise.
Organising conferences, colloquia and seminars as well as publishing papers by researchers at the Belgian Ministry of Defence, and the Institute in particular, fully contribute to knowledge transfer. We are proud to support ISMCR and ELROB'2018.
The High Studies for Security and Defence, in the form of a meeting place with seminars and visits , provides training in these fields for high-level staff, both from the ministry

Tim Van Langenhove

International CBRNE Institute

Ladies and Gentlemen,
Dear friends,
the International CBRNE Institute is very pleased to welcome you to ELROB 2018.
I would like to thank especially the ELROB committee for the trust in our capacities to organize such a great event.
Thank you also to the companies which accepted to sponsor this event, their contribution helped greatly to the organization of this activity.
Finally, thank you to the staff of the ICI and the RPA Hainaut Sécurité for their indispensable support to the success and their kind availability.
The ICI with its 2 groups of experts becomes by its international dimension more and more a key player in all matters concerning CBRNE (Chemical, Biological, Radiological, Nuclear and Explosives) at both national and international level. Indeed, representatives from no less than 34 countries passed through our walls last year; and the trend still seems to be towards increasing this figure this year.
The advent of robotics has greatly improved the response capabilities of both military personnel and first responders in hostile or dangerous environments; it saves lives and is therefore of considerable interest to all.
Our Institute therefore has a role to play not only for the benefit of first responders but also by cooperating with regional and national academic institutions in our country and abroad.
Robotic is now integrated in our “Explosives Knowledge Centre” managed by Professor Yvan Baudoin.
I hope that this week’s trials will be useful to you or at least open your eyes to this very particular subject but also allow you to discuss on the subject with both the experts present and your colleagues.
Feel free to visit the stands in the marquee, they will present the latest technical developments in the field.

Thank you



Director ICI

ELROB 2018

24 - 28 Sept 2018

Mons, Belgium

Team Information

Picture of vehicle:	
Name of vehicle:	Telemax PRO Telemax HYBRID Telemax PLUS
Picture of team leader:	
Name of team leader:	Dr. Andreas Ciossek
Team Name:	Telerob
Team E-Mail:	andreas.ciossek@telerob.com
Logo:	TELEROB
Website:	www.telerob.com
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Outstanding technology and maximum reliability for handling dangerous tasks from a safe distance.

This is our motto, mission and motivation.

With its dual leadership model, Telerob is committed to a complementary and closely knit management concept

Norbert Gebbeken has been the Managing Director at Telerob since 2014. He brings with him more than a decade of managerial experience, including in the international mechanical engineering sector for the oil and gas industries.
Thomas Biehne was appointed Managing Director in 2016 and has held numerous executive positions at Telerob since 2005. As a former explosive device removal specialist and defuser, he offers in-depth know-how of products, markets and technology.
Working together, both managers stand for transparency, professionalism and open and honest business relationships with customers and business partners around the world.

Sales

Our technically versed Sales team is always delighted to present our products and solutions theoretically as well as practically, both at our premises and at our customers' sites. We offer specialist, technical advice in a partnership of equals, and are not afraid to draw comparisons with competitor products. The exceptional capacities and high-quality design of our robots and service vehicles speak for themselves. Working closely with our order processing department, our sales staff provides assistance to customers over the course of the project.

Development

Our specialists in the Electronics, Design, Drive Technology and Software fields are at the heart of Telerob's work. This is where we directly incorporate our customers' experiences and wishes. The highly qualified team is fully focused on transforming innovative ideas and technologies into products and solutions which offer customers practical benefits and true added value.

Production and logistics

Our team, made up of specialist technicians, meticulously handcrafts our robots to meet our customers' specific requirements. The perfection they produce on a daily basis guarantees the reliability of our products. As a rule, the process from the start of production through to final commissioning and handover to the customer takes around 3 months. Because we feel passionate about our "Made in Germany" quality, our production site is based in Ostfildern in southern Germany.
Our experienced logistics team ensures the reliable supply of parts to our Production and Service departments and thus, in turn, guarantees that our processes run smoothly. The optimal management of the more than 10,000 parts which we stock ensures rapid availability and therefore also the permanent operational readiness of our products.

telemax HYBRID

The best of both worlds:
Compact and strong!

Features

- Strong precision 6-axis manipulator with TCP control and automatic tool change
- Reinforced axes
- Lifting capacity up to 45 kg (99 lbs.)
- Compact dimensions
- 4-track drive system with a top speed of up to 10 km/h (6.2 mph)
- More than 30 pre-programmed automatic motion sequences for manipulator and flippers
- Interchangeability of accessories within the telemax family, e.g. batteries, tools, cameras and sensors
- Optional version for CBRN defense

Benefits

- Intuitive control of complex manipulator movements
- Ideal manipulator for working with heavy tools and firing systems
- Precise operating even with heavy objects in confined spaces
- Extreme mobility to overcome stairs, slopes, gaps and obstacles up to 50 cm (20 inches)
- Easy access to predefined automatic motion sequences
- Excels in a wide variety of applications
- Improved resistance against decontamination agents

TELEROB

telemax PRO

The original telemax:
Compact design and high reach!

Features

- Precision 7-axis manipulator with TCP control and automatic tool change
- Telescopic joint allows for increased reach of manipulator
- Lifting capacity up to 30 kg (66 lbs.)
- Compact dimensions
- 4-track drive system with a top speed of up to 10 km/h (6.2 mph)
- More than 30 pre-programmed automatic motion sequences for manipulator and flippers
- Interchangeability of accessories within the telemax family, e.g. batteries, tools, cameras and sensors

Benefits

- Intuitive control of complex manipulator movements
- Precise operation in a wide variety of situations
- Easily manipulate into difficult locations such as baggage compartments or under aircraft seats
- Extreme mobility to overcome stairs, slopes, gaps and obstacles up to 50 cm (20 inches)
- Easy access to predefined automatic motion sequences
- Excels in a wide variety of applications

TELEROB

telemax PLUS

The biggest and strongest telemax:
Versatile and strong!

Features

- Exceptionally strong precision 6-axis manipulator with TCP control and automatic tool change
- Lifting capacity up to 75 kg (165 lbs.)
- Double payload area on the chassis
- 4-track drive system with a top speed of up to 5 km/h (3.1 mph)
- More than 30 pre-programmed automatic motion sequences for manipulator and flippers
- Interchangeability of accessories within the telemax family, e.g. batteries, tools, cameras and sensors

Benefits

- Intuitive control of complex manipulator movements
- Particularly precise operating with very heavy objects
- More space for additional payloads such as: up to 4 batteries and other accessories like repeaters, x-ray systems or sensor platforms
- Good mobility to overcome stairs, slopes and obstacles up to 40 cm (16 inches)
- Easy access to predefined automatic motion sequences
- Excels in a wide variety of applications

ELROB 2018

24 - 28 September 2018

Mons, Belgium

Team Information

GOL STANISLAV

Team E-mail:	likvon@list.ru, pe4alj@mail.ru
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Location:	Russia
Institution/Company:	LLC KB Avrora
Address:	390005, Russia, Ryazan, Gagarina Str. 59/1
Telephone:	+7(910)579-30-13
Fax:	+7 (4912) 92-22-15
Team Description:	The Avrora team represents the KB Avrora limited liability company, the main goal of which is to provide an R&D services to industrial companies and research organizations as well as conduct its own research in the fields of robotics, embedded intelligent systems, mobile autonomous platforms and measurement systems. The majority of both team and KB Avrora members are alumni of Ryazan State Radio Engineering University (RSREU), with the average age of 30 years. The team is a regular participant of All-Russian Robocross trial aimed to test and compare the autonomous vehicles of different teams from many of universities. In the years of 2013-2015 the team was the winner of the Robocross trial; the team was also a participant of ELROB in the years of 2014 and 2016.
Sponsors:	Ryazan State Radio Engineering University (RSREU), Skolkovo Innovation Center

Pictures of the vehicle:	 
Name of vehicle:	Wombat Leader

Pictures of the vehicle:	 
Name of vehicle:	Wombat Follower

1 Basic data about vehicle

Length:	87	cm
Width:	76	cm
Height w/o antennas:	47	cm
Height with antennas:	125	cm
Weight:	80	kg
Ground clearance:	14	cm
Average noise level:	approx. 35	db(A)
Climbing performance:	30	degree
Wheel or track driven:	wheel	--
Propulsion:	Lead acid batteries	--
Endurance:	1	hrs
Max. speed:	6	km/h
Payload:	20	kg

2 Communication equipment

If you have multiple communication links and/or devices please specify all of them (Example: *WLAN, COFDM, Radio link, Video link* etc.).

Function:	Remote control & Emergency stop	--
Type:	Surface Radio	--
Frequency:	2400	MHz
Possible frequency range:	2400 to 2483.5	MHz
Power:	0.1	W
Modulation:	DSMR	--
Number of channels:	23	--

Function:	Telemetry link	--
Type:	WLAN	--
Frequency:	2420, 5220	MHz

Possible frequency range:	2412 to 2484 5150 to 5875	MHz
Power:	0.261, 0.021	W
Modulation:	64-QAM, 16-QAM, QPSK, BPSK	--
Number of channels:	11	--

Function:	Video link	--
Type:	videolink	--
Frequency:	5725	MHz
Possible frequency range:	5725 to 5825	MHz
Power:	0.1	W
Modulation:	n/a	--
Number of channels:	2	--

Function:	Beacon signal transmitter	--
Type:	Surface radio	--
Frequency:	434	MHz
Possible frequency range:	433.05 to 434.79	MHz
Power:	0.01	W
Modulation:	GSK	--
Number of channels:	1	--

3 Sensors equipment

What kinds of sensors are mounted on your vehicle?

Please specify type and basic data (see *examples* below).

Laser:	Velodyne HDL-32E
Vision:	Beward BD-2570-K12
GPS:	Geos5M GNSS receiver
Radar:	77GHz IWR1443-based radar
GNSS/INS system:	SBG Systems Ellipse-2D

4 Computing equipment on vehicle

Number of computers:	1
Number of CPUs:	1
Type of CPU:	Intel(R) Core(™) i7-4500 @ 1.8 GHz
Operating system(s):	Linux Ubuntu

5 Basic data about control station

Pictures of the control station:		
Number of mandatory operators	1	
Number of optional operators	1	
Number of computers:	1	
Number of CPUs:	1	
Type of CPU:	Intel Core i5-6200U	
Operating system:	Linux Ubuntu	
Space needed for control station (LWH):	50 x 30 x 7	cm
Weight of control station:	2.3	kg
Power source needed:	yes	

WOMBAT FOLLOWER

1 Basic data about vehicle

Length:	85	cm
Width:	64	cm
Height w/o antennas:	45	cm
Height with antennas:	123	cm
Weight:	65	kg
Ground clearance:	12	cm
Average noise level:	approx. 35	db(A)
Climbing performance:	30	degree
Wheel or track driven:	wheel	--
Propulsion:	Lead acid batteries	--
Endurance:	1	hrs
Max. speed:	6	km/h
Payload:	20	kg

2 Communication equipment

If you have multiple communication links and/or devices please specify all of them (Example: *WLAN, COFDM, Radio link, Video link* etc.).

Function:	Remote control & Emergency stop	--
Type:	Surface Radio	--
Frequency:	2400	MHz
Possible frequency range:	2400 to 2483.5	MHz
Power:	0.1	W
Modulation:	DSMR	--
Number of channels:	23	--

Function:	Telemetry link	--
Type:	WLAN	--
Frequency:	2420, 5220	MHz
Possible frequency range:	2412 to 2484 5150 to 5875	MHz
Power:	0.261, 0.021	W
Modulation:	64-QAM, 16-QAM, QPSK, BPSK	--
Number of channels:	11	--

Function:	Video link	--
Type:	videolink	--
Frequency:	5725	MHz
Possible frequency range:	5725 to 5825	MHz
Power:	0.1	W
Modulation:	n/a	--
Number of channels:	2	--

3 Sensors equipment

What kinds of sensors are mounted on your vehicle?

Please specify type and basic data (see *examples* below).

Laser:	Velodyne VLP-16
Vision:	Beward BD-2570-K12
GPS:	Geos5M GNSS receiver
Radar:	77GHz IWR1443-based radar
GNSS/INS system:	SBG Systems Ellipse-2D

4 Computing equipment on vehicle

Number of computers:	1
Number of CPUs:	1
Type of CPU:	Intel(R) Core(™) i7-6820 @ 2.80 GHz
Operating system(s):	Linux Ubuntu

5 Basic data about control station

Pictures of the control station:		
Number of mandatory operators	1	
Number of optional operators	1	
Number of computers:	1	
Number of CPUs:	1	
Type of CPU:	Intel Core i5-6200U	
Operating system:	Linux Ubuntu	
Space needed for control station (LWH):	50 x 30 x 7	cm
Weight of control station:	2.3	kg
Power source needed:	yes	

ELROB 2018

24 - 28 September 2018

Mons, Belgium

Team Information

Name of team leader:

Patrik Bylin

Team Name:

Team Brokk Security and Rescue Solutions

Team E-mail:

patrik.bylin@brokk.com

Logo:

BROKK®
Security and Rescue Solutions

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www.brokk.com

Location:

Sweden

Institution/Company:

Brokk AB

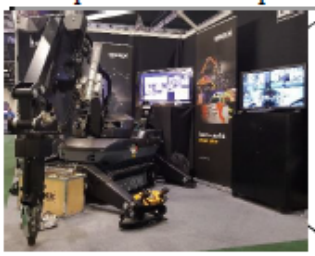
Address:

Risbergsgatan 67, Skellefteå, Sweden

Telephone:

+46761063757

Vehicle Specification Sheet

Pictures of the vehicle:	Please provide detailed pictures from ALL sides of the vehicle
	 
Name of vehicle:	Brokk SR-120D-System

1 Basic data about vehicle

Length:	240	cm
Width:	78	cm
Height w/o antennas:	130	cm
Height with antennas:	Max 200	cm
Weight:	1300	kg
Ground clearance:	10	cm
Average noise level:	Max 104	db(A)
Climbing performance:	30	degree
Wheel or track driven:	Track	--
Propulsion:	Diesel	--
Endurance:	Min 8	hrs
Max. speed:	3	km/h
Payload:	1000	kg

2 Communication equipment

If you have multiple communication links and/or devices please specify all of them (Example: *WLAN, COFDM, Radio link, Video link* etc.).

Function:	Machin Data/Video/Etc.	--
Type:	Radio	--
Frequency:	C-band	MHz
Possible frequency range:	Preferred 5-5.9GHz	MHz
Power:	10 W e.r.p	W
Modulation:	Proprietary	--
Number of channels:		--

Function:	(e.g. Video Downlink, Emergency Stop etc.)	--
Type:		--
Frequency:		MHz
Possible frequency range:		MHz
Power:		W
Modulation:		--
Number of channels:		--

3 Sensors equipment

What kinds of sensors are mounted on your vehicle?

Please specify type and basic data (see *examples* below).

Laser:	TBD
Vision:	EO
GPS:	TBD
Radar:	TBD
Inertial measurement unit:	TBD

ELROB 2018

24 - 28 September 2018
Mons, Belgiu,

Team Information

Name of vehicle:	TULF / StrAsRob
Picture of team leader:	
Name of team leader:	Dr. Alexander Wolf
Team Name:	Smart Military Vehicles
Team E-mail:	Alexander.Wolf@diehl-defence.com
Website:	http://www.diehl.com/de/diehl-defence.html
Location:	Germany
Institution/Company:	Diehl Defence GmbH & Co. KG
Address:	Fischbachstr. 16-20, 90552 Röthenbach a. d. Pegnitz, Germany
Telephone:	+49 911 957 2318
Fax:	+49 911 957 2550
Team Description:	The team consists of some contractors and sub-contractors regarding the German R&D systems TULF (Technologieträger unbemanntes Landfahrzeug) and StrAsRob (Straßentransport mit Assistenzfunktionen von Robotern). The idea is to present the current capabilities of these modified military trucks to a wide audience in a competition which is designed based on military requirements.
Sponsors:	BAAINBw (Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr)

Vehicle Specification Sheet

Pictures of the vehicle:	
	
Name of vehicle:	THeMIS

1 Basic data about vehicle

Length:	240	cm
Width:	215	cm
Height w/o antennas:	111	cm
Height with antennas:	171	cm
Weight:	1450	kg
Ground clearance:	40 cm (front) 60cm (rear)	
Average noise level:	28dB (Diesel Engine)	
Climbing performance:	60 degree	
Wheel or track driven:	tracked	
Propulsion:	Fuel (diesel engine)	
Endurance:	8-10 (0,5-1,5 electric)	h
Max. speed:	22,5	km/h

Vehicle Specification Sheet

Payload:	750	kg

2 Communication equipment

Function:	WLAN	--
Type:	BULLET TITANUM M5HP	--
Frequency:	5170	MHz
Possible frequency range:	5170 - 5875	MHz
Power:	0.32	W
Modulation:	OFDM	--
Number of channels:	9	--

Function:	Remote Emergency Stop				--
Exact device name:	HBC Radiomatic FSE511 + patrol S (remote) + Procom MU 7-CX-rev.2/1 (antenna)				--
Device type:	Radio system				--
Analogue or digital:	Analogue				--
Communication standard:					--
Used frequency:	434,6750				MHz
Possible frequency range:	from:	434,0750	to:	434,775	MHz
Possible tuning steps:	25				MHz
Number of channels:					--
Transmit power:	10				W
Antenna gain:	0				dBi
Channel Bandwidth:					MHz
Max. data rate:					kbps
Modulation:					--

3 Sensors equipment

Laser:	2x Velodyne VLP-16 PUCK
Vision:	-
GPS:	Oxford RT1003 (Novatel)
Radar:	-
Inertial measurement unit:	Oxford RT1003
Ground Movement	-

4 Computing equipment on vehicle

Number of computers:	2
Number of CPUs:	2
Type of CPU:	2x Intel (i7-2715QE)
Operating system(s):	Ubuntu 14.04 LTS 64bit

5 Basic data about control station

Pictures of the control station:	 Samsung S8	
Number of mandatory operators	1	
Number of optional operators	1	
Number of computers:	1	
Number of CPUs:	1	
Type of CPU:	Exynos 8895	
Operating system:	Android	
Space needed for control station (LWH):	148 x 70 x 7	mm
Weight of control station:	173	g

ELROB 2018

24 - 28 September 2018

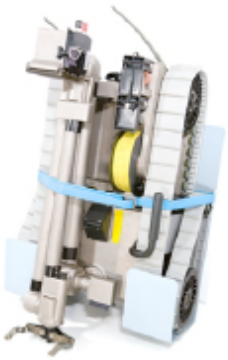
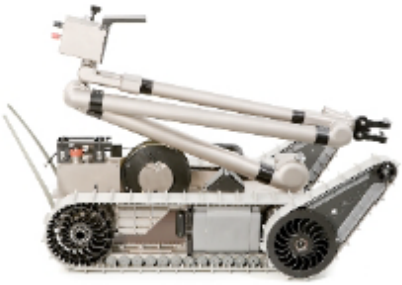
Mons, Belgium

Team Information

Picture of team leader:	
Name of team leader:	Colin Weiss
Team Name:	ELP
Team E-mail:	cweiss@elp-gmbh.de
Logo:	
Website:	http://www.elp-gmbh.de
Location:	Wuppertal, Germany
Institution/Company:	ELP GmbH, European Logistic Partners
Address:	Nützenberger Str. 359, 42115 Wuppertal, Germany
Telephone:	+49 202 698940
Fax:	+49 202 69894-10
Team Description:	ELP GmbH is distributing Endeavor Robotic's range of robotic systems within German-speaking Europe and provides Service and Training for these systems within all of Europe. In addition, ELP is developing accessories and additional capabilities for the Endeavor Robotics equipment.

Packbot 510 EOD

Vehicle Specification Sheet

Pictures of the vehicle:	     

1 Basic data about vehicle

Length:	69 cm (Flippers stowed), 88,9 cm (Flippers extended)	cm
Width:	40.6 cm without Flippers, 52 cm with Flippers	cm
Height w/o antennas:	40.7 cm (Total height from ground to top of the vehicle, Arm stowed, including flexible Antennas)	cm
Height with antennas:	2210 cm (Total height from ground to top, arm extended)	cm
Weight:	33.3 kg including batteries and optional F/O Spooler	kg
Ground clearance:	7.62 cm	cm
Average noise level:	-/- (approx.)	db(A)
Climbing performance:	Stairs (with 5 kg additional) payload: 43° on wood, 38° on carpet, 40° on metal	degree
Wheel or track driven:	Track	--
Propulsion:	Rechargeable Li-Ion Batteries, BB-2590 or similar	--
Endurance:	12 – 15	hrs
Max. speed:	9.3	km/h
Payload:	35 kg	kg

2 Communication equipment

If you have multiple communication links and/or devices please specify all of them (Example: *WLAN, COFDM, Radio link, Video link* etc.).

Function:	Telemetry (Video, Data, Brake/E-Stop)	--
Type:	WLAN 802.11a MESH-Networking, Alternative: WLAN 802.11b/g or uPoint MESH-Radio (MANET)	--
Frequency:	4.9 GHz, Alternative: 2.4 GHz, uPoint: TBC	MHz
Possible frequency range:	4.9 GHz, 2.4 GHz	MHz
Power:	0.4W (max, 4,9 GHz; uPoint: default: 0.3 W/Chain, max: 2W/chain)	W
Modulation:	OFDM	--
Number of channels:	4.9 GHz: 3; 2.4 GHz: 11, fixed to channel 6; uPoint: TBC	--

3 Sensors equipment

What kinds of sensors are mounted on your vehicle?

Please specify type and basic data (see *examples* below).

Laser:	
Vision:	5 Colour Cameras, 1 low light mode, one input for an auxiliary camera (FLIR or Wide-Angle as per mission requirements)
GPS:	uBlox GPS installed in UAP-Module
Radar:	-/-
Inertial measurement unit:	Self-protection IMU in Chassis, uBlox 11 DOF IMU in UAP-Module

4 Computing equipment on vehicle

Number of computers:	2: 1 fixed (main Computer in chassis), 1 optional (ELP-Payload)
Number of CPUs:	1 each
Type of CPU:	Intel Core2 (main Computer in Chassis), ARM Cortex (ELP-Payload)
Operating system(s):	All: Linux, MRC Controller: Android

Packbot and Kobra Control Station

5 Basic data about control station

Pictures of the control station:	

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

KOBRA 710

Pictures of the vehicle:	

1 Basic data about vehicle

Length:	91.4 cm for the chassis 108 cm with 2-link manipulator arm	cm
Width:	54.1 cm with flippers removed 76.7 cm with flippers installed	cm
Height w/o antennas:	45.7 cm stowed (for the chassis only) 73 cm stowed (with 2-link manipulator arm)	cm
Height with antennas:	75.7 cm (with 2 Link-arm mounted)	cm
Weight:	166.5 kg 228 kg with arm installed (both figures are inclusive of battery and flipper weight)	kg
Ground clearance:	7.6 cm	cm
Average noise level:	not determined	db(A)
Climbing performance:	Stair Climbing: 45° Slope: 45°	degree
Wheel or track driven:	Track	--
Propulsion:	(12) BB-2590/U Batteries in a battery box	--

Endurance:	8 – 10 h	hrs
Max. speed:	12.9 km/h	km/h
Payload:	68 kg (gripper lift strength)	kg

2 Communication equipment

If you have multiple communication links and/or devices please specify all of them (Example: *WLAN, COFDM, Radio link, Video link* etc.).

Function:	Telemetry (Video, Data, Brake)	--
Type:	WLAN with small patch antenna (300m LOS), Max. radio output 630 mW	--
Frequency:	Digital radio: 4900 MHz, Alternative: 2400 MHz, uPoint (same as PackBot) optional	MHz
Possible frequency range:	4900 MHz, 2400 MHz	MHz
Power:	0.398 W	W
Modulation:	OFDM	--
Number of channels:	7 possible channels – 4.9 GHz, 3 possible channels – 2.4 GHz	--

3 Sensors equipment

What kinds of sensors are mounted on your vehicle?

Please specify type and basic data (see *examples* below).

Laser:	Optional
Vision:	2 wide FOV cameras in chassis, 1 312x zoom camera in turret, optional external cameras for gripper and/or high-back view
GPS:	No on-board GPS
Radar:	No on-board radar
Inertial measurement unit:	3 axis, full 360 all axis, 180Hz refresh rate

Type of CPU:	Intel Core i7 1.5GHz processor
Operating system(s):	Linux

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Mons, Belgium

Team Information

Picture of team leader:	
Name of team leader:	Bastian Gaspers
Team Name:	Team FKIE & TNO
Team E-mail:	Bastian.gaspers@fkie.fraunhofer.de
Logo:	Fraunhofer FKIE TNO
Website:	www.fkie.fraunhofer.de/de/forschungsabteilungen/cms.html
Location:	Wachtberg, Germany
Institution/Company:	Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE
Address:	Fraunhoferstr. 20 53343 Wachtberg
Telephone:	+49 228 9435 665
Fax:	+49 228 9435 210
Team Description:	The Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE develops technologies and processes with the goals of detecting life-threating risks early and effectively minimizing and managing these risks. In cooperation with strategic partners we address the specific issues and challenges of command and control as well as reconnaissance. Our work is focused on creating effective and efficient human-machine systems, with the human factor playing the central role in the decision making process.. TNO connects people and knowledge to create innovations that boost the sustainable competitive strength of industry and well-being of society. This is our mission and it is what drives us, the 2,600 professionals at TNO, in our work every day.

Vehicle Specification Sheet

Pictures of the vehicle:	
Name of vehicle:	Longcross

1 Basic data about vehicle

Length:	178	cm
Width:	74	cm
Height w/o antennas:	172	cm
Height with antennas:	172	cm
Weight:	400	kg
Ground clearance:	10	cm
Average noise level:	60	db(A)
Climbing performance:	40	degree
Wheel or track driven:	Track	--
Propulsion:	Batteries	--
Endurance:	4	hrs
Max. speed:	13	km/h
Payload:	250	kg

2 Communication equipment

Function:	Data Network	--
Type:	WLAN 802.11a / b / g / n	--
Frequency:	2400 / 5000	MHz
Possible frequency range:	2400 to 2472 / 5000 to 5750	MHz
Power:	0.1	W
Modulation:	GMSK/8PSK/QPSK/16QAM	--
Number of channels:	13 / 19	--

Function:	Emergency Halt	--
Type:	Radiosafe Link	--
Frequency:	433	MHz
Possible frequency range:	433 to 435	MHz
Power:	0.01	W
Modulation:	FM	--
Number of channels:	64	--

3 Sensors equipment

Laser:	2x Sick LMS 511
Vision:	2x Telemax Manipulator Cameras, 2x Prosilica GT1380 Cameras in PTR System
GPS:	XSens MTi-G
Inertial measurement unit:	XSens MTi-G
Microphones:	6x Three on each side for 3D audio

4 Computing equipment on vehicle

Number of computers:	4
Computer1 Number of CPUs:	4
Computer1 Type of CPU:	Intel Core i7
Computer1 Operating system(s):	Linux
Computer 2	Customized FPGA video processing unit
Computer 3	Customized DSP audio stream generator
Computer 4	PC104 Movement Control unit
Computer 4 Type of CPU	Pentium 4, 1.7Ghz

5 Basic data about control station

Pictures of the control station:	
Number of mandatory operators	1
Number of optional operators	1
Number of computers:	3
Computer 1 Number of CPUs:	4
Computer 1 Type of CPU:	Intel Core i7
Computer 1 Operating system:	Linux
Computer 2	Customized FPGA video processing unit
Computer 3	Tiny Green PC for movement & audio
Computer 3 Operating system:	Windows

ELROB 2018

24 - 28 September 2018

Mons, Belgium

Team Information

Picture of team leader:

Name of team leader:	Thorsten Luettel
Team Name:	MuCAR
Team E-mail:	elrob@mucar3.de
Logo:	
Website:	http://www.unibw.de/tas
Location:	Neubiberg, Germany
Institution/Company:	University of the Bundeswehr Munich
Address:	Autonomous Systems Technology (LRT 8 TAS) Werner-Heisenberg-Weg 39 85579 Neubiberg Germany
Telephone:	+49 89 6004 4637 +49 170 5566266
Fax:	+49 89 6004 3074

Team Description:

Our Team MuCAR consists of about 15 team members under the leadership of Dipl.-Ing. Thorsten Luettel. All team members work as research assistants at "Autonomous Systems Technology" institute, which is headed by Prof. Dr.-Ing. Hans-Joachim Wuensche.

Our team developes and operates the two robot vehicles "MuCAR-3" and "MuCAR-4", the third rsp. fourth generation of our Munich Cognitive, Autonomous Robot Cars. The first two vehicle generations drove on German Autobahns under the leadership of Prof. E.-D. Dickmanns as far back as 1987. Both vehicles already have retired to museums.

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.

MuCAR-4 is based on a stock VW Tiguan with a TSI engine, modified to allow computer control of steering, brake, throttle and automatic gearbox.

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 degree LiDAR sensor mounted on the roof of the vehicle. It is advantageous in special applications such as off-road driving, until our vision systems can fully cope with those scenarios as well.

The main vision sensors are forward looking color cameras. Three of them are placed on a two-axis platform inside the vehicle. This arrangement resembles the human vision system, with a tele-camera as "fovea" and 2 slightly outward pointed wide angle cameras for peripheral vision, which can also be used for stereo vision. These three cameras are mounted on a yaw axis platform to allow for active control of the horizontal viewing direction, while the view of the tele-camera with its narrow field of view is inertially stabilized. One vehicle is additionally equipped with some stereo cameras of the roof, providing 3D information in forward and backward direction. Some more cameras working in different spectral regions (SWIR, NIR) complete the camera setup.

Our robust and fast 4D-approach to perception has been augmented by an innovative fusion of vision and LiDAR data and excels in offroad environments featuring poor GPS conditions. Different planning algorithms have shown their capabilities during the last trials.

Team MuCAR participated at the ELROB 2007, 2008, 2009, 2010, 2012, 2016, Eurathlon 2013 and – together with TU Karlsruhe and TU Munich through Team AnnieWAY – at the DARPA Urban Challenge 2007, where this team was one of only 11 teams which made it into the finals on 3 Nov. 2007.

Vehicle Specification Sheet

Pictures of the vehicle:	
Name of vehicle:	MuCAR-3 (Munich Cognitive Autonomous Robot Car, 3rd generation)

1 Basic data about vehicle

Length:	480	cm
Width:	193	cm
Height w/o antennas:	205	cm
Height with antennas:	240	cm
Weight:	2800	kg
Ground clearance:	~30	cm
Average noise level:	81 (approx.)	db(A)
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

2 Communication equipment

Function:	Vehicle-to-Vehicle-Communication (optional)	--
Type:	Amber Wireless AMB8355	--
Frequency:	868	MHz
Possible frequency range:	869.40 – 869.65	MHz
Power:	0.5	W
Modulation:	2-GFSK	--
Number of channels:	up to 8	--

Function:	Vehicle-to-Vehicle-Communication (optional)	--
Type:	Satel Satelline-Easy Pro	--
Frequency:	433	MHz
Possible frequency range:	403 - 473	MHz
Power:	up to 35	W
Modulation:		--
Number of channels:	Spacing 12.5 / 20 / 25 kHz	--

Function:	Telemetry to visitors' area (optional)	--
Type:	Ubiquity Bullet M2	--
Frequency:	2400	MHz
Possible frequency range:	2412-2462	MHz
Power:	Normally 0.1	W
Modulation:	WLAN	--
Number of channels:	13 (only 3 can be used without disturbances)	--

Function:	Telemetry to visitors' area (optional)	--
Type:	Commercial LTE/UMTS/GSM Modem	--

3 Sensors equipment

Laser:	- Velodyne HDL64E-S2 3D LiDAR System - Ibeo LUX 8L LiDAR System
Vision:	- custom-build 2 axis platform inside the vehicle, equipped with: o 2x color cameras (stereo) with wide-angle lenses o 1x color camera with tele lens o 2x NIR cameras with wide-angle lenses - FLIR LWIR camera
Radar:	- Smart Micro System UMRR
Inertial navigation system:	- OxTS RT3003: Full 6 DOF IMU system with integrated RTK-capable GNSS system (operated without RTK corrections during ELROB)

4 Computing equipment on vehicle

Number of computers:	1 high-level computer for all sensor data processing, mapping, planning and control
Number of CPUs:	2
Type of CPU:	Octa Core Intel Xeon E5-2667v4
Operating system(s):	Arch Linux

Number of computers:	2 real-time capable subsystems for - low-level control - analog/digital hardware I/O
Number of CPUs:	1
Type of CPU:	PowerPC integrated in dSPACE (Micro)AutoBox

5 Basic data about control station

Control station is mounted inside the vehicle. No external control station. An external station is optionally used for visualization of vehicles state and mission progress.

Vehicle Specification Sheet

Pictures of the vehicle:	
Name of vehicle:	MuCAR-4 (Munich Cognitive Autonomous Robot Car, 4rd generation)

1 Basic data about vehicle

Length:	443	cm
Width:	181	cm
Height w/o antennas:	170	cm
Height with antennas:	215	cm
Weight:	2000	kg
Ground clearance:	<20	cm
Average noise level:	75 (approx.)	db(A)
Climbing performance:	40	degree
Wheel or track driven:	4 wheel drive	--
Propulsion:	fuel (Super) (Volkswagen 2.0 ltr. TSI engine)	--
Endurance:	8	hrs
Max. speed:	200	km/h
Payload:	>250	kg

2 Communication equipment

Function:	Vehicle-to-Vehicle-Communication (optional)	--
Type:	Amber Wireless AMB8355	--
Frequency:	868	MHz
Possible frequency range:	869.40 – 869.65	MHz
Power:	0.5	W
Modulation:	2-GFSK	--
Number of channels:	up to 8	--

Function:	Vehicle-to-Vehicle-Communication (optional)	--
Type:	Satel Satelline-Easy Pro	--
Frequency:	433	MHz
Possible frequency range:	403 - 473	MHz
Power:	up to 35	W
Modulation:		--
Number of channels:	Spacing 12.5 / 20 / 25 kHz	--

Function:	Telemetry to visitors' area (optional)	--
Type:	Ubiquity Bullet M2	--
Frequency:	2400	MHz
Possible frequency range:	2412-2462	MHz
Power:	Normally 0.1	W
Modulation:	WLAN	--
Number of channels:	13 (only 3 can be used without disturbances)	--

Function:	Telemetry to visitors' area (optional)	--
Type:	Commercial LTE/UMTS/GSM Modem	--

3 Sensors equipment

Laser:	- Velodyne HDL64E-S2 3D LiDAR System
Vision:	- custom-build 2 axis platform inside the vehicle, equipped with: o 2x color cameras (stereo) with wide-angle lenses o 1x color camera with tele lens - custom-build 3-focal stereo system, forward-looking mounted on the vehicle's roof, equipped with: o 3x gray camera with wide-angle lenses - Nerian SP1 stereo vision processor, forward-looking mounted on the vehicle's roof, equipped with o 2x gray cameras - custom-build stereo system, backward-looking mounted on the vehicle's roof, equipped with: o 2x color camera with wide-angle lenses
Inertial navigation system:	- OxTS RT3003: Full 6 DOF IMU system with integrated RTK-capable GNSS system (operated without RTK corrections during ELROB)

4 Computing equipment on vehicle

Number of computers:	1 high-level computer for all sensor data processing, mapping, planning and control
Number of CPUs:	2
Type of CPU:	Octa Core Intel Xeon Gold 6144
Operating system(s):	Arch Linux

Number of computers:	1 real-time capable subsystems for - low-level control - analog/digital hardware I/O
Number of CPUs:	1
Type of CPU:	PowerPC integrated in dSPACE MicroAutoBox

5 Basic data about control station

Control station is mounted inside the vehicle. No external control station. An external station is optionally used for visualization of vehicles state and mission progress

ELROB 2018

24 - 28 September 2018

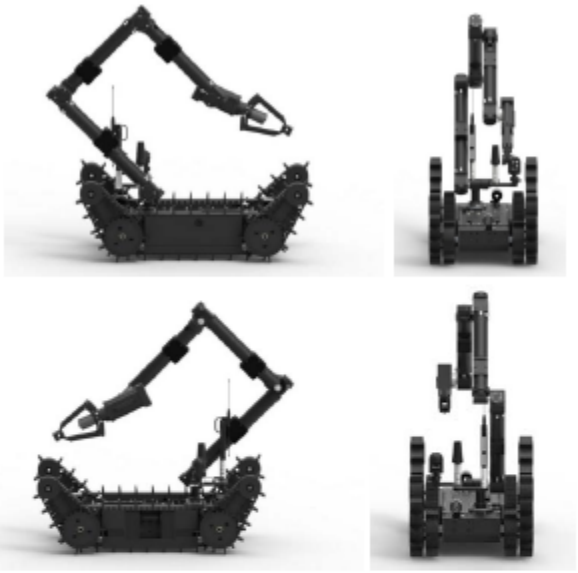
Mons, Belgium

Team Information

Picture of team leader:	
Name of team leader:	Steve Wisbey
Team Name:	NIC Instruments LTD
Team E-mail:	steve@nicltd.co.uk
Logo:	NIC INSTRUMENTS LIMITED www.nicltd.co.uk
Website:	www.nicltd.co.uk

Location:	Folkestone, Kent, UK
Institution/Company:	NIC Instruments LTD
Address:	Gladstone Road, Folkestone, Kent, CT19 5NF, UK
Telephone:	+44 1303 851022
Fax:	+44 1303 850155
Team Description:	UGV Team for NIC Instruments Ltd
Sponsors:	NIC Instruments

Vehicle Specification Sheet

Pictures of the vehicle:	Please provide detailed pictures from ALL sides of the vehicle 
Name of vehicle:	ZEUS

1 Basic data about vehicle

Length:	77	cm
Width:	46.5	cm
Height w/o antennas:	36.5	cm
Height with antennas:	65.1	cm
Weight:	43	kg
Ground clearance:	5.6	cm
Average noise level:	50	db(A)
Climbing performance:	45	degree
Wheel or track driven:	Track	--
Propulsion:	batteries	--

Endurance:	1-4 hours, mission dependant	hrs
Max. speed:	3	km/h
Payload:	30	kg

2 Communication equipment

If you have multiple communication links and/or devices please specify all of them (Example: *WLAN, COFDM, Radio link, Video link* etc.).

Function:	Radio link and COFDM video link	--
Type:	Radio link and COFDM video link	--
Frequency:	Radio: 458.5MHz, Video 1400MHz	MHz
Possible frequency range:	Radio: 458.5MHz – 458.95MHz Video: 1.28GHz to 1.485GHz	MHz
Power:	Radio 0.5W – 5W Video 1W	W
Modulation:	Radio: 4-level FSK, Video: COFDM QPSK	--
Number of channels:	Radio: 37, Video 16	--

3 Sensors equipment

What kinds of sensors are mounted on your vehicle?

Please specify type and basic data (see *examples* below).

Laser:	<5mW
Vision:	Front, rear, nomad, claw and pan tilt cameras
GPS:	Optional
Radar:	N/A
Inertial measurement unit:	N/A

4 Computing equipment on vehicle

Number of computers:	1
Number of CPUs:	2

Type of CPU:	Collibri Tegra
Operating system(s):	Linux

5 Basic data about control station

Pictures of the control station:	Please provide detailed pictures from ALL sides of the control station 	
Number of mandatory operators	1	
Number of optional operators	0	
Number of computers:	1	
Number of CPUs:	Quad core single processor	
Type of CPU:	Intel i5	
Operating system:	Windows 8.1	
Space needed for control station (LWH):	47x35.7x17.6	cm
Weight of control station:	12.5	kg
Power source needed:	Battery	

ELROB 2018

24 - 28 September 2018

Mons, Belgium

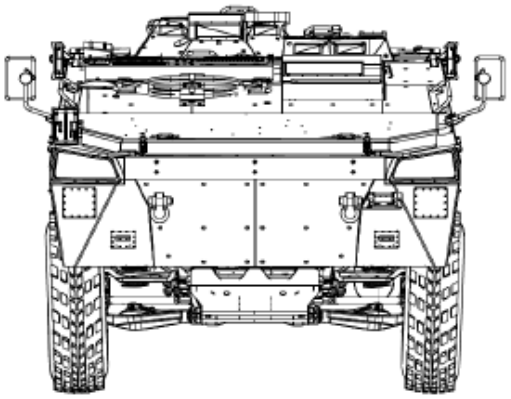
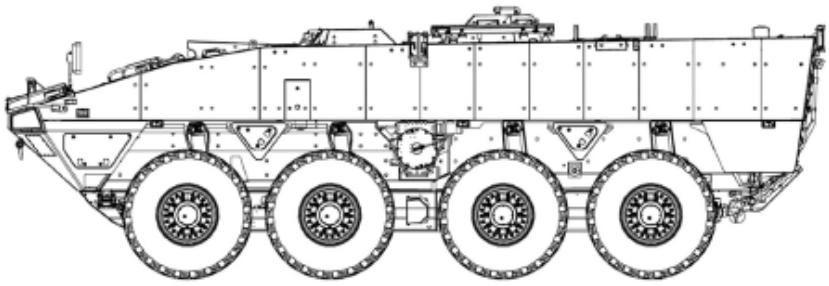
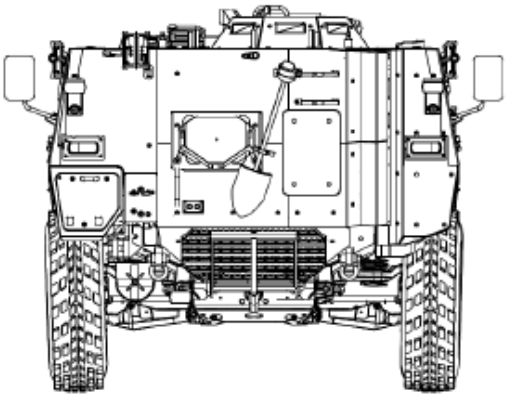
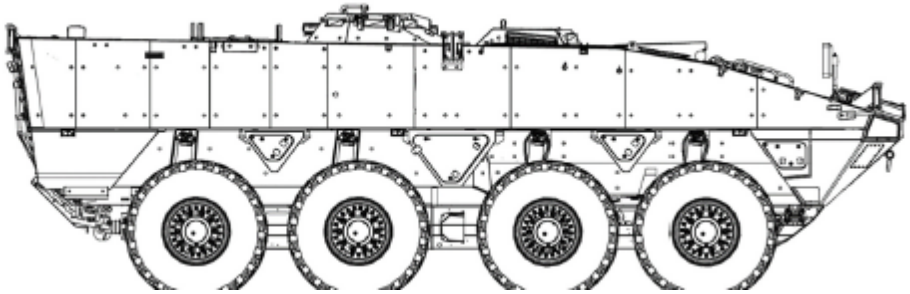
Team Information

Picture of team leader:	
Name of team leader:	Matti Saarikko
Team Name:	PATRIA
Team E-mail:	Matti.saarikko@patria.fi
Logo:	Patria
Website:	www.patria.fi/en
Location:	Finland
Institution/Company:	Patria Land Systems Oy
Address:	Autotehtaantie 6, 13250 Hämeenlinna, Suomi/Finland
Telephone:	+358408696636
Fax:	

Team Description:	Team is coming from Patria Land systems and has developed integrated control system for AMV enabling, various control methods, starting from drive by wire. For Elrob the vehicle is integrated with Diehl Defence autonomy kit.

PATRIA AMV 8x8

Vehicle Specification Sheet

Pictures of the vehicle:	Please provide detailed pictures from ALL sides of the vehicle   
	

1 Basic data about vehicle

Length:	801,5	cm
Width:	283,0	cm
Height w/o antennas:	264,5	cm
Height with antennas:	264,5	cm
Vehicle Gross Weight	27000	kg
Weight:	17000	kg
Ground clearance:	43,0	cm
Average noise level:	-	db(A)
Climbing performance:	70%	degree
Wheel or track driven:	Wheel	--
Propulsion:	Diesel	--
Operating range	700	km
Max. speed:	100	km/h
Payload:	10000	kg

2 Communication equipment

Function:	(e.g. Video Downlink, Emergency Stop etc.)	--
Type:		--
Frequency:		MHz
Possible frequency range:		MHz
Power:		W
Modulation:		--
Number of channels:		--

3 Sensors equipment

Laser:	
Vision:	
GPS:	TBD
Radar:	Continental ARS 408-21
Inertial measurement unit:	TBD

ELROB 2018
TEAM Information

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The team consists of some contractors and sub-contractors regarding the German R&D systems TULF (Technologieträger unbemanntes Landfahrzeug) and StrAsRob (Straßentransport mit Assistenzfunktionen von Robotern). The idea is to present the current capabilities of these modified military trucks to a wide audience in a competition which is designed based on military requirements.
SPONSOR: BAAINBw (Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr)

VEHICLE SPECIFICATION

TULF (Technologieträger Unbemanntes Landfahrzeug)

Pictures of the vehicle:	

1 Basic data about vehicle

Length:	946	cm
Width:	255	cm
Height w/o antennas:	332	cm
Height with antennas:	399	cm
Weight:	12860 (empty)	kg
Ground clearance:	34 cm (front) 29cm (rear)	
Average noise level:	82db(A)	
Climbing performance:	60 degree	
Wheel or track driven:	Wheel (6x6)	
Propulsion:	Fuel (diesel engine)	
Endurance:	750	km
Max. speed:	90	km/h
Payload:	12140	kg

2 Communication equipment

Function:	Vehicle Control	--
Type:	Cobham RMDigi-086087	--
Frequency:	869.4	MHz
Possible frequency range:	869.4 – 869.65	MHz
Power:	0.1	W
Modulation:	COFDM 20KHz 16QAM FEC 1/2	--
Number of channels:	9	--

Function:	Video Transmission	--
Type:	Cobham RMDigi-560600	--
Frequency:	5660	MHz
Possible frequency range:	5660 - 5820	MHz
Power:	0.1	W
Modulation:	COFDM 8MHz QPSK FEC 2/3	--
Number of channels:	9	--

Function:	LTE Based military communication	--
Type:	Mobilicom MCU-100, Mobilicom HPA-20MI	--
Frequency:	2410	MHz
Possible frequency range:	2400-2450	MHz
Power:	2 x 20W peak, 2 x 4W average	W
Modulation:	QPSK / 16QAM	--
Number of channels:	1	--

Function:	WLAN	--
Type:	BULLET TITANUM M5HP	--
Frequency:	5170	MHz
Possible frequency range:	5170 - 5875	MHz
Power:	0.32	W
Modulation:	OFDM	--
Number of channels:	9	--

Function:	Remote Emergency Stop	--
Type:	JAY electronique	--
Frequency:	433.1	MHz
Possible frequency range:	433.1 – 434.674	MHz
Power:	<0.01	W
Modulation:	FM	--
Number of channels:	64	--

Function:	RF Ranging System	--
Type:	TimeDomain PulsON 440	--
Frequency:	4300	MHz
Possible frequency range:	3100 – 4800	MHz
Power:	<0.001	W
Modulation:	-	--

Number of channels:	-	--

3 Sensors equipment

Laser:	2x Velodyne HDL 32
Vision:	1x Xenics Gobi 640-GigE (infrared camera) 2x Jenoptik IR-TCM HD 1024 (infrared camera) 10x Basler acA1300-30gc 1x Basler acA2040-25gc
GPS:	As part of IMU Xsens MTi-G
Radar:	2x Continental ARS 308T 9x UMRR Smart Micro Radar
Inertial measurement unit:	Xsens-MTi-G KVH DSP 3000 (optical gyro)
Ground Movement	Dickey John, radar based sensor

4 Computing equipment on vehicle

Number of computers:	10
Number of CPUs:	11
Type of CPU:	9x Intel (i7-2715QE) + 2x Intel Xeon E5-2640 v3 Prozessor (2,6GHz, 8C/16T, 20MB Cache, 8GT/s QPI, 90W, Turbo, HT)
Operating system(s):	Ubuntu 14.04 LTS 64bit

5 Basic data about control station

Pictures of the control station:	Container is shown on the TULF vehicle on top of this document.	
Number of mandatory operators	1	
Number of optional operators	1	
Number of computers:	2	
Number of CPUs:	2	
Type of CPU:	Intel Core i7, Intel Atom N450	
Operating system:	Ubuntu Linux, Windows	
Space needed for control station (LWH):	400 x 265 x 240	cm
Weight of control station:	approximately 4000	kg
Power source needed:	400V DC or stand alone with power generator	

Pictures of the vehicle:

6 Basic data about vehicle

Length:	946	cm
Width:	255	cm
Height w/o antennas:	332	cm
Height with antennas:	399	cm
Weight:	12860 (empty)	kg
Ground clearance:	34 cm (front) 29cm (rear)	
Average noise level:	82db(A)	
Climbing performance:	60 degree	
Wheel or track driven:	Wheel (6x6)	
Propulsion:	Fuel (diesel engine)	
Endurance:	750	km
Max. speed:	90	km/h

Payload:	12140	kg

7 Communication equipment

Function:	LTE Based military communication	--
Type:	Mobilicom MCU-100, Mobilicom HPA-20MI	--
Frequency:	2410	MHz
Possible frequency range:	2400-2450	MHz
Power:	2 x 20W peak, 2 x 4W average	W
Modulation:	QPSK / 16QAM	--
Number of channels:	1	--

Function:	WLAN	--
Type:	BULLET TITANUM M5HP	--
Frequency:	5170	MHz
Possible frequency range:	5170 - 5875	MHz
Power:	0.32	W
Modulation:	OFDM	--
Number of channels:	9	--

Function:	Remote Emergency Stop	--
Type:	JAY electronique	--
Frequency:	433.1	MHz
Possible frequency range:	433.1 – 434.674	MHz
Power:	<0.01	W
Modulation:	FM	--
Number of channels:	64	--

Function:	RF Ranging System	--
Type:	TimeDomain PulsON 440	--
Frequency:	4300	MHz
Possible frequency range:	3100 – 4800	MHz
Power:	<0.001	W
Modulation:	-	--
Number of channels:	-	--

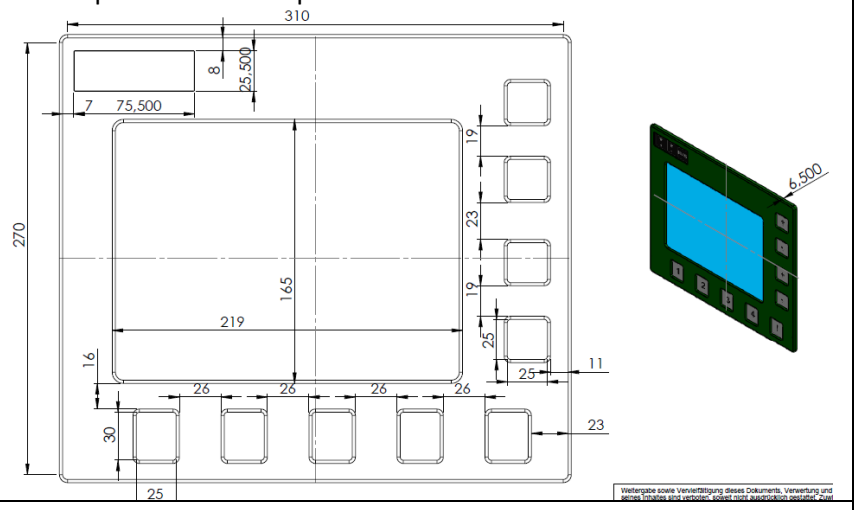
8 Sensors equipment

Laser:	IBEO LUX 8L
Vision:	1x Xenics Gobi 640-GigE (infrared camera) 3x Basler acA1300-30gc 1x Basler acA2000-50gc
GPS:	As part of IMU Xsens MTi-G
Radar:	Continental ARS 308T
Inertial measurement unit:	Xsens-MTi-G KVH DSP 3000 (optical gyro)
Ground Movement	Dickey John, radar based sensor

9 Computing equipment on vehicle

Number of computers:	7
Number of CPUs:	7
Type of CPU:	Intel (i7-2715QE)
Operating system(s):	Ubuntu 12.04 LTS 64bit

10 Basic data about control station

Pictures of the control station:	Please provide detailed pictures from ALL sides of the control station 	
Number of mandatory operators	1	
Number of optional operators	0	
Number of computers:	1	
Number of CPUs:	1	
Type of CPU:	Intel® Core i7-2610UE™, Sandy Bridge, 1.5GHz (Turbo Frequenz max. 2.4GHz)	
Operating system:	Ubuntu 12.04 LTS 64bit	
Space needed for control station (LWH):	None (in StrAsRob integrated)	cm
Weight of control station:	6.5	kg
Power source needed:	None (in StrAsRob integrated)	

ELROB 2018
Team Information

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-

Team is cooperation of several institutions in Oulu region for building high performance mobile robotic systems.

VEHICLE SPECIFICATION

MÖRRI

1 Basic data about vehicle

Length:	80	cm
Width:	60	cm
Height w/o antennas:	50	cm
Height with antennas:	100	cm
Weight:	50	kg
Ground clearance:	12	cm
Average noise level:	60	db(A)
Climbing performance:	20 degrees	degree
Wheel or track driven:	wheels, optional tracks	--
Propulsion:	battery	--
Endurance:	2	hrs
Max. speed:	20	km/h
Payload:	100	kg

2. Communication Equipment

Exact device name:	TBS Crossfire Micro				--
Device type:	RC link + telemetry				--
Analogue or digital:	digital				--
Communication standard:	RED 2014/53/EU				--
Used frequency:	868				MHz
Possible frequency range:	from:	868	to:	869	MHz
Possible tuning steps:	Unknown				MHz
Number of channels:	Unknown				--
Transmit power:	0.025 – 0.1 W, Adjustable				W
Antenna gain:	Unknown				dBi
Channel Bandwidth:	Unknown				MHz
Max. data rate:	57600				baud
Modulation:	DSSS, FHSS				--

Exact device name:	RFD 868x				--
Device type:	serial modem				--
Analogue or digital:	digital				--
Communication standard:	FCC Part 15.247, AS/NZS 4268:2012				--
Used frequency:	868				MHz
Possible frequency range:	from:	868	to:	869	MHz
Possible tuning steps:	Unknown				MHz
Number of channels:	50				--
Transmit power:	0 – 1W, Adjustable				W
Antenna gain:	Unknown				dBi
Channel Bandwidth:	Unknown				MHz
Max. data rate:	460				kbps

Exact device name:	Asus USB-N14			--
Device type:	WiFi			--
Analogue or digital:	digital			--
Communication standard:	IEEE 802.11 b/g/n			--
Used frequency:	2400			MHz
Possible frequency range:	from:	2412	to: 2484	MHz
Possible tuning steps:	5			MHz
Number of channels:	13			--
Transmit power:	0.2			W
Antenna gain:	5 – 9			dBi
Channel Bandwidth:	22 / 40, depends on modulation			MHz
Max. data rate:	300 000			kbps
Modulation:	64QAM, 16QAM, CCK, OFDM			--

3.Sensors Equipment

Laser:	Hokuyo UST20LX *2 Hokuyo YUV30 *1
Vision:	Kinect 2 camera * 2 Zed stereo camera * 2
GPS:	Emlid GNSS
Radar:	-
Inertial measurement unit:	Custom made IMU

4.Computing Equipment

Number of computers:	2

ELROB 2018
TEAM INFORMATION

Team Name: MSAS
Team E-mail: januszbedkowski@gmail.com Logo:
Website: www.mandalarobotics.com
Location: ul. Wagnera 1/53 96-100 Skierniewice, Team Name: MSAS
Institution/Company: MANDALA
Address: ul. Wagnera 1/53 96-100 Skierniewice
Telephone: 0048 501 090 020
Fax:

Team Description:

Our team is focused on robotic 3D mapping applications. The goal is to achieve full autonomy in this task. We start research in this direction some years ago, thus we have already shown our results in several real robotic trials. We demonstrated our first prototype during CELROB 2011. We improved this prototype for competition during Eurathlon 2013 where we successfully delivered 3D maps of the environment. We increased the TRL of our prototype during FP7 ICARUS project. The system was demonstrated during Eurathlon 2015 as a component of ICARUS team. We tested it in EnRicH 2017 and demonstrated improved capabilities of accurate 3D mapping of unknown area.

VEHICLE SPECIFICATION
MSAS

1.BASIC DATA

Length:	80	cm
Width:	60	cm
Height w/o antennas:	120	cm
Height with antennas:	120	cm
Weight:	50	kg
Ground clearance:	10	cm
Average noise level:	67	db(A)
Climbing performance:	15	degree
Wheel or track driven:	wheel	--
Propulsion:	batteries	--
Endurance:	2	hrs
Max. speed:	2	km/h
Payload:	10	kg

2.Communication Equipment

Function:	(e.g. Video Downlink, Emergency Stop etc.)	--
Type:		--
Frequency:		MHz
Possible frequency range:		MHz
Power:		W
Modulation:		--
Number of channels:		--

3.Sensors Equipment

Laser:	Velodyne VLP16
Vision:	Flir Ladybug 5
GPS:	Novatel FlexPack6
Radar:	no
Inertial measurement unit:	Xsens 4gen MTI30

4.Computing Equipment

Number of computers:	1
Number of CPUs:	4
Type of CPU:	Intel 7700
Operating system(s):	Linux

ELROB 2018

TEAM INFORMATION

Antony PENN
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Antony PENN – Team Leader
Benoît Latrille - Maintenance technician Georges WHITE – Business Manager Dominique VERDEAU – ECA Consultant

VEHICLE SPECIFICATION
CAMELEON MK1

Pictures of the vehicle: 	Please provide detailed pictures from ALL sides of the vehicle   

1.Basic data about vehicle

Length:	66	cm
Width:	52	cm
Height w/o antennas:	60	cm
Height with antennas:	60	cm
Weight:	55	kg
Ground clearance:	5	cm
Average noise level:	60	db(A)
Climbing performance:	45°	degree
Wheel or track driven:	Track with flippers	--
Propulsion:	Battery Li-Ion 30VDC	--
Endurance:	2h30	hrs
Max. speed:	6	km/h
Payload:	10	kg

2.Communication equipment

Function:	Data/Video	--
Type:	DIGITAL /COFDM	--
Frequency:	2350	MHz
Possible frequency range:	2300 to 2700	MHz
Power:	0,2	W
Modulation:	QPSK	--
Number of channels:	400	--

3.Sensors equipment

Laser:	Telemeter laser 0 to 7m
Vision:	5 cameras
GPS:	NO
Radar:	NO
Inertial measurement unit:	NO

4.Computing equipment on vehicle

Number of computers:	
Number of CPUs:	2
Type of CPU:	Core I3
Operating system(s):	Linux

5.Basic data about control station

	Please provide detailed pictures from ALL sides of the control station 	
Number of mandatory operators	1	
Number of optional operators	1	
Number of computers:	1	
Number of CPUs:	1	
Type of CPU:	Core I5	
Operating system:	Windows 8	
Space needed for control station (LWH):	50 x 50 x 20	cm
Weight of control station:	5	kg
Power source needed:	220VDC	

ELROB 2018
TEAM INFORMATION

Dr. Marc Lemmermann
Mission Master – Rheinmetall Marc.lemmermann@rheinmetall.com

RHEINMETALL DEFENCE

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Rheinmetall Canada inc.
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1-450-358-2000

1-450-358-1744

Consisting of a multidisciplinary engineer team from various background, Rheinmetall UGV team work full time in order to develop the Mission Master engineered to unburden soldiers in today's battlefield.

VEHICLE SPECIFICATION
MISSION MASTER

1.BASIC DATA

Length:	295	cm
Width:	255 max (cargo stowed)	cm
Height w/o antennas:	195 max (cargo deployed)	cm
Height with antennas:	195 max (cargo deployed)	cm
Weight:	1070	kg
Ground clearance:	19	cm
Average noise level:	Non Available	db(A)
Climbing performance:	40	degree
Wheel or track driven:	Wheels (8)	--
Propulsion:	Electrical	--
Endurance:	8	hrs
Max. speed:	30	km/h
Payload:	600	kg

2. Communication Equipment

Function:	Command, control, monitoring	--
Type:	MPU5, Wide Band Radio (WIFI)	--
Frequency:	2412	MHz
Possible frequency range:	2200-2507	MHz
Power:	1	W
Modulation:	MIMO OFDM (adaptative)	--
Number of channels:	20	--

Function:	Command, control, monitoring	--
Type:	UBIQUITY BULLET M2H4, Wide Band Radio (WIFI)	--
Frequency:	2412	MHz

Function:	Safety Switch	--
Type:	2.4 GHz Safety Switch Air Eagle SR Plus	--
Frequency:	2400 (Adaptative)	MHz
Possible frequency range:	2412-2462	MHz
Power:	0.06	W
Modulation:	MIMO OFDM (adaptative)	--
Number of channels:	20	--

Possible frequency range:	2412 - 2462	MHz
Power:	0.3	W
Modulation:	MIMO OFDM (adaptative)	--
Number of channels:	11	--

Function:	Command, control, monitoring	--
Type:	Tablet (computer WIFI)	--
Frequency:	2400 (Adaptative)	MHz
Possible frequency range:	2412 - 2462	MHz
Power:	0.100	W
Modulation:	OFDM / DSS (adaptative)	--
Number of channels:	11 (Canadian standard)	--

Function:	Remote control	--
Type:	CS458TRT Remote Control	--
Frequency:	458.500 - 459.550 (adaptative)	MHz
Possible frequency range:	458.500 - 459.550 (adaptative)	MHz
Power:	0.01	W
Modulation:	FSK 10K2G1D	--
Number of channels:	20	--

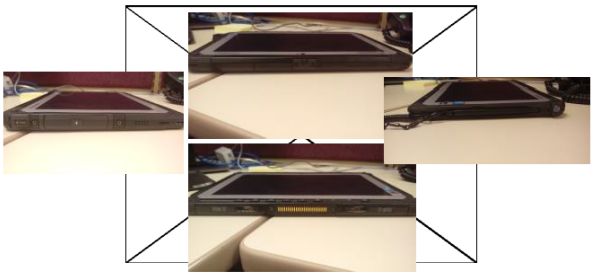
3.Sensors Equipment

Laser:	
Vision:	AXIS F1035-E sensor unit (camera 1080p CMOS sensor for F44)
GPS:	V5330 GNSS Receiver
Radar:	1x Velodyne "puck" VLP-16 (3D LiDAR) 3x Sick sensors TiMxxx (2D LiDAR)
Inertial measurement unit:	MTi-20-VRU-2A5G4

4.Computing Equipment

Number of computers:	1
Number of CPUs:	1
Type of CPU:	Intel® 4th Gen Core™ i3-4010U ULT 1.7 GHz Dual Core, 3MB L2
Operating system(s):	LINUX

5.Basic Data about Control Equipment

Pictures of the control station: 	Please provide detailed pictures from ALL sides of the control station 
Number of mandatory operators	1
Number of optional operators	N/A
Number of computers:	1
Number of CPUs:	1

Pictures of the control station: 	Please provide detailed pictures from ALL sides of the control station 	
Number of mandatory operators	1	
Number of optional operators	N/A	
Number of computers:	-	
Number of CPUs:	-	
Type of CPU:	-	
Operating system:	-	
Space needed for control station (LWH):	170x312x165	cm
Weight of control station:	1,9	kg
Power source needed:	Battery Ni-MH (3,6 V, 1,2 Ah)	

Pictures of the control station:  	Please provide detailed pictures from ALL sides of the control station  	
Number of mandatory operators	1	
Number of optional operators	N/A	
Number of computers:	1	
Number of CPUs:	1	
Type of CPU:	Core i7 2.6Ghz	
Operating system:	Windows 7	
Space needed for control station (LWH):	44X14X8.5	inches
Weight of control station:	35	kg
Power source needed:	Li-On 10.65V 8.55Ah or AC 100V-250V 50/60Hz	