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Concept & Rules

- ELROB -

European Land-Robot Trial

URL: www.elrob.org

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1 Introduction

1.1 European Land-Robot Trial

The European Land Robot Trial (ELROB) comes in two versions:

- C-ELROB, the civil version
- M-ELROB, the military version

The event is not a competition but a TRIAL!

The ELROB is open to:

- Users
  These are (future) professional users of robots.
- Industry
  These are designers and manufacturers of integrated ground robots focusing on considered domains.
- Research
  These are universities and other research institutes focusing on (partial) solutions relevant to the considered domains (e.g.: sensor technology or outdoor navigation).

The proven philosophy of ELROB is:

- ELROB is conducted with a focus on short-term realisable robot systems!
- ELROB is explicitly designed to assess current technology to solve real world problems at hand!
- ELROB in addition is an opportunity to bring together users, researchers and industry to build a community! Therefore ELROB is set-up as a co-operation between representatives from the users community, industry and the research community.

1.2 General structure of the Event

The organizers invites the potential candidates to demonstrate the capabilities of their UGVs/UAVs in demanding scenarios. Each participant can subscribe to one or more scenarios. In advance to the event, the organizer will define and publish the scenarios in detail. This will allow the participants to adequately prepare for the environmental and technical conditions.

The M-ELROB will be accompanied with a comprehensive exhibition covering a wide variety of robotics aspects. Contributions from all robotic areas are welcome to exhibit.

The exact organization and conditions of the trials will be governed by the set of rules published on the website. In the setup phase, the vehicle will be put into operation and prepared for the start on the actual track. The run will be supervised by the organizers. If a participant has to abort the run because of technical difficulty, he might be allowed to repeat the run on request. Violations of the organizer’s rules or instructions will result in exclusion from the event.

2 Eligibility

2.1 Team Membership

A team is comprised of the individuals identified to the organisers on the team roster. Only these individuals are team members. Each team must designate a single individual to serve as the team leader. The team leader must be at least 21 years of age and must hold European citizenship on the date of application to the ELROB, and must remain a citizen for the duration of the ELROB. Proof of European Citizenship for the team leader must be provided with the application as described in the application instructions. The organiser's representatives will verify these documents.

For each team, the team leader will serve as the primary point of contact with the organisers. The team leader must sign the application, must provide a Letter of Intent including the Liability Statement (LOI), and must be present at the meeting with all team leaders and the ELROB. The team leader will specify the team members. An individual may be the leader of only one team but team members may serve on multiple teams.

Team leadership may be transferred from the team leader to another eligible individual; there may be only one team leader at any time. Transfer of team leadership occurs when the organisers receive a new LOI. The form must be signed by the existing team leader and the new team leader. The new team leader must also submit proof of citizenship.

Although the number of individuals listed on the team roster is not expressly limited, the organisers will impose a limit on the number of team members allowed into designated areas at the ELROB event. The organisers will communicate the limit to the team leaders upon notification of selection.

Modified LOIs can NOT be accepted!

2.2 Non-European Participation and Sponsorship

Individuals holding non-European citizenship are eligible to participate in the event on teams with a team leader who is a European citizen. Non-European corporations and non-governmental organizations may participate as team sponsors. Teams receiving funding or any form of support from non-European governments or non-European governmental organizations are not eligible to participate.

2.3 Team Funding and Support

The cost of developing, fielding, and insuring entered vehicles is the sole responsibility of the individual teams. The organisers will not provide funding for the purpose of ELROB entry or participation.

3 Application Procedure

3.1 Basic Requirements

World Wide Web access, e-mail access, and basic word processing are necessary to complete and submit the application and for communication with the organisers of the ELROB staff.

The application consists of three parts:

Part 1: Team Application including Letter of Intent and Liability Statement (at the C-ELROB: Registration fee)

Part 2: Team information, selection of scenario, and Vehicle, Radio, and Exhibition Specification Sheet

Part 3: Membership roster, Technical Paper

Instructions for obtaining above-mentioned ELROB application materials and for proper submission are on the ELROB website.

All parts of the application must be received by the organisers before the specified deadlines for a team to become eligible for participation in the ELROB. Dead lines are specified at the web page.

Materials received after their respective deadlines will not be considered, and will be destroyed by the organisers.

3.2 Submission Procedures

Application documents must be submitted using the transmittal instructions on the forms. The receipt of application documents will be acknowledged by the organisers. Delivery information and official time of receipt will be recorded as follows:

Application materials remitted using any kind of delivery service should be addressed to:

Frank E. Schneider
Neuenahrerstrasse 20
D-53343 Wachtberg
Germany
Tel.: +49 228 9435 481
Fax.: +49 228 9435 16-481
eMail: elrob@fkie.fraunhofer.de / elrob@elrob.org
URL: www.elrob.org

The time of receipt for each package will be logged as recorded in the organiser's mailroom. The time of receipt for each document will be logged by the organisers e-mail system.

3.3 Qualification Process

All steps of the qualification process must be completed by teams that wish to take part in the ELROB. A team that has submitted application parts 1 and 2 the application by the deadline and has received acknowledgement from the organisers becomes an ELROB entrant. A team must submit application part 3 of the application by the deadline in order to remain an entrant.

3.4 Additional Materials

The organisers may request additional information from the teams after the receipt of the application materials. Examples of additional required information include an updated team roster, photographs of the Challenge vehicle, and a photograph of the team.

3.5 Team Promotional Material

Contact information for each team including team leader name, team e-mail address, and team URL will be posted on the ELROB website to enable contact from potential sponsors, other teams, and media. Promotional materials provided by the teams such as the team description paragraph, team sponsor list, team picture, and vehicle picture can also be published on the website. Following the conclusion of the ELROB, team technical papers will also be published on the website.

4 Vehicle Requirements

4.1 Autonomous Vehicle Behaviour

Participating vehicles will require autonomous behaviour and operation to complete ELROB. Fully remote controlled UGVs/UAVs are also allowed.

Nevertheless, Vehicles must be completely unmanned.

4.2 Vehicle Limitations for UGV

The entry must be a ground vehicle that is propelled and steered principally by traction with the ground. The type of ground contact devices (e.g. tires, treads, and legs) is not restricted. The vehicle must not damage the environment or infrastructure at the ELROB route. Vehicle operation must conform to any regulations or restrictions imposed by the applicable land-use authority.

Those vehicles that weight more than 75 kilograms must be equipped with a recovery facility. The vehicle must be able to travel on asphalt pavement without damaging the pavement surface.

The participants should be aware of the fact that huge and/or heavy vehicles will face difficulties in some scenarios. The same holds for small/light vehicles in the long distance out-door scenario.

4.3 Vehicle Limitations for UAV

The UAV must weight less then 5Kg or have special and valid flight permission according to the law of the host country. Getting the permission falls into to the responsibility of the team.

The team must have appropriate and valid aircraft liability insurance for the UAV and the operator. Getting the aircraft, liability insurance falls into to the responsibility of the team.

The maximum cruising altitude is 30 meter over ground.

All teams must obey the aviation rules and laws of the host country.

4.4 Classified Data and Devices

No classified data or devices may be used by a team in preparation for or during the ELROB.

4.5 Tethered Vehicle Systems

Tethered subsystems that are designed to extend more than 10 meters above the surface must be painted to enhance their visibility to helicopter pilots that may need to land near a vehicle. Entrants are advised that the European Aviation Safety Agency (http://www.easa.eu.int) regulate the operation of moored (tethered) balloons. Entrants are advised that the route may be adjacent to utility and power structures and high-voltage power lines.

After the final location for the trials is announced, there might be additional local regulations that must be followed.

4.6 Vehicle Identification Number

Each team will be assigned a unique identification number that shall be displayed on its vehicle on its sides, front, back, and top. The number should be either black or white and have a solid background that extends larger than the number. The colour of the background should contrast with the number such that the number is clearly visible and distinguishable from other signage or

symbols on the vehicle. A vehicle that can operate when flipped over shall also display the number on its underside.

The number can be found on the web page and is identical with the number the team is listed.

The cost of printing and attaching the number is the sole responsibility of the individual teams.

Teams are allowed to obtain sponsorships and to display advertising if such advertisements are not considered inappropriate by the officials. The organisers ELROB logo must be displayed on each vehicle.

4.7 Vehicle Safety

The organisers make no representation as to the safety of any vehicle entered in the ELROB notwithstanding any rule or the acceptance by the organisers of any application document, vehicle specification sheet, video demonstration, or any inspection or demonstration required as a condition of participating in the ELROB.

4.7.1 Radiated Energy Safety Standards

4.7.1.1 Laser Safety Standards

All parties are responsible for maintaining laser safety standards. All trial vehicles must comply with all applicable safety regulations (see http://europe.osha.eu.int/ for details).

After the final location for the trials is announced, there might be additional local regulations that must be followed.

4.7.1.2 RF Radiation Standards

All parties are responsible for maintaining RF safety standards. All trials vehicles must comply with all applicable safety regulations (see http://europe.osha.eu.int/ for details).

After the final location for the trials is announced, there might be additional local regulations that must be followed.

Please note that because of the decision on the "ELROB user meeting" you have to take care of the frequency regulations yourself!

The frequencies reported by teams will be published.

!!! There will be NO frequency management from the organiser !!!

4.7.1.3 Acoustic Safety Standards

All parties are responsible for maintaining acoustic safety standards. All trial vehicles must comply with all applicable safety regulations (see http://europe.osha.eu.int/ for details).

After the final location for the trials is announced, there might be additional local regulations that must be followed.

4.7.1.4 Wireless Emergency Stop (E-stop)

It is the sole responsibility of the team to properly install an E-stop system in its vehicle.

Each E-stop must be fully functional for the participant to be eligible to participate in the ELROB.

The E-stop system has three modes: a RUN mode, a PAUSE mode, and a DISABLE mode. Teams must integrate the E-stop equipment so that the vehicle responds to the E-stop outputs as follows:

E-stop RUN mode enables the vehicle for movement.

E-stop PAUSE mode brings the motion of the vehicle to a prompt stop, with brakes applied to hold the vehicle even if it is on a slope. The vehicle should be ready to resume motion when the E-stop re-enters RUN mode.

E-stop DISABLE mode brings the vehicle to a prompt halt and shuts down all propulsion systems while actively applying and maintaining the brakes.

The required integration of the E-stop system enables the E-stop PAUSE mode to be cycled on or off so that the vehicle can be stopped and resumed during the trial. The E-stop DISABLE mode should be latched so that its state cannot be changed unintentionally after initiation.

Teams should anticipate that their vehicle may receive the E-stop PAUSE signal numerous times during the ELROB, and that the duration of any individual E-stop PAUSE event may be as long as several minutes. Teams should ensure that electrical connections to the E-stop are ruggedized and tested to provide assured electrical connectivity after exposure to adverse (damp or dusty) environmental conditions and a high vibration environment.

4.7.2 Emergency Stop Unit

Each vehicle must be additionally equipped with an externally actuated emergency stop capability. Activating the emergency stop must promptly bring the vehicle to a complete halt in the E-stop DISABLE mode. At least one actuator and its labelling must be easily visible and accessible from anywhere around the vehicle. The manual emergency stop must be easy to identify and activate safely, even if the vehicle is moving at a walking pace. The operation instructions for emergency stop actuators must be clearly labelled in English and German. The instructions must not be interfered with by any other labelling or advertising.

4.7.3 Warning Devices

Each vehicle shall be equipped with visual alarm that is activated according to the state of the E-stop system. The following is a summary of the required behaviour of the alarms.

E-stop RUN mode: Visual alarm on.

E-stop PAUSE mode: Visual alarm on.

E-stop DISABLE mode: No visual alarm.

4.7.3.1 Visual Warning-Vehicle Operating

Each vehicle shall display one or more flashing amber warning lights, the combination of which results in visibility 360 degrees azimuthally around the vehicle. The warning light shall operate when, and only when, the vehicle is in E-stop RUN or E-stop PAUSE mode. The vehicle may not commence movement until the warning light has been in operation for 5 seconds.

The warning light(s) shall comply with standards for warning lights and shall not produce light(s) than can be confused with those of public safety vehicles such as law enforcement, fire, or ambulance.

4.8 Towing Requirements

Each vehicle over 75 kg must be designed to facilitate removal from the route should the vehicle be disabled.

These vehicles should have tow points front and rear, or if the vehicles design precludes towing, the vehicles should have hoist points. Wheeled or tracked vehicles must have a free-wheel mechanism that enables the wheels or tracks to spin freely in order to enable towing.

4.9 Position Determination Signals

Vehicles may be equipped to receive and process electronic position-determination signals (such as GPS, GLONASS, Galileo, WAAS; EGNOS) that are openly available to all teams. Position-determination signals that are not available for free (e.g. OmniStar, SAPOS) are prohibited.

Any costs associated with any subscription service are borne by the team.

GPS signals might not be available throughout the route at all times. GPS alone will not provide adequate navigation information to a vehicle. There will also be dust, smoke, and other visual obscurants on the route, and visual-spectrum-only sensing may not be adequate under these conditions.

4.10 Environmental Impact

Any aspect of vehicle activity or operation that has an unacceptable impact on the environment is prohibited. These activities include destructive vehicle behaviour, the use of abnormally hazardous substances or materials, and generally reckless operation. Potentially hazardous equipment or activities must be identified to the organisers for review in the vehicle specification sheet and at the site visit.

Any explosives and/or ammunition are strictly forbidden!

4.11 Pre-Trial Testing

Testing of trial vehicles or components is the sole responsibility of each team. The use of public lands for this purpose is at the team's own risk and must be in accordance with applicable laws.

5 Scenario Descriptions

See web page

6 Rules

Pushing the development of revolutionary technologies is a key objective of the ELROB. Entrants are invited to communicate directly with the organisers regarding any rule that restricts their ability to demonstrate technical achievement and innovative solutions to intelligent ground vehicle behaviour.

The Chief Judge Team is a group of officials designated by the organisers as such. The Chief Judge Team is the final authority on all matters referred to in the rules, and on all matters affecting the operation of the ELROB.

The Chief Judge Team has the authority to modify the rules at any time. Reasons for rules modifications include, but are not limited to, the accommodation of promising but unexpected technical approaches that would have been prohibited by the rules and the exclusion of approaches that seek to participate without demonstrating the desired technical achievement in vehicle behaviour that is the purpose of the event. The organisers will announce any modifications to the rules with an e-mail to all entrants and a statement on the ELROB website under "Rules".

The Chief Judge Team may revise the schedule of the trials and provide interpretation of the rules at any time and in any manner that is required. The Chief Judge Team decisions regarding the rules are based on a number of factors, such as safety, legal compliance, fairness, trials goals, environmental protection, and efficient operations.

Decisions of the Chief Judge Team are final.

6.1 Procedures at ELROB

A detailed schedule will be available on time.

6.1.1 Departure procedure

Each team has to name a “set-up assistant” and an operator.

These two people are the troop.

The material required has to be moved promptly by the troop from the unload location to the starting point.

The “set-up assistant” will leave the starting area (including control station) as soon as the vehicle has been started.

There will be no support at this location (table, chair, electricity etc.).

Trial vehicles start in sequential order at specified time intervals. Start order is announced at the web page.

Each vehicle must be enabled for operation within 5 minutes after entering the start chute. Vehicles must be prepared to wait in E-stop PAUSE mode in the start chute for up to 30min..

Before each start, the vehicle is in E-stop PAUSE mode. At the designated start time, the E-stop is switched from PAUSE to RUN and the vehicle must depart the start area promptly after the mandatory 5-second delay for the visual alarm.

6.1.2 Mode of operation

The vehicle can be operated by teleoperation, semi-autonomous (waypoints), autonomous or in any combination of these methods.

There is only one control station allowed.

Only the operator is allowed to control the vehicles.

6.1.3 Vehicle Control

An official may place any vehicle in E-stop PAUSE mode for safety or operational reasons. The official later returns the vehicle to E-stop RUN mode so that it may continue.

ELROB officials must have unrestricted access to the UVG's E-stop functionality during actual trial run(s) and even during the preparation.

If a vehicle does not progress within 5 minutes of resuming E-stop RUN mode the trial is aborted. The team may apply for a second attempt.

If dangerous or destructive behaviour by a vehicle is imminent, an official places the vehicle in E-stop PAUSE mode and the trial is aborted. If necessary to stop it, the official places the vehicle in E-stop DISABLE mode. The team may apply for a second attempt.

The organisers will take measures to stop a vehicle that does not respond promptly to an E-stop command, even if these measures may result in damage to the vehicle.

6.1.4 RF and any other Communication Equipment

After the final location for the trials is announced, there will be additional national and local regulations for RF and other communication that must be followed.

Please note that because of the decision on the "ELROB user meeting 2008" you have to take care of the frequency regulations yourself!

The frequencies reported by teams will be published on the web.

The overall height of the control station antenna must not exceed 2,5 meter (two-and-a-half meter).

The overall height of the vehicle antenna must not exceed 2,5 meter (two-and-a-half meter).

To be precise: No antenna of any RF or other communication equipment used by the team shall exceed the overall height of 2,5 meter (two-and-a-half meter).

For those who do not understand overall height: From the ground (on the soil) to the highest point of the complete construction (in the air).

!!! There will be NO frequency management from the organiser !!!

6.1.5 Trial Route

There will be NO inspection of the operational area allowed or possible.

A team will not physically intervene in any aspect of vehicle operation or physical participate in vehicle tracking from the time the vehicle clears the start chute until it is returned to the team. A vehicle is returned to the team after the trial is aborted or after it clears the arrival line. Refuelling of vehicles is not permitted.

Teams will not operate any vehicles or position any team members along or near the route during the ELROB except at designated viewing areas.

While vehicles are on the route, the organiser's officials might follow the vehicle.

If a vehicle is in E-stop RUN mode and the vehicle does not progress for longer than 5 minutes, the trial is aborted. The team may apply for a second attempt.

If the organiser's officials determine that it is not possible for a vehicle on the route to finish in less than 10 minutes while travelling at the maximum speed limit over the remaining segments of the route and allowing the vehicle to continue would hinder ELROB operations, the trial is aborted. The team may apply for a second attempt.

6.1.6 Route Definition

Per scenario, three route definitions will become available over the time:

1. preliminary general description of the scenario and the route
2. detailed description of the scenario and the route
3. map and way points of the route

6.1.7 Obstacles

The route will include mobile obstacles and on-the-fly modifications. For example, a dead-end can appear where the previous participant had a free road!

The vehicle must avoid collisions with any obstacle, moving or static, on the route. The organisers will place obstacles along the route to test obstacle avoidance capabilities. Incidental or non-damaging contact with obstacles may not result in trial abortion.

6.1.8 Intentional Interference and Damage

Intentional interference with other vehicles is prohibited. Intentional interference is any activity that, in the opinion of the Chief Judge Team, is intended to degrade another vehicle's ability to compete.

Any team responsible for the intentional damage of property that does not belong to that team may be excluded from the event. Intentional damage includes damage that occurs as a result of failure to prevent damage that could have been foreseen and includes damage that adversely and materially affects the performance of another team. The Chief Judge Team will have the final say in all matters involving damage.

6.1.9 Improper Vehicle Contact

A team may not make or cause physical contact with its vehicle after it has departed the start chute and before it is returned to the team. Physical contact includes indirect contact with tools.

6.1.10 Jettisoning hazardous Material on the Route

Except for normal by-products of power generation, the intentional jettison of any dangerous or hazardous material from a vehicle is prohibited and may result in exclusion from the event. If a portion of a vehicle unintentionally falls from the vehicle while on the route, the organisers will notify that team, and the team is responsible to recover such debris once all qualified vehicles have cleared the affected area.

A smokescreen or any other obscurant intentionally discharged from a vehicle is specifically prohibited.

6.1.11 Arrival Area

After a vehicle crosses the arrival line, it is impounded for an inspection. Teams may not interact with their vehicle until it is released by an organiser's official.

6.1.12 Abortion of trials

A vehicle may not continue on the route if the trial was aborted. The organisers will coordinate with the team to recover the vehicle from the route. Teams will enter the route area only when so directed by the organiser's officials. The team may apply for a second attempt.

6.2 Data Requirements

ALL data requirements have to be met. If you submit, data to the officials that do not comply with the formats specified in the following section, it will be not handled / accepted.

6.2.1 Position encoding

The reference coordinate system that is used in all ELROB activities is:

Universal Transverse Mercator coordinate system
http://en.wikipedia.org/wiki/Universal_Transverse_Mercator_coordinate_system

The geodetic reference system that is used in all ELROB activities is:

GRS 80 or Geodetic Reference System 1980
http://en.wikipedia.org/wiki/GRS_80 http://en.wikipedia.org/wiki/World_Geodetic_System

The following waypoint list is an example:

#UTM (GRS80) 3 waypoints

#alpha

32U 559431.82 5545416.83

#bravo

32U 559427.28 5545324.43

#exit point

32U 559422.03 5545299.19

6.2.2 Graphics encoding

The graphics file formats that are used in all ELROB activities are:

Portable Network Graphics (PNG)
http://en.wikipedia.org/wiki/Portable_Network_Graphics

and/or

JPEG (ITU-T T.81, ISO/IEC IS 10918-1 and if needed ITU-T T.84)
http://en.wikipedia.org/wiki/Jpg

6.2.3 Data transfer / exchange

All data transfer/exchange in ELROB activities will be done via WebDav.

You will connect your computer to a standard IPv4 based Ethernet using a CAT6 Twisted pair 8P8c/RJ45 cable. The cable will connect your computer via a switch to the server. There are no other devices on this dedicated network.

You can either select a arbitrary static IP address in the range of 10.10.10.[11-111] or you can fetch an address via DHCP from the server with the range 10.10.10.[112-254].

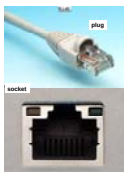
Then you can access the mission data on our server using WebDAV (http v1.1 based). The access requires a login and a password, which you will receive from us beforehand.

When you finished your mission, you will put the results on our server, again using WebDAV with same login and password.

The following schematic drawing will give you a basic idea of how it will work:

The rules are subject of change! Please see www.elrob.org for current version!

Your computer
with 8P8C/RJ45 socket



Our 8P8C/RJ45 cable

Our switch

Our 8P8C/RJ45 cable

Our Server

WebDAV
(http v1.1)

Ethernet
IPv4

password protected
WebDAV folder

Your IP
Static 10.10.10.[11-111]
xor
DHCP 10.10.10.[112-254]

Server IP
10.10.10.10

Example folder URL for data exchange
http://[team_name]:[passwd]@10.10.10.10/[team_name]/

Example URL
http://[team_name]:[passwd]@10.10.10.10/[team_name]/GPS_convoy_file.txt

Related reading to this topic:

Ethernet

http://en.wikipedia.org/wiki/Ethernet

IP v4

http://en.wikipedia.org/wiki/IPv4

DHCP

http://en.wikipedia.org/wiki/Dhcp

WebDAV

http://en.wikipedia.org/wiki/WebDAV

HTTP v1.1

http://en.wikipedia.org/wiki/Hypertext_Transfer_Protocol

8P8C/RJ45

http://en.wikipedia.org/wiki/8P8C

http://en.wikipedia.org/wiki/Registered_jack_naming_confusion

Twisted pair Cat6 cable

http://en.wikipedia.org/wiki/Twisted_pair

http://en.wikipedia.org/wiki/Category_6_cable

IP address

http://en.wikipedia.org/wiki/IP_adress

URL

http://en.wikipedia.org/wiki/URL

Switch

http://en.wikipedia.org/wiki/Network_switch

Server

http://en.wikipedia.org/wiki/Web_server

http://en.wikipedia.org/wiki/File_server

6.2.4 Character encoding

The character encoding that is used in all ELROB activities is:

UTF-8 (8-bit UCS/Unicode Transformation Format)
http://en.wikipedia.org/wiki/UTF-8

6.2.5 Time encoding

The time formats that are used in all ELROB activities are:

Coordinated Universal Time (UTC)
http://en.wikipedia.org/wiki/UTC

For example: 1971-05-16T23:46:01 UTC

and for program use

UNIX time/POSIX time
http://en.wikipedia.org/wiki/POSIX_time

The following code sample would produce a valid “full UNIX time stamp”:

```
#include <stdio.h>
#include <sys/time.h>
int main(void)
{
   struct timeval     tv;
   gettimeofday (&tv, 0);
   printf ("%d.%06d", tv.tv_sec, tv.tv_usec);
   return 0;
}
```

which should for example result in an output like: 915148798.750000

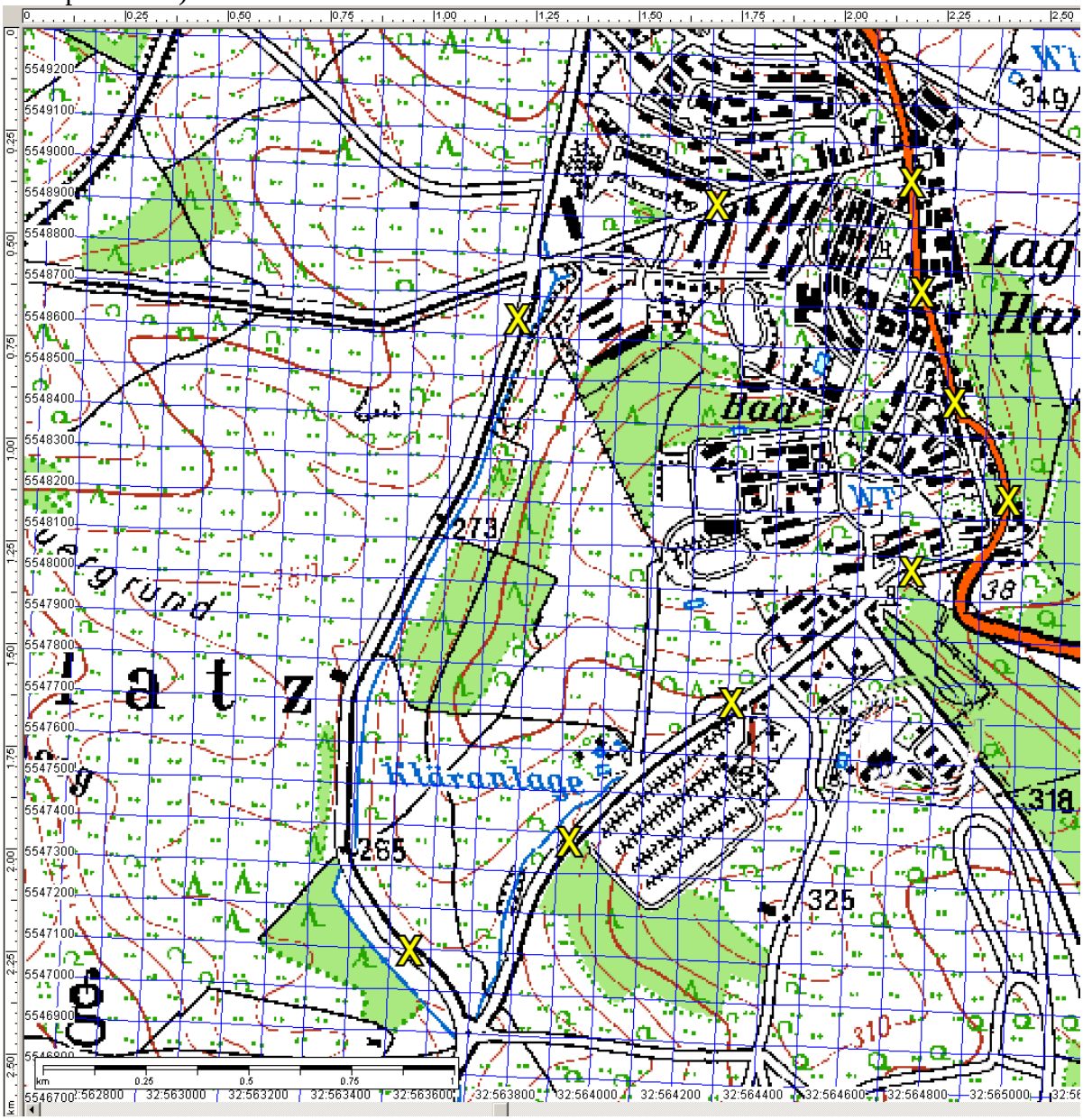
6.2.6 Input data

Input data refers to the data that you will receive from the ELROB officials in electronic format via data link.

At the current stage that will be:

The rules are subject of change! Please see www.elrob.org for current version!

1. A section of a digital map with UTM grid and UTM co-ordinates in JPG or PNG format (see example below)



2. A list of UTM coordinates, that might specify a list of target areas, a list of waypoints or a list of boundary points (see example for waypoints below)

```
# UTM (GRS80)
12 waypoints
35W 427433.55 7216222.93
35W 427241.47 7216235.05
35W 427117.71 7216185.88
35W 427088.03 7216191.55
35W 427108.11 7216218.62
35W 427520.44 7216880.68
35W 427503.51 7216931.69
35W 427481.76 7216963.17
35W 427476.80 7217015.29
35W 427502.91 7217047.02
35W 427503.51 7216931.69
35W 427565.50 7216725.99
```

6.2.7 Output data

Output data refers to the data that the ELROB officials will receive from you in electronic format via the data link.

At the current stage that will be:

1. A section of a digital map in JPG or PNG format that contains driven route as a plotted path and the position of the detected OPI labelled with an X .
   (see example below, driven paths are plotted as yellow lines, OPI as red X)

   Also a text file containing a list of UTM coordinates including a full UNIX time stamp that reflect the route driven by your vehicle; all in consecutive order (see example below)
   # UTM (GRS80)

[full UNIX time stamp] 35W 427433.55 7216222.93
[full UNIX time stamp] 35W 427241.47 7216235.05
[full UNIX time stamp] 35W 427117.71 7216185.88
[full UNIX time stamp] 35W 427088.03 7216191.55
[full UNIX time stamp] 35W 427108.11 7216218.62
[full UNIX time stamp] 35W 427520.44 7216880.68
[full UNIX time stamp] 35W 427503.51 7216931.69
[full UNIX time stamp] 35W 427481.76 7216963.17
[full UNIX time stamp] 35W 427476.80 7217015.29
[full UNIX time stamp] 35W 427502.91 7217047.02
[full UNIX time stamp] 35W 427503.51 7216931.69
[full UNIX time stamp] 35W 427565.50 7216725.99

2. The file name of the digital pictures for the correctly detected OPI must contain the UTM coordinate of the OPI (see example below)
   [full UNIX time stamp]_35W427433.55_7216222.93.png
   or
   [full UNIX time stamp]_35W427433.55_7216222.93.jpg

   Also a text file containing the list of UTM coordinates including a full UNIX time stamp that reflect the positions of the detected OPI all in consecutive order (see example below)
   # UTM (GRS80)
   [full UNIX time stamp] 35W 427433.55 7216222.93
   [full UNIX time stamp] 35W 427117.71 7216185.88
   [full UNIX time stamp] 35W 427503.51 7216931.69
   [full UNIX time stamp] 35W 427481.76 7216963.17
   [full UNIX time stamp] 35W 427476.80 7217015.29

7 Ranking system

Follow the rules for every scenario conscientiously.

Please, read the concept & rules paper carefully.

From the control station, you will not be able to see the entire operational area.

There will be only one operator allowed at the control station.

The operator must not leave the control station during the trial.

There will be no communication between the operator and other people e.g. team members during trial.

If a participant has to abort the trial because of technical difficulties, the chief judge team may allow repeating the trial, if an empty start slot is available.

Trial runs will be terminated when a competitor is unable to complete it within the time allowed.

The ranking system is generally organised in three hierarchical factors:

1. Primary ranking factor
   For all scenarios, the first and foremost ranking factor will be autonomy. Though this may lead to a discussion about our philosophy, we have decided to judge “autonomy” in the following way:

   Running Time (RT): The time from receiving the mission data until the electronic submission of the collected data (the maximum time is the time allowed for this scenario). Any data handling is part of the running time.

InterAction Time (IAT): An interaction starts at the moment when someone interacts with the vehicle and/ or the operator console (or any other device that interoperates with the control station and/ or the vehicle) and ends in the moment when this interaction is finished. Example: You touch the operator console to enter another GPS waypoint or you watch a video stream e.g. to detect objects or steer the vehicle manually. If you remote control the vehicle over the complete time of the trial, you will have an IAT that is identical to your running time (RT).

We will measure the time you interact with the system (vehicle and/or operator console) aka IAT. You will achieve a higher degree of autonomy by minimising the quotient formed from the IAT divided by the time you need to complete the scenario aka RT.

The minimum achieved IAT quotient of all contestants (Minimum Ratio - MR) will be divided by your result, so that you can achieve a result between 0 and 1:

Ranking factor #1 = MR / (IAT/RT)

2. Secondary ranking factor
For every scenario, the result is determined as follows: your result (YR) is divided by the highest result (HR) of all contestants, so that you can achieve a result between 0 and 1:

Ranking factor #2 = YR / HR.

Moreover, the second factor is especially designed for the different scenarios:

a) Reconnaissance scenarios day/ night:
Your result will be the number of detected "Objects of Potential Interest (OPI)"[1]. Best quotes for the highest number of detectable OPI)

b) Camp Security scenario:
Here, we count the number of OPI that you hunt down and identify correctly.

c) Movements or Autonomous Navigation scenario:
Speed is dominated by the distance.

YR = average speed / (remaining distance to target x remaining distance to target)

d) Mule scenario:
Shuttle as often as possible between the two locations. We will count the number of correct changes/turns you make.
YR = (turns x turns) x average speed

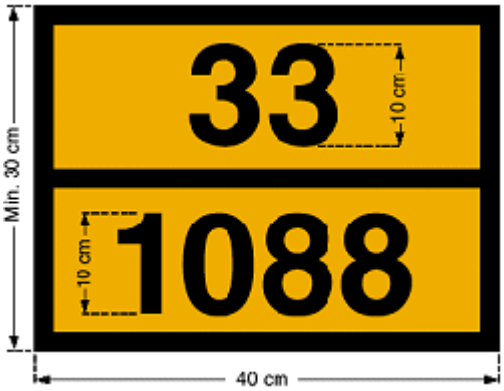
For civil ELROB only: For the scenarios c) and d) we would like to encourage you to also detect the OPI along the route.

3. Bonus ranking factor
These bonus points might make the difference if the main score is equal between two participants.
a) providing a digital map which includes a plot of the driven track and the position of the detected OPI
1 point for the complete plot of the track (maximum of bonus points == 1)

[1] Objects of Potential Interest (OPI) are identified through specified objects (e.g. ERICards), threats or intruders. Correctly detect OPI including their positions in UTM coordinates (minimum accuracy of 5m per position) with a minimum of false reports.

1 point for each correct position of an OPI in the map (maximum of bonus points == number of detectable OPI)

b) digital pictures of the correct detected OPI in a quality that allows an easy identification of the OPI
1 point for each correct and identified OPI including position (maximum of bonus points == number of detectable OPI)



OPI examples

Please be sportsmanlike and play fair!

If there are weaknesses in this ranking system, feel free to tell us.

If the jury gets the impression that someone is trying to cheat, trick or outsmart anybody, it will take appropriate action.

8 Appendix A: Definitions

Arrival Zone

The arrival zone is that area behind the arrival line, and within the boundaries designated for that purpose.

Arrival Line

The arrival line is a line at the end of the route.

Chief Judge Team

The Chief Judge Team is a group of officials designated by the organisers as such. The Chief Judge Team is the final authority on all matters referred to in the rules, and on all matters affecting the operation of the ELROB that are not explicitly referred to in the rules.

Commercially Available

Commercially available refers to services or materials that are sold, leased, or licensed to the general public.

Departure Area

The departure area is that area before the departure line, and within the boundaries designated for that purpose. The departure area is not part of the route.

Departure Line

The departure line is at the beginning of the route. It defines part of the boundary of the departure area.

Departure Signal

The departure signal is given sequentially to each vehicle by enabling it for operation via the RUN mode on the E-stop system.

Entrant

An entrant is a team that meets the eligibility requirements and has satisfactorily submitted parts 1, 2 and 3 of the application (receipt of which has been acknowledged by the organisers).

Government

For purposes of these rules, government refers to national or international governing bodies and all official agencies that are directly responsible to them. It includes the European Governments, all European military organizations, the European Union, and all other non-European governments and non-European government agencies. Government explicitly does not refer to sub-national organizations such as state or local governments.

Europäische Leistungsschau Robotik (ELROB)

German expression for “European Land-Robot Trial”

ELROB Website

Application forms and the most authoritative and up-to-date information about the ELROB can be obtained at the URL: http://www.elrob.org

Media Representative

A media representative is anyone who is accredited by the organisers as such.

Official

An official is any person designated by the organisers for the purpose of administering or monitoring any aspect of the ELROB.

Openly Available

Openly available refers to services or materials that are available to anyone without charge, such as software that is available for public download or GPS signals.

Qualification Process

The qualification process refers to the sequence of steps a team must successfully complete to be selected for the ELROB. This includes submission of the application, submission of an acceptable vehicle specification sheet, and submission of an appropriate technical paper.

Route

The routes consist of a departure line, an arrival zone, and a lateral boundary. The route is the area included within boundaries specified by the organisers in the route definition.

Rules

The rules posted on the ELROB website are the official governing set of regulations and guidelines of the organisers ELROB. The Chief Judge Team is the final authority on all rules and all aspects.

Liability Statement

See TeamApplication form available on the ELROB website.

Start Chute

The start chute is an area at the ELROB directly before the departure line. A team must place its vehicle in the start chute prior to enabling it for operation.

Spectator

A spectator is any person who is not a team member, official, or media representative. During the ELROB, areas will be designated for spectators.

Team

A team comprises two parts: a qualified team leader and any other individuals who have been appropriately designated by the team leader as team members in the application. Corporations or other organizations may participate as sponsors only. Team members may contribute their individual labour, individually owned materials and equipment, and individual funds to a team. Individuals holding non-European citizenship may participate only as members of a team led by a European citizen. Modifications to the team roster may be submitted to the organisers with submission of the technical paper.

Team Leader

A team leader is the individual European Citizen identified to the organisers during the application process responsible for the following: primary point of contact for team communication with the organisers, signatory of the Certification of Team Funding and Support, signatory of the Liability Agreement, presence at all stages.

Team Member

A team member is a team leader or individual who has been pre-designated by the team leader as a team member in the application process.

Team Sponsor

A team sponsor is an organization that contributes labour, materials, services, equipment, or funds to a team.

Technical Paper

A formal document describing the engineering details of the vehicle design and operation, a technical paper is required for all teams. Final versions of these Papers will be published on the

organisers website following the conclusion of the event for purposes of information interchange. Information on technical paper content and required format will be available on the ELROB website.

Vehicle

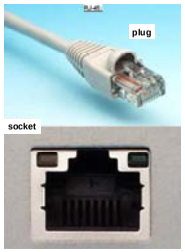
A vehicle is the unmanned ground vehicle system that has been entered by a team for the ELROB.

Vehicle Specification Sheet

The vehicle specification sheet is a mandatory part of the application, and part of the qualification process. This submission describes the basic capabilities of the vehicle for planning, safety, and selection purposes. This form is available on the ELROB website. Failure to complete this form properly and submit it before the deadline may result in disqualification.

The rules are subject of change! Please see www.elrob.org for current version!

Your computer
with 8P8C/RJ45 socket



WebDAV
(http v1.1)

Our 8P8C/RJ45 cable

Our switch

Ethernet
IPv4

Our 8P8C/RJ45 cable

Our Server

password protected
WebDAV folder

Your IP
Static 10.10.10.[11-111]
xor
DHCP 10.10.10.[112-254]

Server IP
10.10.10.10

Example folder URL for data exchange
http://[team_name]:[passwd]@10.10.10.10/[team_name]/

Example URL
http://[team_name]:[passwd]@10.10.10.10/[team_name]/GPS_convoy_file.txt