

**Draft - 15 May 2009**

# Concept & Rules

## **- ELROB -**

### European Land-Robot Trial

URL: [www.elrob.org](http://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 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.

## **1.3 Scenario Descriptions**

See web page

**The rules are subject of change! Please see [www.elrob.org](http://www.elrob.org) for current version!**

## **1.4 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 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.

## **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, 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.

### **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.

**The rules are subject of change! Please see [www.elrob.org](http://www.elrob.org) for current version!**

## **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 Vehicle Requirements**

### **3.1 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 unmanned.

### **3.2 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 (such as 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 large and/or heavy vehicles will face difficulties in the urban scenario. The same holds for small/light vehicles in the out-door scenario.

### **3.3 Vehicle Limitations for UAV**

The UAV must weight less then 5Kg or have a 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 a 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.

### **3.4 Classified Data and Devices**

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

### **3.5 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.

### **3.6 Vehicle Identification Number**

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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 with.

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.

### **3.7 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.

#### **3.7.1 Radiated Energy Safety Standards**

##### 3.7.1.1 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.

##### 3.7.1.2 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.

##### 3.7.1.3 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.

##### 3.7.1.4 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.

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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.

### **3.7.2 Manual Emergency Stop Unit**

Each vehicle must be additionally equipped with an externally actuated manual emergency stop capability. Activating the manual 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 manual emergency stop actuators must be clearly labelled in English and German. The instructions must not be interfered with by any other labelling or advertising.

### **3.7.3 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.

#### **3.7.3.1 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.

## **3.8 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.

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### **3.9 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 openly available (e.g. OmniStar, SAPOS) available to all teams 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.

### **3.10 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!

### **3.11 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.

## **4 Application Procedure**

### **4.1 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.

### **4.2 Submission Procedures**

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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@fgan.de](mailto:elrob@fgan.de)  
URL: [www.elrob.org](http://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.

### **4.3 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.

### **4.4 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.

### **4.5 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.

## **5 Procedures ELROB**

A detailed schedule will be available on time.

### **5.1 Departure Area**

When instructed to do so, each team must move its vehicle promptly to the start chute. Trial vehicles start in sequential order at specified time intervals. Start order is announced at the web page.

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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.

## **5.2 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.

## **5.3 Trial Route**

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 ground 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.

Each vehicle must remain within the route boundary from its departure from the start chute to its arrival at the arrival zone.

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.

### **5.3.1 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

## **5.4 Obstacles**

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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.

## **5.5 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.

## **5.6 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.

## **5.7 Jettisoning Material on the Route**

Except for normal by-products of power generation, the intentional jettison of any 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.

## **5.8 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.

## **5.9 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 Frequently asked Questions (FAQ)**

See web page

# **7 Appendix A: Definitions**

## *Arrival Zone*

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

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#### *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.

#### *3. 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 rules are subject of change! Please see [www.elrob.org](http://www.elrob.org) for current version!**

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*

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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.