

Competition Rulebook

Swiss Rover Challenge

1. Rover Specifications

1.1. Overview

Your rover needs to fit in a 600x500x500mm cube.

It needs to drive on the ground with wheels.

It needs to be actuated by brushed DC motors of 25mm diameter.

It needs to be powered by a single certified 18V Li-ion power tool battery (ex: Makita).

It can be produced by any means, including but not limited to:

- 3D Printing
- Laser cutting
- Welding
- Machining

1.2. Control

Your rover needs to be controlled over standard wireless communication protocol such as:

- Wifi 2.4Ghz
- Wifi 5.0Ghz
- Bluetooth

Any antennae or emitters present on the platform should respect the specifications as described by **ETSI**, the *European Telecommunications Standards Institute* under the **RED Directive** (Radio Equipment Directive 2014/53/EU). Here is an overview :

Protocol	Frequency Band	Max Power (EIRP)	ETSI Standard
Wi-Fi (2.4GHz)	2400 - 2483.5 MHz	100 mW (20 dBm)	EN 300 328
Wi-Fi (5 GHz)	5150 - 5350 MHz	200 mW (23 dBm)	EN 301 893
Wi-Fi (5 GHz)	5470 - 5725 Mhz	1 W (30 dBm)	EN 301 893
Wi-Fi (5 GHz)	5725 - 5875 Mhz	25 mW (14 dBm)	EN 300 440/SRD
Bluetooth	2400 - 2483.5 Mhz	100 mW (20 dBm)	EN 300 328

1.3. Safety

Your rover needs to be equipped with a functional safety circuit able to fully disconnect any power stage from the voltage source in case of an emergency. This should be implemented with a secure and easily accessible e-stop button wired in series with the main voltage source of the vehicle.

The vehicle shouldn't have any exposed bare wires that risk short circuiting with other vehicles or conductive objects during the competition.

The battery should be charged with a CC/CV Li-Ion charger designed specifically for the battery used. In no case should the battery be charged with a homemade device that is not properly rated to charge Li-ion batteries as this could pose a risk of over-charging and potentially lead to a fire.

The battery should also be designed with a fast-blowing fuse of rated current 10A or less to break the circuit in case of an overcurrent situation due to a short circuit. In no case will a bypassed fuse be accepted into the competition.

1.4. Autonomy

Your rover needs to be able to be remotely controlled by any of the following means:

- A gamepad
- A PC
- A phone application

Your rover should stop and wait at a standstill when no control input is given or when connection is lost (no runaway vehicles).

Your rover should be able to drive forwards, backwards and turn. Your rover can also have more complex routines such as following a curve, driving a set distance and then stopping, or turning a known angle.

If your rover can be controlled remotely without direct line of sight (for example with an operator watching a camera feed), you should inform the judges and will receive extra points for blind task completion.

If your rover can perform complete tasks autonomously (no operator input), you should inform the judges and will receive extra points for autonomous task completion.

If you decide to return to a simpler control mode, your extra points will be deduced from your score as the task (or parts of it) were not achieved fully blind/autonomously.

2. Competition Tasks

The tasks will be split in two time slots, morning tasks and afternoon tasks:

Morning Tasks - 10h00 to 12h00	(1) Presentation	(2) Navigation	
Lunch Break - 12h00 to 13h00	Lunch Break		
Afternoon Tasks - 13h00 to 15h00	(3) Manipulation	(4) Tug-of-War	(5) Race

2.1. Presentation - 1h00

Each team will have 10 minutes to present their entire year's worth of work and the capabilities of their rover to the audience before competing in the technical tasks.

Following are the various points that will be expected from each team:

1. Team Presentation - 2 minutes
 - a. Team name & Logo
 - b. Members of the team & their field of expertise
 - c. Prior experience in robotics engineering
2. System Engineering - 3 minutes
 - a. General system overview of the rover
 - b. Year long timeline
 - c. Work repartition between team members & interfaces
 - d. Testing & system validation
3. Detailed Work Presentation - 5 minutes
 - a. Mechanics
 - b. Electronics
 - c. Software
4. Questions & Scrutiny - 5 minutes

(1) Presentation - Scoring Sheet	
Quality of Slides	20 points
Clarity of Oral Presentation	20 points
System Engineering	40 points
Detailed Work Presentation	80 points
Questions & Scrutiny	50 points

2.2. Navigation - 1h00

This task is done by each team individually, each team having 10 minutes.

The purpose of the navigation task is to show the ability of your rover to precisely navigate around a complex terrain while keeping track of its current location and obstacles around it.

Your rover will start at the **spawn location**, it will then need to navigate across to three key vantage points: **V1, V2 and V3 (in order)**. After that, it will have to cross **The platform**: a 500 [mm] wide sheet of wood lifted at a height of 300 [mm]. If successful, it will have to reach the fourth vantage point, **V4**. From that point, it will have to circle counter-clockwise around a large obstacle: **the mountain** one single time and then return to the **spawn location**.

Navigation Map

(2) Navigation - Scoring Sheet	
V1 Reached	20 points
V2 Reached	20 points
V3 Reached	20 points
The Platform Traversed	60 points
V4 Reached	20 points
The Mountain Circled	40 points
Successful Return to Spawn	20 points
Vantage Point not Reached in Order	-10 points
Rover Touched	-20 points
Rover Picked Up	-50 points

Doing elements of this task line of sight (watching the rover) will give the points written above.

Doing elements of this task blind (with camera feedback) will double the amount of points.

Doing elements of this task autonomously will quadruple the amount of points.

2.3. Manipulation - 1h00

This task is done by each team individually, each team having 10 minutes.

Teams must include a hook somewhere on their rover to grab the load, it can be an actuated hook (or arm) or it can be a static system. They may also push the load around without losing any points although it is not recommended as it could take an extended amount of time.

Load 1 will be a 500 [gram] basket set on the floor attached to a horizontal hoop at a height of 100 [mm] designed to be hooked into. The hoop will be of circular shape with a diameter of 12mm.

Load 2 will be a 200 [gram] basket set on the floor attached to a smaller horizontal hoop at a height of 100 [mm] designed to be hooked into. The hoop will be of circular shape with a diameter of 12mm.

The team will need to drag load 1 from a pickup location marked by tape on the floor to a dropoff location, also marked by tape on the floor. The team will then need to unhook from load 1, drive to a second location (also marked by tape), hook into a load 2 which will be smaller and more delicate. They will then need to drag it back to the first dropoff location and unhook it precisely.

(3) Manipulation - Scoring Sheet	
Successful Hooking	10 points
Successful Drop Off	30 points
Successful Unhooking	50 points
Unhooking by Hand	-20 points

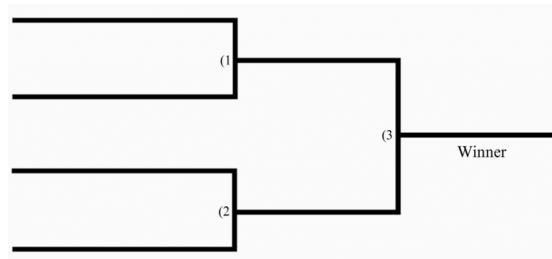
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Doing elements of this task blind (with camera feedback) will double the amount of points.

Doing elements of this task autonomously will quadruple the amount of points.

2.4. Tug of War - 0h30

This task is done in the form of a 4 team double elimination bracket, see below:



The teams are drawn at random using an online randomised drawing tool.

Each round is done in 3 sub-battles, each one of them on different surfaces:

1. Smooth flooring (polyurethane)
2. Grass
3. Gravel

A 1 meter long tug of war setup will be prepared. Both rovers start at an equal distance from the center line, the first one who pulls the other one outside of the square wins the round.

The winner of the round moves on to the next round.

Teams must include a hook centered at the back of their rover to tie a strap to.

(4) Tug-of-War - Scoring Sheet	
Winning one sub-battle	10 points
Winning the semi-finale	40 points
Winning the finale	100 points

2.5. Race - 0h30

This task is done by every team simultaneously.

A race around a novel circuit will be organised between all the rovers, the circuit is not announced prior to the competition as to make the teams develop a flexible system with a good balance between tire grip, torque and acceleration. In addition, an intuitive and robust controller mapping needs to be developed for precise real-time control.

Here are some key features which will be present during the task:

- Switchbacks
- Ramps of a max inclination of 25 degrees (or 46% grade)
- Gravel and other surfaces

(5) Race - Scoring Sheet	
1st Place	150 points
2nd Place	100 points
3rd Place	60 points
4th Place	30 points
5th Place	0 points

Touching the rover at any moment nets -20 points, carrying it over an obstacle nets -50 points.