WRSC 2013 rules

(Preliminary version in English)
(Version française : http://www.ensta-bretagne.fr/lebars/wrsc2013/Rules_2013-04-17_FR.pdf)

Categories of robots

- Small autonomous sailboats up to 1 m long, 2 m high, 100 kg, referred to **Microsailboats category** (**MS** code).
- Autonomous sailboats up to 4 m long, 10 m high, 500 kg, referred to **Sailboats category** (**S** code).
- Any type of autonomous boat up to 4 m long, 10 m high, 500 kg, referred to **Motorboats category** (**M** code).

Organizers might refuse any dangerous or inappropriate robot... Ask the organizers before if necessary. All the robots should have all the necessary things to ease the process of getting them into the water, start, stop, recovery and work safely. Robots that can go at more than a speed of 5 kn should have the ability to be remotely controlled (for safety reasons). However, it is strongly recommended that all robots can be remote controlled.

Ranked robots

There will be **distinct rankings for each category**. Each robot will need a unique name and get at least 1 point during the tasks to be ranked. A ranked robot might be weighed or measured several times (and maximum values will be used) if it has significant changes during the competition (important parts changed, use of a backup robot…). A journal paper (around 10 pages) and a video (to describe the robot, its building process, its algorithms, its philosophy….) should be provided 15 days before the competition. Moreover, a short presentation should be done during the competition. All these documents will be published on the WRSC website and YouTube after the competition. Their quality will be evaluated (100 points max).

A GPS tracker should be provided by organizers for each robot during the competition (probably a Motorola Defy Mini smartphone in a Krusell Sealabox waterproof box, or an equivalent). It should store the robot positions in a log file each second. Time will be in UTC. All the robots should have some space or attach point for this device. However, it is strongly recommended that competitors store the same type of data as well as a maximum of information on their state themselves in case of a problem (for example an Excel-compatible log file t;x;y;theta;...;actions;detections;...).

Teams

There will be 2 types of teams:

- **Students teams**: at least 50% of students (including PhD students as students), one of the student being the Team Leader, max of 10 people and have at least 1 robot. Their robots will be ranked in the **student ranking** if they comply with the ranked robot rules.

- **Open teams**: the only requirements are a max of 10 people and have at least 1 robot. Their robots will be ranked in the open ranking if they comply with the ranked robot rules.

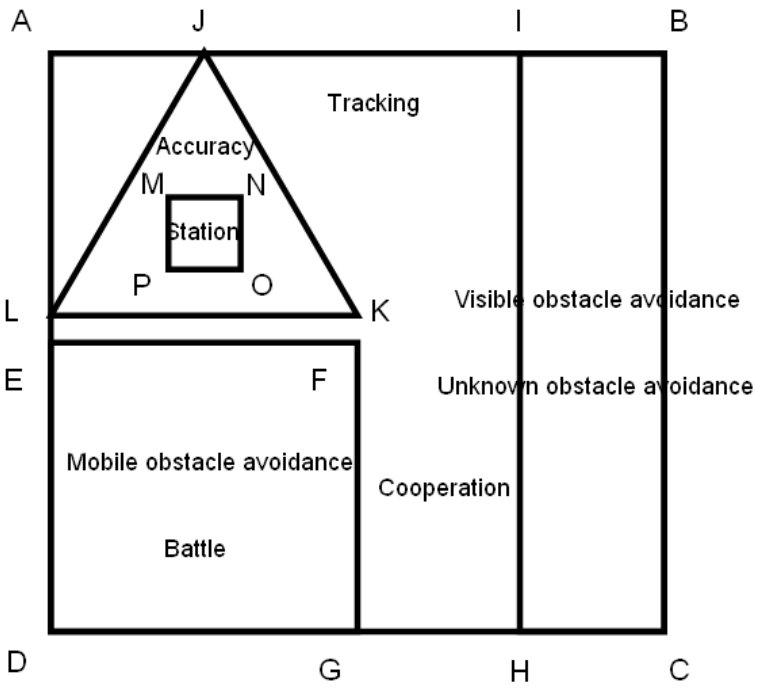
There will be **priority rules** for the attribution of time and space slots, chase boats, GPS trackers, judges... necessary to validate points for a task:

- Ranked robots from student teams (highest priority).
- Ranked robots from open teams.
- Other robots from students teams.
- Other robots from open teams.

A zodiac (or other type of small motorboat) should be provided to each team when possible. During the competition, at least 1 judge will be onboard and might take control of the zodiac at any time. 2-3 tables around 10 chairs should be given to each team, as well as Internet and electricity (bring your own international adapters if needed). Teams can have several robots. There should not be registration fees for all students (including PhD students), teams and robots, only registration fees of around 50€ for non-student conference participants. Organizers will limit the number of teams, people and robots if necessary.

Competition tasks

Unless differently specified (endurance task…) or particular conditions (avoiding a collision with other robots…), no point for a task will be given if a manual or remote human intervention is done on a robot during a task where the robot should be autonomous. Moreover, only 1 attempt will be possible for tasks with all the competitors in the same time (due to organisation issues). Otherwise, the points earned for the best attempt should be used.



Station keeping task

Go autonomously inside the MNOP square (side of 50 m), stay in the middle during 5 min and leave it. The competitors will be allowed to choose the starting point, which will be outside the square. The robot will be considered as regulated in the middle of the square 5 min after the beginning of the attempt. The robot will be required to be outside the square max 15 min after the beginning of the attempt. No point will be given if the robot never comes inside the square or is not outside at the end of the attempt. The GPS tracker log file will be used to compute automatically the time spent inside the square as well as the maximum and average distance to the center between the 5th and 10th minute after the beginning of the attempt, and check validation conditions. The points will be given using the following formula: max(30,6*nb_min_inside_square)+max(20,500/max_dist)+max(50,250/avg_dist). Buoys will be installed to indicate visually the square position, but they will not be used to compute the points.

Max time of an attempt: 15 min
Max points: 100
MS+S+M

Accuracy task

Follow autonomously an JKL triangle (side of 50 m for category MS, 200 m for others). The competitors will be allowed to choose the starting point, but the triangle will have to be followed in the JKLJ order. The triangle will be considered as begun when the robot will have reached the perpendicular to JK in J and finished when the perpendicular to LJ in J will be reached. No point will be given if the first perpendicular is never reached or the last perpendicular is not reached max 50 min (25 min for category MS) after the first perpendicular. The GPS tracker log file will be used to compute automatically the maximum and average distance to the triangle, and check validation conditions. The points will be given using the following formula: max(50,50/ecartmax)+max(50,50/ecartmoy). Buoys will be installed to indicate visually the square position, but they will not be used to compute the points.

Max time of an attempt: 50 min (25 min for category MS)
Max points: 100
MS+S+M

Downwind speed task

Cover autonomously as fast as possible a distance of 400 m (100 m for category MS). All the robots (or in several groups) will start in the same time from an AB line and will have to reach a CD line (lines of 400 m (100 m for category MS) width, making an ABCD square with a side of 400 m (100 m for category MS)). No point will be given if the CD line is not reached max 30 min after the beginning. The GPS tracker log file will be used to compute automatically the max and average speed, and check validation conditions. The points will be given using the following formula: max(50,vmax)+max(50,vavg), v in m/s. These points will be adapted to take into account the size differences between robots using the formula: multiplication by sqrt(overall hull length) (for microsailboats and sailboats). Buoys will be installed to indicate visually the lines positions, but they will not be used to compute the points.

Max time: 30 min
Max points:100

MS+S+M

Upwind speed task

Same as above except the placement with respect to the wind.
Max time: 30 min
Max points:100
MS+S

Sidewind speed task

Same as above except the placement with respect to the wind.
Max time: 30 min
Max points:100
MS+S

Swarm behaviour task (sponsored by CGGVeritas ?)

Follow autonomously and accurately the following position input: desired_position(t) = (t/t_end)*end_position+(1-t/t_end)*begin_position. The GPS points begin_position and end_position will be at a distance of 100 m. No point will be given if the robot has not covered at least 100 m max 30 min after the beginning. Several robots will start in the same time to show a swarm behavior where robots are progressing synchronously. The GPS tracker log file will be used to compute automatically the deviations (sqrt(integral(sqr(norm(position-desired_position))), and check validation conditions. A ranking depending on the deviations will be made, the best getting all the points and the last getting 0 points.
Max time: 30 min
Max points:100
MS+S+M

Mobile obstacle of known position avoidance task

Navigate autonomously in a DEFG square with a side of 200 m and leave it when a disruptive boat enters in the square. The competitors will be allowed to choose the starting point, which will be inside the square. The disruptive boat will keep a constant speed and heading during its crossing of the square, which will be in the 45 min after the beginning of the attempt. The disruptive boat (probably a zodiac) will be made visible on radar and will send by Wifi, XBee its position, heading, speed (the competitors will be allowed to use their own emitting box). No point will be given if the robot comes at less than 5 m of the disruptive boat, if the robot leaves the square before the disruptive boats enters it or if the robot has not left the square 15 min after the entrance of the disruptive boat in the square. The GPS tracker log files from the disruptive boat and the robot will be used to check automatically these conditions. Buoys will be installed to indicate visually the square position, but they will not be used to compute the points.
Max time of an attempt: 60 min
Max points: 100
MS+S+M

Immobile and visually particular obstacle avoidance in straight line

Go and come back (possibly several times) autonomously on 400 m (100 m for MS category) from a starting line HC to an arrival line IB (lines of 50 m (20 m for MS category) width, forming a HIBC rectangle of 400 m * 50 m (100 m * 20 m for MS category)) avoiding a big immobile obstacle (probably 5 zodiacs stopped and chained, of distinct colour (probably

orange, red or yellow) from other boats (but the 5 will have the same colour), visible on radar but not emitting any particular message). The big obstacle will be placed after the departure of the robot and in its trajectory, at least at 50 m (20 m for MS category) in front of the robot and 50 m (20 m for MS category) before the arrival line. No point will be given if the robot comes at less than 5 m of the big obstacle, if the arrival line IB is not reached at least 1 time 45 min after the departure or if the robot leaves the HIBC rectangle before the big obstacle entered it. The GPS tracker log files from the big obstacle and the robot will be used to check automatically these conditions. Buoys will be installed to indicate visually the position of the lines, but they will not be used to compute the points.
Max time of an attempt : 45 min
Max points : 100
MS+S+M

Unknown and immobile obstacle avoidance in straight line

Same as above but with an obstacle without distinct color.
Max time of an attempt: 45 min
Max points: 200
M

Tracking task

Follow autonomously a zodiac equipped with a buoy of a diameter of 50 cm and of a particular colour (probably orange, red or yellow) on a distance of 100 m and by staying at less than 10 m from it. The zodiac will have a speed close to 0.25 m/s and will follow an unknown and not straight trajectory. The starting point will be at 5 m from the buoy. Points = consecutive number of m covered by the zodiac with the robot at less than 10 m. The GPS tracker log files from the zodiac buoy and the robot will be used to check automatically these conditions.
Max time of an attempt: 10 min
Max points: 100
M

Tow and cooperation task

A 1st robot tows a 2nd robot on at least 100 m and then frees the 2nd robot and stop. The 2nd robot starts and then covers additionally at least 100 m, with all that steps in less than 45 min. 30 points if the 1st robot managed to tow the 2nd robot on 100 m, 30 points if the robots managed to separate without subsequent collision, 40 points if the 2nd robot covered the additional 100 m. Points will be multiplied by 2 if one of the robot is a sailboat. Points will be multiplied by 3 if one of the robot is a microsailboat. The 2nd robot will be considered as correctly towed if it stays at less than 10 m of the 1st robot. They will be considered as separated as soon as this distance is reached. The GPS tracker log files from the 2 robots will be used to check automatically these conditions. As this task involves 2 robots, all earned points will be given to each robot.
Max time of an attempt: 45 min
Max points: 300
MS+S+M

Chase/naval battle task (sponsored by MBDA)

In this task, a robot will be the prey and the other the predator. The predator will have to go as close as possible to the prey while the prey will try to avoid avoid the predator, while staying

in a DEFG square with a side of 200 m (MNOP square with a side of 50 m for MS category). Robots will communicate (the waterproof smartphones provided by organizers might be used to get robots heading, speed and positions by Wifi). Only robots of the same category will be allowed to compete. A robot will be only allowed to participate to 1 battle for each role. The prey will get points proportionally to the time while the predator is not at less than 10 m (5 m for MS category). No point will be given to the prey if this happens in less than 5 min. The predator will get 1/3 of the points if it managed to be at less than 30 m (15 m for MS category) of the prey, 2/3 at less than 20 m (10 m for MS category) and all the points at less than 10 m (5 m for MS category). The GPS tracker log files from the 2 robots will be used to check automatically these conditions. Buoys will be installed to indicate visually the square position, but they will not be used to compute the points.
Max time of an attempt: 20 min
Max points: 300
MS+S+M

Mill task

Make the highest number of loops autonomously in 15 min and in a DEFG square with a side of 200 m. The counting of loops will be stopped if the robot leaves the square and will only resume when it come inside. No point will be given if the robot makes less than 5 loops. The GPS tracker (that includes a compass) log file will be used to check automatically these conditions. A ranking depending on the number of loops will be made, the best getting all the points and the last getting 0 points. Buoys will be installed to indicate visually the square position, but they will not be used to compute the points. The idea of this task is to explore the interest of retrieving energy using wind force on the sail (see http://www.ensta-bretagne.fr/jaulin/paper_mill.pdf).
Max time of an attempt: 15 min
Max points: 100
MS+S

Endurance and measurements task (sponsored by Ifremer)

Cover autonomously an area (making measurements) of a side of 500 m or make another type of trajectory during at least 8 h, (2 h for M category). All the robots will be launched in the same time. Possible measurements : various water parameters (temperature, salinity, oxygen, chlorophyl, depth, quality, waves...), air parameters (speed, wind angle, temperature...), sounds, pictures, videos, sonar, radar, lidar…, estimation of energy consumption, forces and torques on actuators… The competitors should announce in advance the trajectory and measurements planned to be able to get points. 300 points will be given by judges. Points will be given according to the following criterias : covering quality of the area, measurements quality, number and nature of potential physical or remote manual interventions during the task…
Max time of an attempt: 10 h
Max points: 300
MS+S+M

Travelling salesman special task (sponsored by ENSTA Bretagne and Ifremer)

Competitors will have to use VAIMOS autonomous sailboat to cover a trajectory through predefined GPS points (and predefined accuracy) in an order that can be chosen (http://en.wikipedia.org/wiki/Travelling_salesman_problem). The GPS points will be the

same for all competitors and will be defined at the beginning of the competition (trajectory of less than 2 hours in normal conditions). A user guide explaining how to use VAIMOS will be provided (how to define a trajectory for VAIMOS, settings that can be easily changed…). The idea of the task is to make competitors think about an optimal route taking into account wind conditions and physical as well as algorithm characteristics of an autonomous sailboat. VAIMOS log files will be used to validate the trajectory and compute the total time. A ranking of best times among the teams will be made and a special prize should be given to winners of this task.

Planning

- 2013-09-02 : Conferences and installation of teams, robots setup, visit of ENSTA Bretagne in the evening+welcome buffet/dinner/barbecue.
- 2013-09-03 : Continuation of conferences, beginning of tasks at Moulin-Blanc.
  17h00 – 18h00 : Downwind speed task.
- 2013-09-04 : Tasks at Moulin-Blanc.
  17h00 – 18h00 : Upwind speed task.
- 2013-09-05 : Tasks at Moulin-Blanc.
  16h00 – 17h00 : Sidewind speed task.
  17h00 – 18h00 : Swarm behaviour task.
- 2013-09-06 : Endurance task and presentations, demos of invited robots (VAIMOS autonomous sailboat from Ifremer, ASV MOBESENS from Ifremer, ASV from GESMA, ASV OCARINA from LATMOS, Handivoile, ASV Seawave… ?) and awards ceremony followed by buffet (place to be defined: centre nautique, ENSTA Bretagne, Oceanopolis… ?).

Awards

There will be awards based on points gathered by each robot for the **3 categories** (Microsailboats category, Sailboats category and Motorboats category), **each divided in a student ranking and an open ranking**:

- Student Microsailboat
- Student Sailboat
- Student Motorboat
- Open Microsailboat
- Open Sailboat
- Open Motorboat

Special awards will be given also (e.g. Best MicroMagic, Best SailBot, Best Gas Motorboat, Best Electric Motorboat, Most Innovative, Best First Year Team…).