Program Booklet
of the 8th

Prototype Contest

# Field Robot Event

June 12th 2010

Technische Universität Braunschweig

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# Index







# Contest information

Below you will find the rules of the Field Robot Event 2010 (as of June 7, 2010). Any subsequent changes are available on the website www.fieldrobotevent2010.de.

## Task 1: "Basic"

Within three minutes the robot has to navigate through long curved rows of a maize field to cover as much distance as possible. On the headland it has to turn and return in the adjacent row. There will be no plants missing in the rows. This task is all about accuracy and smoothness of operation within the rows. The headland turning is not as important as in the last year's events.

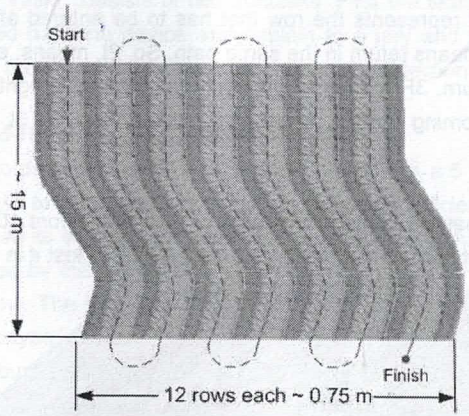


Figure 1: Task 1 "Basic"

**Assessment:**

1. The distance travelled in 3 minutes is measured. If the end of field is reached within this time, the total time counts. Distance and time are observed by officials.
2. Touching the robot *within the rows* results in a penalty of 5 metres (per touch). The number of touches is counted by the officials.
3. A manual intervention *at the end of a row* to help the robot entering the next row will be punished with a penalty of only 2 metres.
4. Destroying a plant (e.g. kinked maize stem) results in a penalty of 1 metre (per plant). The officials will decide whether a plant is broken or not.
5. Distance and time results in a team ranking.
6. The overall points for the Field Robot Event 2010 Champion will be given as follows (similar to Formula1 point system): First place in this task: 10 points - Second place: 8 points - Third place: 6 points - ...5-4-3-2-1-1-1-1... points. Not participating in this task results in 0 points.

## Task 2: "Advanced"

The robot should cover as much distance as possible within 3 minutes while navigating between straight rows of maize plants. It should be able to follow a certain predefined pattern over the field. At various places in the maize field, plants will be missing in either one or both rows over a length of maximally 1 metre. The headland border may not be perpendicular to the crop row orientation. The difference in length of two subsequent rows will be less than 1 metre. A headland of only 1.5 metres will be available for turning (see assessment 4).

Coding of the row-pattern through the maize field is done as follows. S means start, L means left-hand turn, R means right-hand turn and F means finish. The number before the L or R represents the row that has to be entered after the turn and the single number 0 means return in the same path. So, 2L means: enter the second row after a left-hand turn. 3R means: enter the third row after a right hand turn. The row shown in figure [coming soon] is coded as follows: S - 4L - 0 - 3L - 3R - 1R - 3L - 1R - F.

The code of the pattern is made available to the competitors 10 minutes before the start of the competition without having the opportunity to test it in the maize rows.

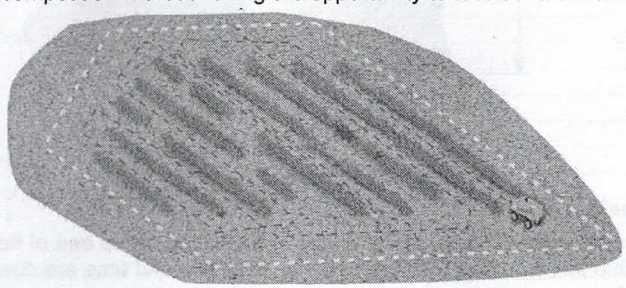

Figure 2: Task 2 "Advanced"

**Assessment:**

1. The distance travelled in 3 minutes is measured. If the end of field is reached within this time, the total time counts. Distance and time are observed by officials.
2. Touching the robot results in a penalty of 5 metres (per touch). The number of touches is counted by the officials.
3. If the robot enters the wrong row after the headland turning, it results in a penalty of 5m. The penalty for any interaction during the headland will be 8m. Anyway the vehicle must be set into the correct row by hand if the headland turning was not successful.
4. Crossing the headland boundary located at the end of the rows by a distance of more than 1.5 metres or twice the length of the robot results in a penalty of 5 metres per crossing; number of crossings are counted by officials.
5. Destroying a plant (e.g. kinked maize stem) results in a penalty of 1m (per plant).
6. Distance and time results in a team ranking. The following sequence for the overall points for the Field Robot Event 2010 is used: 10-8-6-5-4-3-2-1-1-1-1... Not participating in this task results in 0 points.





## Task 3: "Professional"

The "Professional Task" consists of two subtasks. First the teams will have to demonstrate their weed handling device and explain to a jury and the audience how it works. Afterwards they have to demonstrate their weed detection system.

**Subtask 1: "Weed-Handling-Device"-Demonstration**

The teams have to present a weed handling device. Within a 5 metres long straight maize row they have to prove its functionality as well as its efficiency.

Every team can use its own type of weed with a self defined shape and colour. The weed will be placed by the jury in between the maize plants either on the left or the right side of the row. The jury will judge the function as well as the efficiency of the device. A realistic type of weed as well as an economic and ecological extinction device will be honoured by the jury.

**Subtask 2: "Weed-Detection"-Demonstration**

The robot should cover as much distance within 3 minutes while navigating through straight rows of maize. Between the maize plants randomly distributed artificial weeds have to be detected. Plastic flowers will be used for the weeds (details following soon). The successful detection has to be characterized by an audible or visual signal. Additionally it must be shown on which side of the row the weed has been detected. It is not required to 'handle' the weed if you do not want to. Anyway you will not get additional points for a 'extinction action'.

At the headland the robot has to do a headland turn and return in the next row. In between the first 2 metres at the beginning of each row there can be an obstacle within the rows (e.g. an additional maize plant). In this case the robot has to leave the row and enter the next row.

In this part there will not be any jury points. Only the "hard facts" will be scored by the officials.

**Update:**

The ratio of correct detections - correct position as well as correct side - to false detections will be multiplied by the travelled distance (minus penalty meters) and added as bonus meters.Example: Ten plants counted but only five correct detections - Ratio: 0.5. The travelled distance (minus penalty meters) is 20m. This results in an overall distance of: 20m + 20m * 0.5 = 30m.

Figure 3: Taks 3 "Professional"

**Assessment:**

1. "Weed-Handling-Device" – Demonstration
   a. The jury ranks all robots at the end of the extinction device demonstration subtask. The points for this subtask are based on ranking number. The following sequence is used: 10-8-6-5-4-3-2-1-1-1-1…
   b. If the control device does not work during the first run, the team will get one additional chance after all the other robots.
   c. A realistic type of weed as well as an economic and ecological handling device will be honoured by the jury and result in a better ranking.

2. "Weed-Detection" – Demonstration
   a. The distance travelled in 3 minutes is measured. If the end of field is reached within this time, the total time counts. Distance and time are observed by officials.
   b. Touching the robot results in a penalty of 5 metres (per touch). The number of touches is counted by the officials.
   c. A manual intervention at the end of a row to help the robot entering the next row will be punished with a penalty of 8 metres.
   d. Destroying a plant (e.g. kinked maize stem) results in a penalty of 1 metre (per plant).
   e. Distance and time results in a team ranking. The following sequence is used: 10-8-6-5-4-3-2-1-1-1-1…

3. The points from both subtasks will be added. If two teams have the same number of points, the team with the better detection device (subtask 2) will be ranked higher.
4. The following sequence for the overall points for the Field Robot Event 2010 Champion is used: 10-8-6-5-4-3-2-1-1-1-1… Not participating in this task results in 0 points.





## Task 4: "Cooperative Challenge"

Cooperation between one or more robots has to be demonstrated. There is no given task the robots have to fulfil. The robots can drive, fly or even swim (if it is raining cats and dogs). The application should have an agricultural background and has to be shown on the field.

To enforce the exchange between all participating teams, the jury points will be multiplied by a factor. If a single team or two teams from the same university / city show(s) their cooperating idea, the jury points will be multiplied by 1. Teams from different cities within the same country will get their points multiplied by 1.5. For cross-country cooperation the points will be multiplied by 2. No more than two teams should cooperate. The teams have to find cooperating partners on their own (e.g. teams from older events).

The teams have to submit a paper before the event starts (not more than one page) to inform the jury as well as the audience about their idea.

**Assessment:**

1. The jury ranks all the robots after the performance of all teams.
2. The idea and the quality of the demonstration are most important.
3. This task is optional and will be awarded separately. There will be no overall points for the Field Robot Event 2010.

## Task 5: "Freestyle"

Robots are invited to perform a free-style operation on the field. Fun is important in this task as well as an application-oriented performance. One team member has to inform the jury and the audience about the idea.

**Assessment:**

1. The jury ranks all the robot performances at the end of the task.

This task is optional and will be awarded separately. There will be no overall points for the Field Robot Event 2010.

## Additional Task Information:

- Unlike the last years, there won't be any jury points for the basic, advanced and professional[1] tasks. Only the "hard facts" will be considered by the officials.
- During the tasks the robots will have to wait in a Parc Fermé, so that no further testing or modification is possible. Between the tasks there will be a 10 minute break for the teams to prepare their robots for the next challenge (change batteries, etc.).
- From the moment a robot is given permission to start, it must start within one minute. If the robot doesn't start within this time, it has one more chance to start after all other teams. If it does not start within one minute for the second time, the robot is disqualified for that task.
- Large robots and/or robots with a probability of destroying the field will always start at the end of the task (after all second chances restarted again).
- There will be an award for the first three ranks of each task. The basic, advanced and professional tasks together will yield the overall winner of the Field Robot Event 2010.
- If two or more teams have the same number of points for the overall ranking, the team with the better placements during all three tasks will be ranked higher.

For the first three disciplines it is not allowed to use GPS (or rather GNSS). It is allowed only for the cooperating as well as the freestyle task.

Before the start every team has to explain to the officials, which kind of hardware they are using. If they are using simple hardware (e.g. infrared or ultrasonic distance sensors combined with cheap microcontrollers) instead of high end equipment (e.g. embedded PCs, laser range finder), they will get 6 additional points. For a medium complex solution 3 additional points will be given.

[1] Only the weed killing device will be judged by the jury (see task 3).





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