Student Competition CLAWAR 2004

General Guidelines

The aim of CLAWAR's annual climbing competition is to encourage and challenge students from many different areas to design and develop small climbing machines that are able to locomote themselves up different vertical surfaces. The rules are fairly flexible, in terms of how the students tackle the wall, but there will be extra credit given to robots exhibiting features that are novel and have extra 'useful' features, such as some intelligent capability or being able to translate from a horizontal surface to a vertical one.

The climbing robot's design needs to be autonomous, carry the appropriate sensors and locomotion control systems on-board and should be able to negotiate a variety of arbitrary shaped obstacles placed randomly on the vertical wall. The autonomy requirement does not necessarily apply that the power supply should be on-board.

The climbing competition will be conducted using just one wall. However, the wall is designed in such a way that several different features of the climbing machines can be tested, and should challenge the skill and ingenuity of their designers to overcome as many of the problems as possible.

The challenges set out are as follows:

- **Task 1:** To simply climb the vertical surface, starting at the bottom, finishing at the top with no obstacles or barriers.
- **Task 2:** To climb the vertical surface, starting at the bottom, finishing at the top with randomly placed obstacles in the path of the machine.
- **Task 3:** To climb the vertical surface, starting at the bottom, finishing at the top but machines must successfully negotiate a small barrier (1cm high, 1cm wide) that is designed to obstruct the vehicle's progress up the wall.
- **Task 4:** To start on the horizontal plane, locomote itself onto the vertical surface and then proceed to climb the wall.

Dimensions and technical details of the walls are given here, where sizes of the climbing machine can be estimated due to the dimensions of the gaps through which the machine needs to pass. In any event the robots should not exceed 30cm in size. The wall will be made of a ferrous metal to accommodate magnetic adhesion, but it will also be flat and smooth enough to also allow for suction attachment.

Scoring

The competition will be held at a specific time (to be announced closer to the time) during the CLAWAR 2004 conference in Madrid. A panel of experts will carry out the judging of the competition, to award points to each robot, and ultimately the prizes to the winning designers. They will endeavour to be both impartial and fair, allowing all entrants the opportunity to demonstrate fully all

the features of their machines, but time will be limited and selected at the judges' discretion. Each individual robot will accumulate points based upon a set of criteria (detailed below), and also upon which of the tasks are attempted. The tasks have each been assigned a certain 'weighting', which will be taken into consideration when allocating points to individual machines. This is because they progressively pose increasing levels of difficulty to the machine developers. The judges will use following categories as a basis for allocating credits to each individual machine.

- Novelty
- Easy of use
- Level of autonomy/intelligence
- Speed / time of ascent
- Versatility - Capability to complete several of the set tasks
- Simplicity of concept – for commercial manufacture

Points

The basic requirement of any of the machines is to locomote from the bottom of the vertical wall, to the top, and depending on what the robot is capable of doing, the points for the tasks completed will be allocated as follows

Criteria	Number of Possible Points
The further the robot gets up the wall, the more point that will be awarded	20
If the robots manage to avoid the obstacle by touch (including the sides and the top of the wall)	5
Bonus points for avoidance without contact	5
Bonus for successfully negotiating the 1cm high square barrier at top of the wall	10
If a robot successfully locomotes from the horizontal plane, to the vertical	15
If the robots have the capability of climbing using suction (more versatile)	5
Judges discretion: 1. Novelty 2. Easy of use 3. Level of autonomy/intelligence 4. Speed / time of ascent 5. Versatility - Capability to complete several of the set tasks 6. Simplicity of concept – for commercial manufacture	20

This table is only to be used as a guideline, and there is a certain amount of flexibility in the scoring of the competition that will allow those machines that inspire the judges to be rewarded accordingly.

Prizes

It is expected that the competition will be sponsored by a number of industrialists and prizes will be awarded for the best machine in each category. All entries need to be registered with Mr. Luis Pedraza by 31st August 2004 (specify types of wall to operate on). In addition, there will be other awards for innovative design features.

Clarification on any aspect of the competition can be obtained from the competition or conference organisers:

Mr. Neil Heyes, QinetiQ, UK njheyes@qinetiq.com

Mr. Luis Pedraza, I.A.I., Spain lpedraza@iai.csic.es

FAQ List

This list will aim to answer any of your questions with regards this competition, and publish them so that all the participants get equal benefit. Any question should be directed towards **Mr. Neil Heyes** (njheyes@qinetiq.com).

The wall will be made of a ferrous metal to accommodate magnetic adhesion, but it will also be flat and smooth enough to also allow for suction attachment

Q - Is the size of the robot limited to 30 cm in each dimension (cube), or only with respect to the ground (2 D)?

A - The size is limited to the footprint of the robot on the surface of the wall (vertical). In any case, take this dimensions only as reference.

Q - Is the wheight of the robot limited in some way?

A - There is not this kind of limitation, but for safety reason, it will be better to not have a machine of more than 10 Kg. A security cable fixed on the upper part of the wall will be available.

Q - What kind of wall we will found for the competition?

A - The wall we prepared is a ferromagnetic one, 2m X 2m in size. It is sorrounded by a barrier 10 cm height and a base 2m X 0.5m in size. It is a very flat surface (like glass) and also some junction are negligible.

Q - Is it allowed to touch obstacles and the (side) wall? Will it be punished?

A - It can touch the sides, but must not move the obstacles. It will not be punished for this. However, it is not allowed for the robot to run to one of the sides of the wall and then just follow it up until it reaches the top (in the interests of true competition). If the robot can complete the task by

detecting the obstacle without having to physically touch it, then the judges will look this on favorably.

Q - How close should the robot stop to the top wall? Should it be indicated by the robot that it feels to have reached the top? How?

A - There will be a white finishing line, positioned 30cm from the top of the wall, which the robot must cross in order to complete the task.

Q - Are the different rating criteria and tasks weighted? What is the individual weight? (Of course, I know that leaving this question open allows more freedom to build different robots and to judge the results. But in designing a specific machine it is very important for optimizing many design decisions to know it in more detail. Furthermore, the judgment appears more transparent and fair.)

A - I accept what you say with regards the scoring system, and you are right, by leaving the scoring system flexible, it will allow for easier judging of each individual robot. However, I also agree with your point about defining a scoring system now, so that the judging will be more transparent, and robot designs can be optimized to gain the most points. In brief, the basic requirement of any of the machines is to locomote from the bottom of the vertical wall, to the top, and depending on what the robot is capable of doing, the points will be allocated accordingly

Q - Is it intended that a single machine should run different tasks? Or should a specific machine be built for each task? In other words, is it allowed to prepare different machines individually for each task? Or may a robot be modified to adopt it to a specific task?

A - Ideally 1 robot would perform all tasks un-modified. Second best would be to have 1 robot being adapted to do specific things. Third, individual robots would be entered for individual tasks.

Q - How many obstacles will be placed on the wall? What is their minimal distance? What is their shape?

A - The number of obstacles are undefined. The minimum separation of them will be 35 cm. The shape of the obstacles is like a cube 10cm X 10cm X 10cm; take this shape and dimensions only as reference. Not convex or piramidal shape will be used.

Q - Will the rating take the number (and closeness) of obstacles into account?

A - No This will probably be left to the judge discretion.

Q - Is the starting point (and orientation) of robot arbitrarily placed at the bottom of the wall?

A - Ideally YES! In the interests of promoting robotic design to become commercially useful, it is seen that a certain amount of usability needs to be incorporated in the design. This means that someone who had no involvement in the design or production of a robot, can easily set it up, and start it off on it task. Again, if interaction from the designers is needed, then this will be reflected in the scoring, at the judge discretion.

Q - Does the position of the end point matter? (Should it be for instance in the middle of the top wall?)

A - A cross or an object with a specific mark (like a strong white light) will

be placed at the top of the all, the closer you get, the better the score will be.

Q - Who places the machine at the starting position, the competitor or e.g. a member of the jury?

A - As detailed above, but a certain amount of flexibility is allowed as we are all aware how temperamental these experimental machines can be!

Q - Who places the obstacles (and barrier) on the wall? Is it allowed to tune the robot to the specific arrangement?

A - The judges / organisers of the competition will place the obstacles. The robots must cope with this as best as possible, if they can complete the task, modifications can be made but this will be taken into consideration with the scoring. The horizontal/low part of the table will be obstacles-free if you need this.

Q - Is there an opportunity for the competitors to test and tune their robots prior to the competition on the wall (and obstacles) which is used for the competition?

A - Yes hopefully we can organise an area where the wall can be permanently set up and anyone can test their robots at any time during the week of the conference.

Q - I think it is usefull to allow 2 or 3 runs for any robot (and task) and to take the best result. In this way the stress on the team is reduced because such machines do not always work very reliably.

A - There will be the possibility to have a few runs at the wall at the actual time of the competition.

Q - Some comments on the last competition also indicated that it is important to allocate a specific time slot and room for the competition. This increases the role the competition will play on the conference and allows a greater audience (and public media) to participate.

A - Yes, I also think that there should be a specific time slot and location allocated to the competition. However, I am unable to tell you this at the present time, I release this information closer to the time.

The Wall

The wall, as specified in figure 1 will test various aspects of the climbing machines. The vertical surface of the wall will be 2 m x 2 m. It will have a horizontal section at the foot of the wall measuring 2 m x 0.5 m. There will be a 10 cm high barrier around the edge of the wall to limit the motion of the robots. The overall surface of the wall will be made out of a ferrous metal, but will be smooth enough to allow for vehicles with suction devices to operate. A number of 3 dimensional objects will be placed on the wall for the robots to navigate around. There will be a small adjustable (removable) barrier placed on the wall of size 2 m with a cross section of 1 cm x 1 cm, made of a non-ferrous material.

The wall is designed to test the following features:

- Successfully climb a vertical wall, from bottom to top, without any human interaction.
- Navigate around obstacles of a previously unknown size and location.
- Test a vehicles' ability to overcome small steps on an otherwise flat surface.
- Test the ability to transfer locomotion from a horizontal plane to a vertical one.