

Collaborative Autonomous Navigation in a Networked Environment (CANINE)



April 2ND - 6TH, 2012
Oakland University
Rochester, Michigan

January 14, 2011 Version 7

| Change Log | | | |
|-------------------|----------------|----------------------------|--|
| Date | Version | Section | Description |
| 1/14/11 | Ver. 7 | --- | Added Change Log |
| 1/14/11 | Ver. 7 | I.2 | Clarified that multiple vehicles may be used |
| 1/14/11 | Ver. 7 | II.4 | Clarified showing process |
| 1/14/11 | Ver. 7 | II.4 | Clarified what happens if operator does not throw object at least 10 m or throws it out of bounds |
| 1/14/11 | Ver. 7 | II.4 | Clarified starting positions of robots |
| 1/14/11 | Ver. 7 | QA Appendix | Added additional question/answers/clarifications from the kick-off meeting |
| 1/14/11 | Ver. 7 | III.3, III.4, III.6 | Disallowed tracking devices for these challenges |
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I COMPETITION INFORMATION

I.1 TEAM ENTRIES

The six team entries were down selected from 24 proposals which were received through the Robotics Technology Consortium (RTC) as part of the Other Transaction Agreement (OTA) with the Department of Defense (DoD).

I.2 VEHICLE CONFIGURATION

The down select event is designed for a small semi-rugged outdoor vehicle. Vehicle chassis can be fabricated from scratch or commercially bought. Entries must conform to the following specifications:

- **Design:** Must be a ground vehicle (propelled by direct mechanical contact to the ground such as wheels, tracks, pods, etc or hovercraft). **You are able to use as many vehicles as can fit in the 2 m. radius starting circle.**
- **Gripper/Arm/Fetching capability:** Any conventional gripper or scoop should be sufficient to pick up simple objects ranging from the size of a baseball to a basketball with a max weight of three kilograms.
- **Length:** maximum length two meters.
- **Width:** maximum width one meter.
- **Height:** Not to exceed two meters (excluding emergency stop antenna).
- **Weight:** maximum weight of the platform is 100 kilograms
- **Propulsion:** Vehicle power must be generated onboard (via generator, battery, etc, that is – the vehicle cannot be “plugged in” during a run)
- **Speed:** For safety, a maximum vehicle speed of 20 kph will be enforced. All vehicles must be hardware governed not to exceed this maximum speed.
- **Mechanical E-stop location:** The E-stop button must be a push to stop, red in color and a minimum of one inch in diameter. It must be easy to identify and activate safely, even if the vehicle is moving. It must be located in the center rear of vehicle at least .5 meter from ground, not to exceed one meter above ground. Vehicle E-stops must be hardware based and not controlled through software. Activating the E-Stop must bring the vehicle to a quick and complete stop.
- **Wireless E-Stop:** The wireless E-Stop must be effective for a minimum of 40 meters. Vehicle E-stops must be hardware based and not controlled through software. Activating the E-Stop must bring the vehicle to a quick and complete stop. During the down select events, the wireless E-stop will be held by the Judges.
- **Safety Light:** The vehicle must have an easily viewed solid indicator light which is turned on whenever the vehicle power is turned on. The light must go from solid to flashing whenever the vehicle is in autonomous mode. As soon as the vehicle comes out of autonomous mode the light needs to go back to solid.

I.3 WRITTEN REPORT REQUIREMENTS

A 10-20 page written report is required to be submitted electronically by **March 19, 2012**. The report should be in PDF format and will detail the overall system, including hardware, software, control, and perception/sensing capabilities.

I.4 SCHEDULE

The year one down select will take place **April 2-6, 2012** at Oakland University in Rochester, Michigan. The schedule is as follows.

| | | |
|---------------------|--|--|
| Monday, April 2: | 1500-1700 | Registration and equipment drop off |
| Tuesday, April 3: | 0800-1100 1100-1400 1400-1700 | Practice session one on course one and two Practice session two on course one and two Practice session three on course one and two |
| Wednesday, April 4: | 0800-1100 1100-1400 1400-1700 1800 2000 | Practice session four on course one and two Practice session five on course one and two Practice session six on course one and two Qualification test Equipment lock down |
| Thursday, April 5: | CANINE down select 0900-1030 1030-1200 1200-1330 1330-1500 1500-1630 1630-1800 | Down select trial one Down select trial two Down select trial three Down select trial four Down select trial five Down select trial six |
| Friday, April 6: | Media Day 0800-0900 0900-0930 0930-1000 1000-1030 1030-1100 1100-1130 1130-1200 1200-1230 1230-1400 1400 | Robot line up Speeches, placing, awards First place demo Second place demo Third place demo Fourth place demo Fifth place demo Sixth place demo Closing social event Teardown |

I.5 QUALIFICATION

All vehicles must pass a qualification to be able to compete in the CANINE down select. To qualification the vehicle must pass/perform all of the following criteria.

- **Length:** The vehicle will be measured to ensure that it is under the maximum of two meters long.
- **Width:** The vehicle will be measured to ensure that it is under the maximum of one meter wide.
- **Height:** The vehicle will be measured to ensure that it does not to exceed two meters high; this excludes emergency stop antennas.
- **Weight:** The vehicle will be weighed to make sure it is not more than 100 kilograms.
- **Mechanical E-stop:** The mechanical E-stop will be checked for location to ensure it is located on the center rear of vehicle a minimum of .5 meter high and a maximum of one meter high and for functionality.
- **Wireless E-Stop:** The wireless E-Stop will be checked to ensure that it is effective for a minimum of 40 meters. During the performance events the wireless E-stop will be held by the Judges.
- **Safety Light:** The safety light will be checked to ensure that when the vehicle is powered up the light is on and solid and when the vehicle is running in autonomous mode, the light goes from solid it to flashing, then from flashing to solid when the vehicle comes out of autonomous mode.
- **Speed:** The vehicle will have to drive over a prescribed distance where its maximum speed will be determined. No change to maximum speed control hardware is allowed after it is tested.

I.6 SECURITY

Starting 1500 on Monday until 2000 on Wednesday, teams are allowed 24 hour access to the site and their team tent; they are only allowed on the course during their scheduled practice sessions. Any team on the course outside their scheduled times will be disqualified. There will be security guards protecting the team areas from 1800 to 0800 each day Monday through Thursday.

I.7 INDEMNIFICATION AGREEMENT

There will be a Waivers of Claims that will need to be signed by each individual who will be participating at the down select event. This will also cover a release on all photos and video of the participants.

II CANINE CHALLENGE

II.1 OBJECTIVE

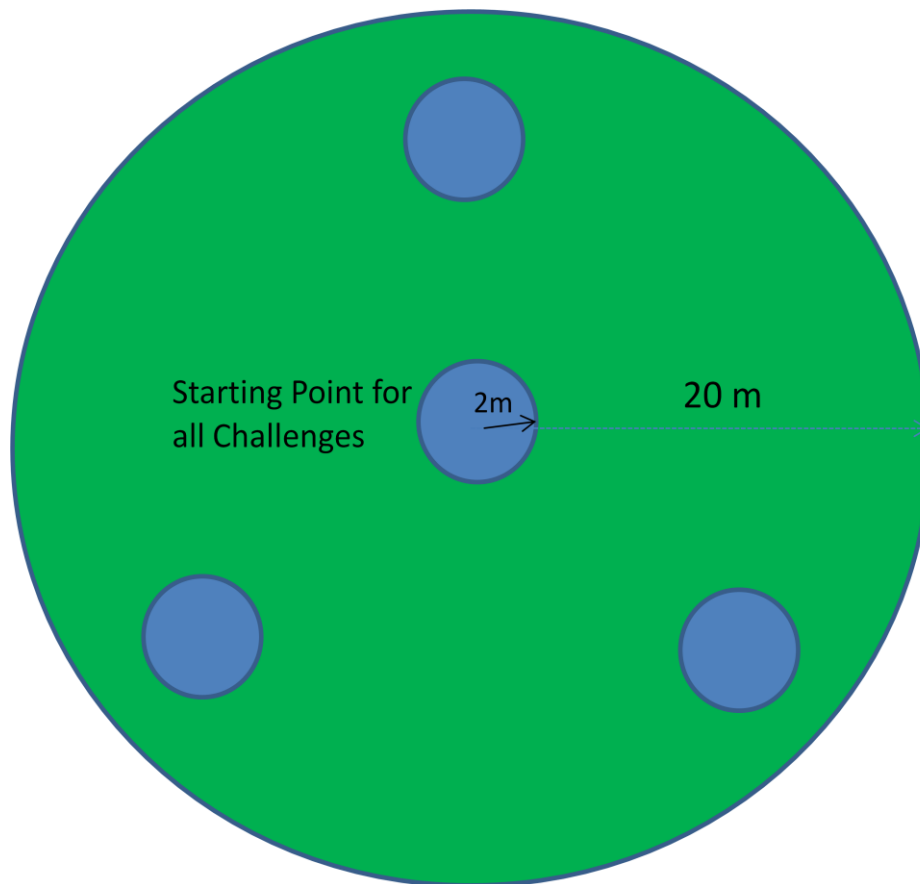
A fully autonomous unmanned ground robotic vehicle must negotiate 6 challenges for the year 1 effort of CANINE.

II.2 VEHICLE CONTROL

Vehicles must be unmanned and autonomous. They must compete based on their ability to perceive the course environment and avoid obstacles. Vehicles cannot be remotely controlled by a human operator during competition. All computational power, sensing and control equipment must be carried on board the vehicle.

II.3 OBSTACLE COURSE

The entire course is enclosed within a semi-circle with a 20 meter radius. The starting point will be roughly in the center of the course and will consist of a semi-circle with a two meter radius. There will be three more semi-circles randomly dispersed throughout the course. See diagram below.



Practice CANINE Map

II.4 COMPETITION PROCEDURES

- The CANINE year 1 effort down select event will test fetching capability.
- It consists of 6 challenges of increasing difficulty worth ten points each.
- Each team has 6 attempts per challenge to successfully complete each one. Once a challenge has been completed, the team must move on to the next challenge.
- Challenges MUST be completed in order, i.e. before attempting Challenge 2, Challenge 1 must be successfully finished.
- There is a ten minute maximum setup time allowed before the challenges begin. Once ready, teams then have 60 minutes to complete all six challenges and ten minutes to exit the course. See below for an example time line for the competition.
- The team is allowed at most two members to transport its robot to the next challenge. To transport the robot from one challenge to the next, the team may teleoperate it or carry it. During the actual challenges, operators may not guide the robot. In challenges involving a starting and ending point, the operator will need to move to the ending point after objects are shown to the robot.
- You can show the robot the object with your hand, on the ground, or put it in its gripper, but you cannot use any other special equipment or touch the robot during this process of showing/learning. Most of the objects that will be used during the competition will be available during practice. However, we reserve the right to use like and/or similar objects of different color during any challenge.
- Some challenges require the operator to throw the object at least 10 m away from the starting point. After the throw, should the object not make contact with the ground at least 10 m away (it is allowed to bounce back within the 10 m distance) or should the object somehow land out of bounds, the operator is allowed to retry the throw, but time will continue to run. Re-throwing does not constitute an attempt.
- Before the start of a challenge, robots can be positioned within the starting circle any way in which the operator wishes. After the throw, the operator cannot reposition the robots. All robots involved in a challenge must be at the starting point before a challenge begins.
- The three teams with the most points will have the opportunity to work on year two efforts. Tie breaks are decided using total time.
 - The competition will take place in the event of medium rain but not in heavy rain or lightning.
 - Judges/officials will assign a designated starting order.
 - No team participant is allowed on the course before the team's first run.
 - An official will carry the E-Stop.
 - An attempt will be declared valid when a designated judge gives the start signal at the designated starting time. An attempt will continue until one of the following occurs:
 - The vehicle finishes the course.
 - The vehicle is about to make contact with an obstacle and/or a judge.
 - The vehicle was E-Stopped by a judge's call.
 - The team E-Stops the vehicle.

II.5 PRACTICE COURSES

There will be two practice courses with three practice slots of three hours each for both Tuesday and Wednesday (12 total) practice sessions. Teams will be allowed one practice session a day and will sign up for times on a first-come, first-serve basis during registration.

After Wednesday's practice session ends, there will be a qualification test from 1800 to 2000 for all the robots to ensure that meet all the requirements and that all safety systems are operating correctly. After completion of the qualification test, all robots will be turned in and locked up to prevent any additional hardware or software changes. During the day of the competition, the only alterations allowed

are minor repairs (i.e. changing of batteries, tightening fasteners, NO software changes or replacing hardware).

To prepare for possible major breakdowns (since major repairs are not allowed on competition day), a team may have a backup vehicle for use. This backup vehicle must also pass the qualification test and will also be locked up afterwards. We will provide security for the lockup.

II.6 HOW COMPETITION WILL BE JUDGED

- All judges and human obstacles will be wearing Army Combat Uniforms (ACU).
- There will be four field judges with four stop watches. At least one field judge will be carrying a bell to signify the stoppage of a run or when time is called.
- There will be three luminaries to oversee the judges.
- At any time, judges can call an administrative pause during the competition. This time will not penalize the team running.
- Team placing will be based on points. In the event of a tie, total time will be used as the tiebreak.
- As described above, a team has a maximum of six attempts to successfully complete a single challenge. After six attempts, a team's run is finished. The point breakdown is as follows:
 - Successfully complete the challenge in one attempt: ten points
 - Successfully complete the challenge in two attempts: eight points
 - Successfully complete the challenge in three attempts: six points
 - Successfully complete the challenge in four attempts: four points
 - Successfully complete the challenge in five attempts: two points
 - Successfully complete the challenge in six attempts: zero points, but may move on to the next challenge
- Successfully completing the challenge is defined as bringing back the correct object from the field of play and any part of the robot, possessing the object, breaking the virtual cylinder surrounding the end point.
- If an incorrect object is brought to the end point, and the robot possessing the incorrect object breaks the virtual cylinder surrounding the end point, the attempt will be declared as unsuccessful.

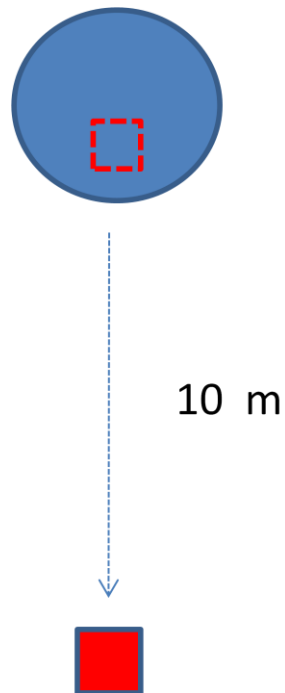
II.7 GROUNDS FOR DISQUALIFICATION

- Judges will disqualify any vehicle which appears to be a safety hazard.
 - Intentional interference with another team's vehicle and/or data link will result in disqualification of the offending team's entry.
 - Damaging the course or deliberate movement of the obstacles or running over the obstacles may result in disqualification.
 - Actions designed to damage or destroy an opponent's vehicle are not in the spirit of the competition and will result in disqualification of the offending contestant's entry.
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III CHALLENGES

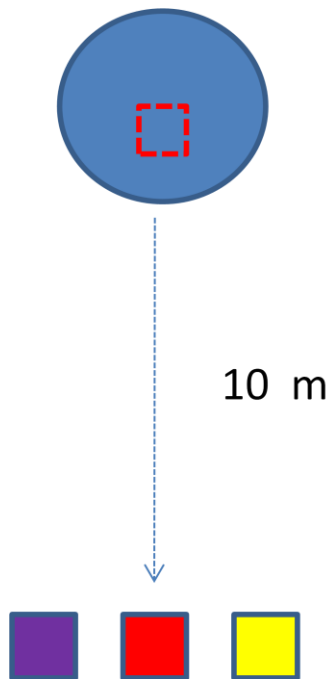
III.1 ONE

From the course starting point, the CANINE vehicle will be shown a single object by the operator. That object will then be thrown a minimum of 10 meters from the outside edge of the 2 m circle in the direction of the challenge. The CANINE vehicle must then retrieve the object and bring it back to the operator at the starting point.



III.2 TWO

From the course starting point, the CANINE vehicle will be shown a single object by the operator. That object will then be thrown a minimum of 10 meters from the outside edge of the 2 m circle in the direction of the challenge. There will be other objects in the field of similar shape but of different colors. The CANINE vehicle must retrieve the original object it was shown and bring it back to the operator at the starting point.



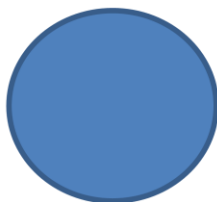
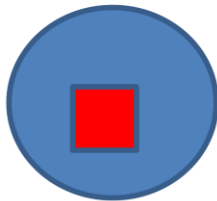
III.3 THREE

From the course starting point, the CANINE vehicle will be shown a single object by the operator. There will be an identical object placed within a 10 meter radius of the starting point. Also within the 10 meter radius are objects of the same shape but of different color.

The CANINE vehicle must search for the object of the same shape and color as the original and bring it to the operator, who has moved to the Challenge 3 Ending point.

The exact location of the Challenge 3 ending point will not be given. ~~; however, a tracking device may be used to track the operator's location.~~

Starting Point



Challenge 3
Ending Point

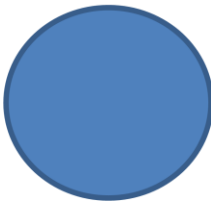
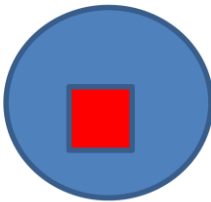
III.4 FOUR

From the course starting point, the CANINE vehicle will be shown a single object by the operator. There will be an identical object placed within a 10 meter radius of the starting point. Also within the 10 meter radius are objects of the same color but different shape.

The CANINE vehicle must search for the object of the same shape and color as the original and bring it to the operator, who has moved to the Challenge 4 Ending point.

The exact location of the Challenge 4 ending point will not be given. ~~; however, a tracking device may be used to track the human operator's location.~~

Starting Point

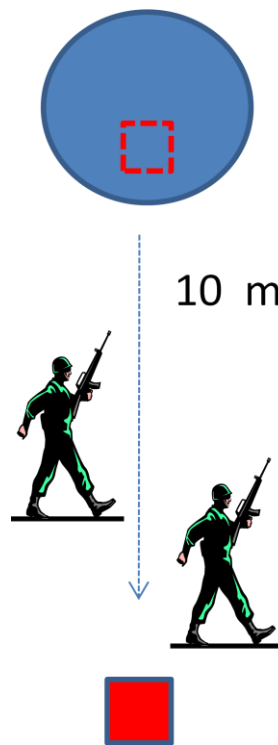


Challenge 4
Ending Point

III.5 FIVE

From the course starting point, the CANINE vehicle will be shown a single object by the operator. That object will then be thrown a minimum of 10 meters from the outside edge of the 2 m circle in the direction of the challenge. The CANINE vehicle must then retrieve the object and bring it back to the judge at the starting point.

Human judges will be standing between the starting point and the object to act as obstacles. The CANINE vehicle must navigate its way to the object and back while avoiding contact with the human judges.

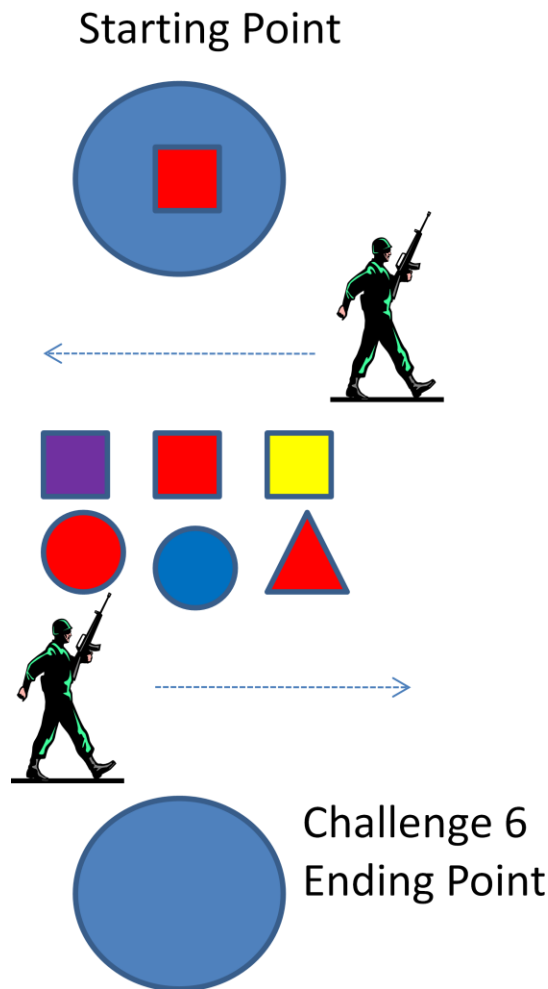


III.6 SIX

From the course starting point, the CANINE vehicle will be shown a single object by the operator. There will be an identical object placed within a 10 meter radius of the starting point. Also within the 10 meter radius are objects of the same shape but of different color and objects of the same color but different shape.

The CANINE vehicle must search for the object of the same shape and color as the original and bring it to the operator, who has moved to the Challenge 6 Ending point. The exact location of the Challenge 6 ending point will not be given. ~~;- however, a tracking device may be used to track the operator's location.~~

There will also be multiple human judges walking around to serve as dynamic moving obstacles. The CANINE vehicle must be able to successfully navigate through the course without making contact with any of the human judges.



Questions Received by Participants.

1) The competition is scheduled for April 2012, but our RTC Task Agreement lists an end date of November 30, 2011. Do we need a no-cost extension to continue to charge to this contract from December 2011 to April 2012?

Yes, awaiting response from Picatinny.

2) If a robot is sufficiently light (under 100 lbs/45 kg) that it is physically unable to cause serious injury, is a software-based E-Stop sufficient?

No.

3) Can you provide a list of the possible objects that will be used in the Phase I competition?

Softball-sized objects, dog toys, kids toys, dumbbells, etc.

4) The rules say, "Any conventional gripper or scoop should be sufficient to pick up simple objects ranging from the size of a baseball to a basketball with a max weight of three kilograms." Can we assume that a parallel-jaw gripper that can pick up a baseball and a basketball and can lift up to 3 kg will be sufficient to pick up any objects used in the Phase I competition?

Yes

5) Can batteries be swapped out between attempts to complete a given challenge?

Yes, but it still counts as part of your 60 minutes.

6) Can we assume that GPS will be available during the competition?

Yes, but we cannot guarantee the quality of the signal.

7) Can we assume that the ground will have a relatively uniform color and texture?

Yes, it will be a fairly flat grass field.

8) When the operator shows the object to the robot, can the operator put the object on the ground or does it need to remain in the operator's hand?

It can remain in his hand or on the ground, but no other equipment/stand may be used.

9) During Challenges 3, 4, and 6, where the operator moves to a new ending point, can the operator make any gesture toward the robot (e.g. waving arms).

Yes, operator can make hand/arm gestures or vocal commands at the new location, but explicit directions cannot be given from the start point to the end point.

10) When the robot delivers the object to the operator, how close does the robot need to get to the operator?

The robot just has to break the plane of the circle that the operator is standing in.

11) After showing the object to the robot, can the operator hit a button to take the robot out of learning mode and put it into retrieval mode?

No physical contact with the robot. You may use voice or hand signals.

12) Can the robot run different software for each Challenge, or does the same software need to accomplish all six Challenge tasks?

No, the same software load must reside in the robot from e-stop checkout to completion of competition.

13) Will copies of the presentations at the kickoff meeting and answers to all of the questions be distributed via email?

We will do our best to document and send out all the questions/answers.

Course information

- Will the robot be allowed to perceive the field of play prior to being shown the object? Yes. Perception can begin after the robot enters the inner circle, but it's using your 60 minute time limit. The robot must proceed directly to the inner circle when entering the field.
- Will the starting and destination points be marked in some way on the ground? If so, what method will be used for marking them? Yes, but we will not tell you how.
- Will the boundary of the field of play be marked in any way? Yes, the outer boundary will be marked with a white line.
- On page 6, the rules state that there will be semi-circles, but the diagram shows circles. Is this just a typo, or will there be semi-circles rather than circles? It was stated that way since we cannot guarantee that it will be a perfect circle. They will be closed ellipsoids.
- What will the surface type of the field be? If it is grass, what will be the length of the grass? In particular, is it possible for the object to be significantly obscured

by grass? **It will be a fairly flat grass field. Cannot guarantee length of grass but it will be fairly low-cut. The grass will not cover most of the object.**

Can you clarify the process of “showing” the object to the robot?

- In particular, will the operator be holding the object in their hand, or will it be on some kind of a stand or on the ground? **It can be in your hand or on the ground, but no stands or any special equipment.**
- Will the operator show all sides to the robot or just a single viewpoint? Will there be some way for us to indicate to the robot when the “showing” period is starting and when it is ending? **You can do whatever you want within your 60 minutes.**
- Will we be able to guide the operator as to where to locate the object during the showing period (e.g., present the object at a certain distance from the robot)? **You cannot guide the robot where to go. You can show the object any distance away you want as long as you, the object, and the robot stay within the circle.**
- If the object will be held in the operator’s hand, will the operator be wearing any gloves or clothing, and, in particular, will there be any easy way to distinguish the object of interest from the operator’s hand or arm? Note that it will be possible for a robot to find a hand or arm of an observer or human obstacle in the field of play. **The operator can wear anything he chooses.**
- Can we assume that the object of interest will not be a human hand or arm? **Yes, no human hands or arms.**

Object colors

- What is meant by “different colors”? For example, would “light green” and “dark green” be considered different colors? **The hues of the object will be more distinct than “light” or “dark.”**
- Will the objects have uniform color? **Yes, as far as the uniformity of commercial products can be guaranteed.**
- Is there a set of colors from which the objects will be chosen from? **The visible spectrum.**
- Will the objects be a distinct color from the ground or obstacles? **They will not be the exact same color as the ground or obstacles.**

Object shapes:

- What does it mean to be a “different shape”? For example, would a 5 cm sphere and a 10 cm sphere be considered to be the same shape? **Your example describes the same shape, but different sizes. We will have objects of different shapes AND sizes.**
- Will there be the potential that the objects may appear to be the same shape from all available viewpoints? For example, if one shape was a cube, and another was a cube with a hole in only one side, these would be indistinguishable from most viewpoints. **We cannot guarantee that all objects are completely indistinguishable**

from all viewpoints. We will do our best to make the object shapes distinguishable from each other.

- Is there a set of shapes from which the objects will be chosen from? If not, are there any rules governing object shape? **No, and no.**
- What are the objects made of? Will they be able to be “gripped” or will they have to be scooped? **Any commonly found materials among dog toys, balls, kids toys, and similar objects. They can be gripped or scooped; it is up to your design.**
- Do you anticipate the objects will have to be lifted high enough to clear any obstacles? Or is a 3-4” lift, enough to clear grass and small objects, likely sufficient? **There will be no obstacles within close proximity of the objects.**

Obstacles:

- In task 5 and 6, what will be the approximate number of human obstacles? **1 to 10**
- Will human obstacles be spaced a minimum distance apart? **No**
- Will we be guaranteed an open path to the object of a certain width? **Yes, there will be a guaranteed path to the object that is at least 1 m wide.**
- In task 6, is it allowable for the human obstacles to completely block access to the object for a period of time? **At no time will the object be completely blocked.**

Robot Operation:

- Is any interaction allowed w/ the robot to transition from a “learning” mode to “fetching” mode? I.e., audible signals, visual cues, etc.? **Hand gestures or voice commands are allowed.**
- Can we have diagnostic and visualization information sent back in real time to our OCU during the competition run? **As long as it’s not being used to control the robot.**

• Rules:

- Is time paused between each of the six challenges, or does it continue to run? **It continues to run.**
- Will the objects actually be thrown? **Yes, the operator will throw the object in challenges 1, 2, and 5**
- Can we find out what human judges and obstacles will be wearing? **Army combat uniforms**
- Can we make use of GPS/DGPS? Is there any information on the availability and reliability of GPS on the competition field? **Yes, but no guarantees on the quality of it.**
- Can other objects be touching the object of interest? **Potentially if you throw the object on another object; otherwise, grass.**
- Can the object of interest be under other objects? **If you throw it and it ends up like that.**

- If we disturb or move an object during the first try of a challenge, do they get moved back, or do they stay where they are during the second try? **The objects are reset and re-thrown after each attempt.**
 - Does the robot have to drop the object in the circle for completion, or can it be removed manually? **It just has to break the plane of the inner circle that the operator is standing in.**
 - W.r.t. a backup vehicle, could we bring a backup vehicle but be allowed to move our electronics stack between vehicles? Cost of multiple electronics stacks could be prohibitive on a program this size. **Section II.5 states that no software changes or replacing hardware is allowed; this would fall under that ruling.**
 - What do you mean by “hardware governed not to exceed the max speed”? Does this mean mechanically? Can it be electronically governed through settings in the speed controller? **The speed cannot be controlled by the main computer. It can be controlled by gear ratios or an independent micro-controller.**
 - Is there a time limit for each task? On page 7, it suggests that there is no time limit, but on page 8, it suggests that a judge can determine when the time limit has been exceeded. **You have 60 total minutes from start to finish, with 6 maximum attempts per challenge.**
 - What does “in the direction of the challenge” on page 9 mean? Does this mean that the robot will be placed in a direction approximately facing the direction in which the object will be thrown? **No, it does not that it’s the direction the robot will face. It’s the general direction in which the challenge will occur.**
 - Can the operator carry a small GPS with radio to relay his position to the robot? **No, the operator may not carry any electronic device which interacts with the robot.**
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I. HARDWARE REQUIREMENTS:

1) How important is the 100 Kg weight limit - is it a hard limit? Why is this needed given the size and speed limits?

100 kg is the weight limit, go over it and you will be disqualified from the competition (Section 1.5). The weight limit is given for safety reasons.

2) The mechanical E-stop - does it have to be a button? The Segway RMP200 has a cord based system for mechanical E-stop, is that acceptable?

The mechanical E-stop does have to be a button as described in section 1.2 of the CANINE Official Competition details. The location of the E-Stop button is also specified in section 1.2 of the CANINE Official Competition details.

3) The rain-proof requirement will be an issue, is there a possibility of puddles and mud on the ground? Weather proofing the sensors will require significant effort and increase the cost of this effort?

The field has relatively good draining. We cannot guarantee there won't be any puddles from medium rain.

II. CANINE CHALLENGES:

1) The text in Section II.3 OBSTACLE COURSE is unclear. The diagram shows circles and text mentions "semi-circles"? What is the purpose of the 3 circles apart from the starting circle scattered around the field - are these alternate start or end positions?

It was stated that way since we cannot guarantee that the circles will be a perfect circle. They will be closed ellipsoids. The three smaller circles are alternate ending positions as described in challenges 3, 4 and 6.

2) Under COMPETITION PROCEDURES are software changes/reloads allowed between challenges?

No, this is explicitly called out in the next section II.5 Practice Courses.

3) Under COMPETITION PROCEDURES when an attempt is unsuccessful, the time is stopped when E-stop is hit. When the vehicle reattempts the challenge does the time restart from the stopped time or zero?

This is an error in the rules. That entire paragraph will be omitted. Time will not be stopped and started again by the team.

4) Under PRACTICE COURSES - teams are allowed a Backup vehicle, does it have to be IDENTICAL or just has to meet the requirements?

The back-up vehicle just has to meet the requirements of the competition. The backup vehicle will have to conform to the E-stop and change requirement called out in section 11.5 Practice Courses.

III. CHALLENGES:

1) How is the object "shown" to the robot - is it allowed to be scanned for a 3d model or 2d images from different viewpoints?

It can remain in his hand or on the ground, but no other equipment/stand may be used. You can do whatever you want within your 60 minutes.

2) How is the "direction of the challenge" defined? Is it decided by the direction of the throw or is it constrained within an angular sector relative to start?

It's the general direction in which the challenge will occur. It is decided by the person throwing the object.

3) For challenges involving multiple objects, what will be the separation between the objects? This will affect the design of the scoop.

There will be a guaranteed path to the object that is at least 1 m wide.

4) For the challenges involving tracking an operator at the end point, is there any restriction on the technologies that can be used for the tracking system?

(a) Can RF tags with a few fixed ground base station antennas/receivers be used for tracking the operators? **No**

(b) Are the role players allowed to carry our RF tracking devices? **No, the operator may not carry any electronic device which interacts with the robot.**

(c) Are we allowed to put RF antennas/receivers within the area of the exercises? **No**

(d) Should the ground station antennas/receivers be outside the 20m diameter circle? **NA**

5) For challenge 5, are the judges absolutely stationary or is there possibility of some movement? **Humans are never absolutely stationary; there could be arm movements, head movements, slight foot leg movements.**

Additional Hardware related question:

1. Can batteries be replaced between events?

It is your 60 minutes, spend it as you please.

2. What type of substantiation of hardware speed governing is required?

The speed cannot be controlled by the main computer. It can be controlled by gear ratios or an independent micro-controller.

Additional questions relating to II CANINE Challenges:

3. How much terrain variation can be expected in each obstacle course area?

The challenges will be using the same field.

4. How soft will the ground be in the challenge areas? (especially if there is medium rain)?

It is fairly firm ground covered in grass. Obviously, rain will soften it up a little.

Additional questions relating to III Challenges:

5. What is the range of object shapes? Could they be polygonal solids? Hockey puck type plates?

Softball-sized objects, dog toys, kids toys, dumbbells, etc.

6. Does "bringing the object" of interest back to the operator simply entail the goal location or must the object be presented to the operator?

The robot just has to break the plane of the circle that the operator is standing in.

7. How close will the color variations be?

The hues of the object will be more distinct than "light" or "dark" of the same color.

Questions/Answers/Clarifications from the CANINE Kick-off meeting January 12, 2011

Can you mark the circle so robot knows where to go back to? **No, but you can stand within the circle wherever you want so the robot knows it made it back to the circle.**

Are RFID tags or GPS locators allowed? **No, only passive tracking is allowed.**

Are antenna base stations allowed? **No.**

Can you clarify hand gestures/voice commands/whistles? **You can gesture, or use voice commands, or whistle (with no additional equipment such as an actual whistle) as long as you are not explicitly telling the robot where to go.**

What is the smallest object you would use? **2 inches minimum height and width; 4 inches minimum length**

Can you run over objects? **Yes.**

Can you clarify e-stop distance? **Once an e-stop is pushed, you must cut off all power to mobility and stop within a meter from when the initial e-stop was applied.**

Can you drag an object? **No.**

Is a screen on the robot OK? **A screen of no more than 13.1 inches diagonal on the robot is allowed.**

Please clarify human/robot collisions. **Humans always have the right of way and will continue on their path unless a robot is in its path and the human will collide with it. In this case, humans will stop in their paths.**

Please clarify the use of robots optimized for certain challenges. **All robots must leave the starting point once a challenge begins. In the case of multiple robots, only if there is a system failure, individual robots may be removed between attempts and challenges.**

If the robot(s) brings back all of the objects on the field, will that be acceptable? **No, if a robot retrieves an incorrect item and breaks the virtual cylinder of the end point, it will be considered an unsuccessful attempt at the challenge.**

January 14, 2011 Version 7