



Walking Robot Foot Races 2006

Objective:

Walking robots compete in head-to-head races over varied rough but equal terrains. The robot will win points based on design, speed, and overall coolness. Competitors that accumulate the most points over three races shall win.

Background:

Why walk when you can drive? There are several advantages to building robots that can walk rather than drive. Walkers are more efficient than wheeled robots when confronted with rough and uneven terrain. In addition, walking robots are more lifelike, and thus more interesting to many people.

The reason that many people avoid building walkers is that they are more challenging than their wheeled counterparts. It can be said that few tasks are tougher in robotics than building an adept walker, particularly an adept biped. Many high profiled failures have made it appear almost impossible for the hobbyist to construct a truly functional walker.

Luckily, the past decade or so has brought significant advances in both the propulsion and control of walkers. The focus on biomimicry has brought advances in central pattern generators (CPG), neural networks, Nervous (Nv) Nets, and Subsumption. Taken as a whole, these technologies have reduced the complexity for walkers, and, consequently, many different walkers are emerging from labs and basements across the world.

The ECRG Walking Robot Foot Race is a competition meant to test the metal of all walkers, including bipeds, quadrupeds, hexapods and more. Thus, many people and institutions can demonstrate their prowess in this emerging area.

Competitor Design Parameters: Walker

These rules serve as guidelines only. The judges have the right to clarify, augment, or modify these rules for the good of the competition and to promote fairness. As always, the judges' decisions will be considered final.

Size and shape. The competing walker must initially fit within the boundaries of a 45 cm (1.5') cube. During competition, the walkers can vary their geometry as necessary but cannot deliberately leave any part of themselves behind. For all races or challenges, walkers must finish the race with all components that were present when they started the race.

Motion. For the purposes of this competition, we define a walker as a robot that moves by oscillating its legs. The legs must move back and forth to achieve motion. If the legs are directly connected to the gear motor, then the gear motor must be oscillating. Otherwise, the gear motor may move continuously and drive the legs using a crank or camshaft mechanism.

Continuous rotary motion, wheels, and spoked wheel designs are not considered walkers. For example, robots such as Rhex, Turbots, or Whegs are not eligible for the walker competition. The judges are the final arbiters of what constitutes a leg and whether its action is within the rules.

Control. Competing walkers must be autonomous robots. To encourage creativity, tethers to off-board computers are allowed. These tethers are for control only and all power supplies must remain on the robot. Any walkers that use human-operated or guided remote controls will be disqualified.

Propulsion and power. Walkers may make use of electrical systems with gear motors, or air pneumatic systems. No other propulsion or power devices are allowed (including combustion, nuclear, et cetera). All power supplies must be carried on board the walker. Safety concerns for participants and spectators are a top priority, and judges will disqualify any walker that they deem to be a safety hazard.

In-heat Repairs. The walkers cannot have parts removed or added between races with the exception of replacing broken components necessary to the operation of the competitor. Reprogramming is allowed providing the robot is ready by the on desk call.

Walker Competition Procedure:

Pre-race testing. Participants will have one or more possibilities to test their robots on the racing platform prior to the event. Given the flow of the Games, the opportunity for testing may be on a different day than the event and may be on a different (but similarly constructed) racing platform. Participants should check the ECRG schedule of events for testing times.

The on deck call. Robots will receive an "on deck" call before their run. Robots must be ready to run when their race is called. Participants have three minutes from the "on deck" call to get the robot ready.

Racing procedure. One robot will run down the racing platform at a time. At the signal from the judge, the participant will start the robot. Robots will be timed from the point in time where they first cross the starting line until they completely cross the finish line. The robots have a maximum of 3 minutes (180

seconds) to complete the course. Once the time is up, the race is ended regardless of whether or not the robot has crossed the finish line.

Robots must remain on the racing platform at all times. Occasionally, a robot turns back to the starting line and walks off the course. Participants may return the robot to the starting point in this circumstance. There is no point penalty. However, the official race time will not be reset.

Excepting when the robot returns to the starting point and walks off the racing platform, no one can interfere. No participant or judge may touch the track or the robot during a race. Tethered robots must be autonomous, remote control is prohibited. If a judge determines that participants are interfering with the event, their robots will be disqualified.

A robot may be unable to complete the race. This can happen for a number of reasons, such as losing power or becoming stuck on the course. In this scenario, the judges and participant may agree to end the race prematurely. The official time will be the maximum race time and no points will be awarded for completing the course.

Number of races. Robots will have at least three opportunities to race. Judges may elect to hold more than three races. In such a circumstance, the best three race times will be used for scoring.

The Competition Platform:

The racing platform will be approximately 1 meter long, containing no less than one "L" shaped elbow, with the surrounding walls measuring a minimum of 20cm (8") tall. The competition shall include:

- Wall Following
- Beacons
- Level Distance Race
- Optional Carpeted Section

Wall Following. The Foot Race aims to measure the agility and speed of a walking robot. In the interest of focusing on these qualities, we have simplified the navigation requirements. Walking robots may use traditional wall-following techniques to navigate the racing platform. These include keeping a tactile switch or lever on the wall.

Extra points will be awarded for walkers that complete the race without hitting the walls. The robot forfeits these points if the body (but not a sensor) hits any wall.

Beacons. Robots may use any other forms of navigation to locate and move to the finish line, including IR tracking and homing beacons. Participants may place a beacon of their own design and making at the finish line.

Such a homing beacon has two restrictions. First, the beacon must operate without human interaction. The beacon cannot enable the participant to remotely control the robot. Second, the beacon cannot interfere with the performance of other competitors. At the judges' discretion, any participant found using

a beacon that does not meet these requirements may be asked to not use the beacon or may be disqualified from event.

Level Distance Race. Here is a quick quiz for the budding roboticist: is it easier to walk across a flat, paved driveway, or to walk across an overgrown field? If you chose the paved driveway, then you're on your way to a successful robot building career. For the purposes of this event, the walkers will compete on a level, flat surface by default.

Optional Carpeted Section. Of course, competing on a flat surface barely taps the true potential of a walking robot. Commensurate with the goals of driving innovation and seeing robots perform over rough terrain; a carpet is available to interested participants. Before the race, the low pile carpet section will be placed across the race platform.

Extra points will be awarded for walkers that complete the race on carpet.

Scoring Method:

1. The total number of possible points is 100.
2. The robot's walking speed counts for 60 points. The walker's speed in centimeters per second is determined by dividing the distance traveled by the average race time. The walker with the highest cm/s will be awarded all 60 points. The remaining walkers will be awarded points based on their comparative speed.
3. 2 points are awarded for each race ran where the robot did not touch the walls, for a total of 6 possible points.
4. 2 points are awarded for each race ran on carpeting, for a total of 6 possible points.
5. 2 points are awarded for each race finished, for a total of 6 possible points. A finished race is one where the robot crosses the finish line in 3 minutes or less.
6. 1 to 10 points are awarded based upon coolness and other design considerations. The judges may use any criteria to determine this score, including audience participation.
7. 12 point bonus will be awarded to any bipedal walker.

Scoring Worksheet:

The judges will use a worksheet similar to the following when scoring.

Robot's Name	Scuttle
Participant's Name	John Doe
Leg Length	9.5
Biped (0 If No, 12 If Yes)	12

Race Number	1
Race Time in Seconds	79 seconds
Raced Without Hitting the Wall (0 If No, 1 If Yes)	0
Raced on Carpet (0 If No, 1 If Yes)	1
Crossed the Finish Line (0 If No, 1 If Yes)	1

Final Scoring:

Factor	Value	Points	Notes
Leg Length	9.5		
First Race			
Race Time in Seconds	79		
Without Hitting the Wall	0		
Raced on Carpet	1		
Crossed the Finish Line	1		
Second Race			
Race Time in Seconds	180		
Without Hitting the Wall	1		
Raced on Carpet	1		
Crossed the Finish Line	0		
Third Race			
Race Time in Seconds	84		
Without Hitting the Wall	1		
Raced on Carpet	1		
Crossed the Finish Line	1		
Scoring			
Total Race Time	343		Given an estimated course length of 100 cm 60 / Fastest Speed in the Event Ceiling(Speed * Point Adjustment) Wall Count * 2 Points Carpet Count * 2 Points Finish Count * 2 Points Judge awarded, out of ten possible points Judge awarded, 12 extra points if a Biped
Average Race Time	114		
Speed cm/s	0.87464		
Speed Point Adjustment	550,458.72		
Speed Points		14	
Wall Count	2		
Wall Points		4	
Carpet Count	3		
Carpet Points		6	
Finish Count	2		
Finish Points		4	
Cool Design Bonus		8	
Biped Bonus		12	
Final Score		81	

Acknowledgements:

Portions of these rules have been adapted from the Portland Area Robotics Society (PARTS) 2003 walker racing rules.

PDXbot.03 Walker Race Rules

<http://www.portlandrobotics.org/rules/walker-rules.html>