Walker Triathalon

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Originally Created by Dr. Mark Tilden and adapted for the WCRG by Dave Hrynkiw

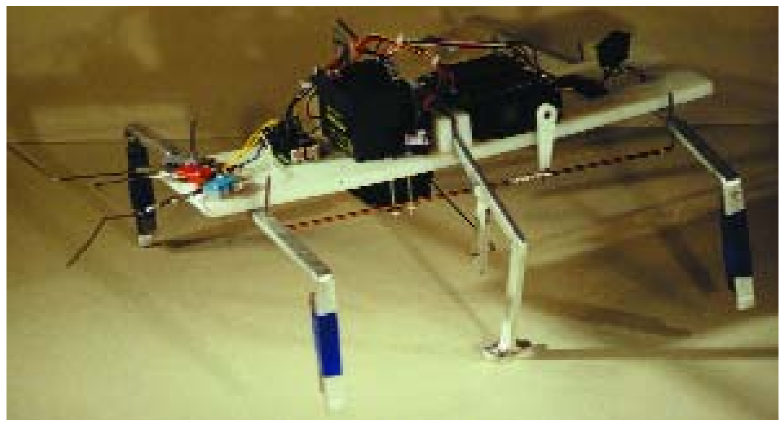
✻ 2002 Rule Changes:

- ***Reclassification as an open (non-BEAM specific) event***
- ***Removal of Walker-Sumo***
- ***Introduction of Hallway-Follower***
- ***"Absurd Size" mismatch equalization***

Object:

Legged robots face off against each other in speed/progress/ability challenges over various rough but equal terrains. Devices shall be awarded points based upon their ability to handle the broadest range of challenges. Competitors which accumulate the most capability points shall win.

Background:



Despite massive deforestation, over 50% of the earth's land mass is still impassable by wheeled or tracked vehicles, and exponentially less so when you reduce the scale of your vehicle to, say, toy size. Legs are much more efficient for handling rough terrain, soft surfaces, and climbing, but there are few tasks tougher in robotics than building a adept walking creature. Once the problems of weight-to-power, suspension, compliance, balance, and reliability are overcome, there is still the daunting task of control.

In the past few years, new control systems based upon biology-inspired central pattern generator (CPG) designs have been making headlines. Neural net, Nervous net, subsumption, and even new multi-tasking algorithms have reduced the size and complexity of controllers to a very feasible level. Consequently, many different walking machines are emerging in labs and basements across the globe.

Many of these devices are still primitive (some are also horrendously expensive), but all are invited to come to the Robot Games to "strut their stuff", including those devices that are built from kits.

In building a walking machine, the biggest problem most commonly faced is the weight to power problem. Many devices cannot even support themselves, let alone lift a leg to take a step, so be careful to make sure the frame design can support the battery deadweight it must carry. Always put the battery central and low on the walker body, and support it well so that the controller does not have to worry about shifting masses as it walks. Use nicads where possible as they have an excellent voltage stability over the variable loads walkers can put on the power supply.

Most of all, remember that good programming can never make up for bad mechanical design. On insect-like (arthropod) walkers, the accuracy of leg positions is not crucial as it is in robot manipulator designs, so you can trust flexible designs to insure stability.

Walking machines are composed of only two basic operations, lift and drive. Lift determines the height of an obstacle a machine can walk over effortlessly, and drive the distance the device can travel with each step. The variability in lift comes from a machines ability to regulate the height of it's steps so that it takes only slight lift steps on level terrain (optimizing the device power for drive), and the variability in drive comes from the devices ability to travel forwards, backwards, turn left, right, and travel trapezoidally. All these factors determine the ability subsets of a competent walking machine.

Walker Triathalon

Remember, most walking machines are significantly less efficient than wheeled or tracked devices because the motors driving the legs undergo repetitive current load starts, stops, accelerations, and reversals. Experiment well in advance, and always, where possible, over-design by 800% to compensate for the inherent perversity of the universe. Although your robot may handle its power load well, any good design must allow for the fact that gopher holes do exist, and any one can dangerously stall out your motor, strip your drive gears, or break your inflexible legs. Opportunities to "break a leg" will definitely be presented at the games.

Competitor Design Parameters:

1 For this competition, a "walking" machine is defined as a mobile machine supported on individually propelled motivating limbs operating in a cyclic fashion. Suspension-wheeled vehicles, spoke wheels, tracks, and mobile manipulator platforms are not viable competitors. Judges shall arbitrate the worthiness of any entry.

2 Competitors may be of any size up to a limit of having all the legs within a 5′ diameter (the standard size of the Sumo competition ring).

3 Competitors are not allowed to drop, throw, separate, or leave behind any part of their chassis. For all races or challenges, competitors must finish with everything they started with.

4 Robot Competitors must not deliberately damage the challenge platforms, other competitors, judges, or spectators in any way. The judges will remove any competitor they feel represents a danger.

5 The device must use only mechanical power, or mechanical power converted from a source of electrical energy. Chemical, compressed gas, nuclear, or combustion power methods are not allowed to run in the competition area, though they will be allowed to run outside if acceptable to the designers and judges.

6 Competitors cannot have parts removed or added to them between races with the exception of replacing broken components necessary to the operation of the competitor.

7 Point penalties will be deducted if devices must have external power fed to them by tether, being fi of the total points earned.

Racing Platforms:

Because of the broadness of the field and the possible ranges of robot sizes and abilities, platforms shall be made up at the time of competition to suit particular device features. Competitions shall include:

- Obstacle challenge race
- Level distance race
- Hallway Following

Challenge Procedure:

Given that walking robots are most likely not to be similar in design, functionality, and capability, every effort will be made to ensure this competition is run fairly, but final rulings will always be made by the judges, with no appeals possible.

The final scores will be tallied from the points won in the three event competitions.

Obstacle Challenge Race

The obvious challenge to any walking robot is to climb over obstacles in its way. The ultimate goal of any walking robot builder is to construct a device that would make their wheeled counterparts shrug and roll home in inglorious defeat. With this in mind, the Obstacle Challenge Race will pit walking machines against a suitably challenging course, where the goal is simply to traverse the environment.

WALKER TRIATHALON

The Obstacle Challenge course is approximately 8 feet long and 4 feet wide (the classic dimensions of wall construction materials), with obstacles include (but are not limited to) marbles, styrofoam chips covered in cloth, plastic DIP chip carriers, and a low wall. Obstacles will be scattered evenly upon the course surface, with the progressively difficult and dense obstructions placed further down the track.

Devices will be run individually, and have three minutes to get as far down the track as possible (without escaping off the side edges), with the distance achieved recorded if the track hasn't been entirely traversed.

Electrically powered homing beacons may be placed to assist the robot stay within the competition platform boundary.

In the case of an absurdly slanted competition (i.e.: between a small hand-sized robot and a huge car-sized robot), a handicap will be calculated to each robot, being the distance travelled to win must be 10 times the longest diagonal distance measured across the most-distant feet of the robot. In such an event, obstacle sizes will also be proportioned accordingly.

Commensurate with the importance of a robots ability to cross heavy terrain, the points awarded for this event will be 6 points for first place, 5 for second place, and 4 for third place. Hallway Following

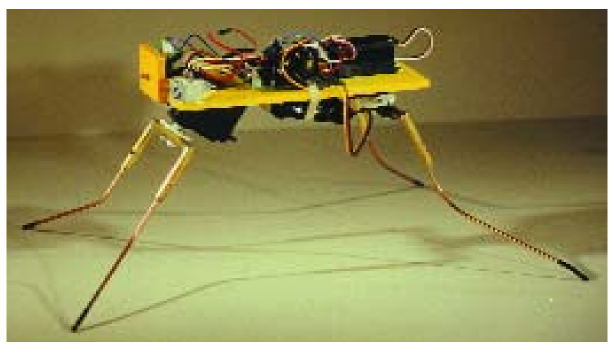
Unlike wheeled robots, a walking robot has considerably more parameters to adjust when making corrections to the desired travel vector. Simply walking over obstacles isn't sufficient in itself to deem a walking robot superior to a wheeled robot; the ability to navigate is of huge importance to the success of an autonomous robot.

As per the "Level Distance Race", the devices will be lined up against an arbitrarily set starting line aimed towards a finish line that is not immediately visible to the robot. The race track will be approximately 1 meter wide, containing no less than one "L" shaped elbow, with the surrounding walls measuring a minimum of 20cm (8") tall. At the given signal, competitors will activate and release their creations in a mad dash to the finish line.

Electrically powered homing beacons may be placed at the finish line to assist the robot's navigation to the finish line.

Being able to direct the motion of a robot is of considerable importance to a successful design, and thus the points awarded for this event are higher than the straight distance run. 5 points for first place, 4 for second place, and 3 for third place.

LEVEL DISTANCE RACE



This event will be run with all devices competing, and if space allows, simultaneously. History has shown that size isn't the governing factor when it comes to speed. Consider the effort it takes you to squash a pesky cockroach, or catch a cat ricocheting around a bathroom when you're trying to bathe it. The human is a much larger animal, but slower in many regards. The same can also apply to robots of different sizes.

Devices will be lined up against an arbitrarily set starting line aimed towards a similar line measured out 3 meters away (10 feet). The starting line will be approximately 3 meters wide (10 feet), with 3' high walls defining the left and right perimeter of the race track. When given the signal, competitors will activate and release their creations in a mad dash to the finish line.

Devices that interfere with each other will not be allowed to be separated during the event, or run at a later time. For this reason, a competitor may want to delay releasing their device when the race is run, just to pick an obstacle-free path to the finish line.

In the event that more than one heat has to be run, the top robot from each heat will compete in a final race to determine first, second, and third places.

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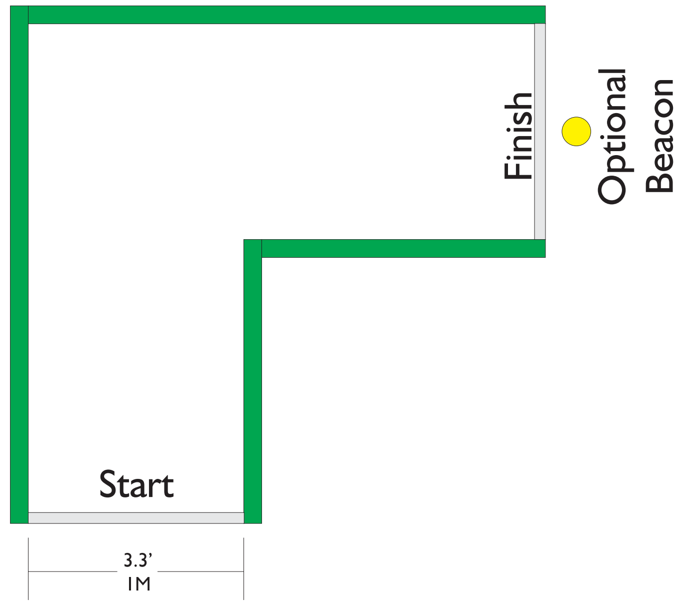
Speed is secondary to a devices ability to cross and navigate through heavy terrain, and thus the points awarded for this event are lower than the other events. 4 points for first place, 3 for second place, and 2 for third place

HALLWAY FOLLOWING



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