

This rules revision is open for member comments until the close of the February General Meeting. After considering member comments and after committee approval the revised rules will stand for the 2012 Robot Rally. Comments may be made in person or posted on the list server.

Rules for
“Polyathlon”
 Version 120121 DRAFT

This rules revision is mostly a reformatted version of the 2010 rules. Substantive changes are highlighted in yellow, usually with comments.

Object of the game: What is a polyathlon?

Polyathlon is a series of contests or events similar to the athletic decathlon where robots compete to determine the best over all performers. Each contest will be scored based on performance and then the scores totaled to determine the over all winner. The number of contests in our polyathlon may change each year. Contests are designed and selected to have conflicting optimization parameters. For example finding and pushing targets favors a wide robot but avoiding obstacles favors a narrow robot.

Each contest is fairly simple so that everyone has a chance to compete. A robot need not compete in every contest but will get zero points for contests not entered.

All of the contests in polyathlon are individual events. That is to say individually timed and measured, as opposed to head to head matches.

General rules

1. Bots

- a) Robot Size: Bots must initially fit inside a 12x12 inch square or 14 inch circle. . After starting, the robot may expand, but only to the extent the robot would fit in an 18 inch diameter circle. The robot’s height will be limited at all times to 18 inches.
- b) Weight limit – 20 lbs.
- c) Swarm bots are or other multiple bots NOT permitted.
- d) Bots may be deemed unsafe and subject to disqualification by judges before starting or during the event.
- e) Bots may not deposit anything on any playing surface. Bots may not mark the playing surface with any substance such as ink or paint.

2. Hardware and Software:

- a) Robot hardware design is fixed and cannot be changed between contests. You may not add or subtract mechanical components. Robots may extend arms, shift sensor positions or change shape using actuators after starting. The robot hardware may also be adjusted manually in a 15 second window before starting. For example, manually shifting the position of a sensor or arm is OK if it takes less than 15 seconds and can be done at the starting position.
- b) Software can be changed between contests. This may be done by switches, jumpers, changing memory modules or by downloading new software.
- c) The robot’s "brain" must be contained on the robot. Links to remote computers are only allowed for the downloading of new software before a contest and for telemetry from the robot.
- d) Data may not be sent to the robot during a contest. Remote stop and start signals are permitted as they enhance safety.

3. Sequencing of contests

a) The contests will be conducted one at a time. For example, all contestants will complete simple line following before starting advanced line following. The judges will determine the event sequence and announce it prior to the start of the Polyathlon.

b) Contestants will be allowed 2 or 3 attempts to complete a contest depending on time available. The best score will be used. Each contestant will do a single run. After everyone has completed his or her first run the second round will begin and then the 3rd if time is available.

Sequence Example:

Simple Line Following: Bot1, Bot2, Bot3, Bot1, Bot2, Bot3

Advanced Line Following: Bot1, Bot2, Bot3, Bot1, Bot2, Bot3

Etc.

c) The time between attempts cannot be determined in advance. It will depend on the number of competitors and the time they take to complete each contest run. The judges may set a minimum time and/or maximum time that a competitor has to prepare between runs.

Obstacles and Targets: Some polyathlon contests use obstacles and or targets.

a) These objects will be constructed from 3" schedule 40 PVC drain pipe, cut to 3.5" long.

b) Bear in mind that 3" pipe has an actual diameter of 3.5" and schedule 40 denotes a wall thickness of 0.216". Drain pipe is cellular. (foamed core with smooth walls) (This is the most commonly available pipe in this size.)

c) Objects will have all edges deburred

d) No attempt will be made to remove maker's marks/labels form the pipe

5. Contests:

a) Basic Line Follower

1. **Goal:** Complete the course faster than your opponents.

2. **The course** will be a simple oval with turn radius no less than 6 inches. The "line" is 3/4 inch black electrical tape on a white surface. Lines will be at least 8 inches from the edge.

3. A time limit of 90 seconds will be imposed. Failure to complete the course within 90 seconds will result in a score of zero.

4. **Human help is permitted in Basic Line Follower. A contestant or assistant may help a wandering robot back to the line. The robot may not be manually advanced along the track. A 5 second penalty will be assessed for each assist.**

5. If the course is short then the judges may elect to have the robots traverse 2 or more laps.

b) Advanced Line Follower

1. **Goal:** Complete the course faster than your opponents.

Moved to the General section. Clarified description

Rule 5.a)4. Was in place for the 2011 contest but was not documented.

Rule 5.b) 2. Was in place. The intersection distance was not documented. The course will be measured and this distance entered

2. **The Course** will have intersecting lines and 90 degree turns. Non-intersecting lines will be spaced apart greater than 8 inches. Intersections will be 90 degrees. **Intersections shall have at least XXX inches of straight run leading to** and from the crossing.. The "line" is 3/4 inch black electrical tape on a white surface. Lines will be at least 8 inches from edge.
3. A time limit of 90 seconds will be imposed. Failure to complete the course within 90 seconds will result in a score of zero.
4. Human help is NOT permitted in Advanced Line Follower.
5. A Robot that loses the line and regains it may continue. A **robot that reverses direction will be considered as not finishing.**

c) **Beacon Killer**

1. **Goal:** Travel 10 feet to make contact with a beacon from a random start orientation in the least time.
2. **Beacon:** Contestant may use the club's Cube Quest polarized white light beacon. (See Autonomous Cube Quest Rules for details.) Alternately the contestant may supply his own beacon. Beacons shall fit in a 12" square. (Stands and holders excluded)
3. **The Arena:**
 1. A Starting box 18" square.
 2. A beacon box 12" square shall be 10 feet distant (edge to edge)
 3. Overall size of the contest area will be determined by the judges. This will be based on the area available at the venue. There will be at least 3 feet of arena area beyond the beacon to allow robots to turn if needed. Also there will be at least 2 feet of arena area behind the Starting box. Thus a length of 17.5 feet is the minimum. It is permitted that the arena be bounded by a wall or walls
4. **Robot Starting Placement:** Robot will be placed 10 feet from beacon pointed in a starting direction set by the judges. The starting direction will be at least 70 degrees from the beacon direction. All contestants will be placed in the same direction for each attempt.
5. **Revealing of Start Direction:** The Judges will not reveal the Starting direction until all contestants are ready. Changes to code or settings are not allowed after the starting direction is revealed.
6. **Second and Third Rounds:** The judges will select a new start direction for each round of attempts.
7. **Timing:** Robots will have a 5 second delayed start. Time starts when robot starts moving and ends when it touches the beacon. Robots have a maximum of 60 seconds to complete this task. . Failure to complete the course within the allotted time will result in a score of zero.

Rules 5.c). Note changes in rules 4,5 & 6

d) **Beacon Killer with obstacles**

1. **Goal:** Travel 10 feet to make contact with a beacon from a random start

orientation in the least time without moving **obstacles (much)**. A time penalty will be imposed for each obstacle moved too far.

Rules 5.c).
Clarified rule 1
Note changes in
rule 3.

2. **Beacon: - The Arena - Robot Starting Placement: - Revealing of Start Direction:** These rules are the same as above
3. **Second and Third Rounds:** The judges will select a **new start direction** for each round of attempts. Additionally the judges **must relocate at least one obstacle** for each round of attempts. It is the Judge's option to reveal or conceal obstacle locations prior to the start of a round.
4. **Obstacles:** Five to twenty objects will be placed in the arena between the robot and the beacon.
 1. Obstacles will be at least 2 feet apart, edge to edge.
 2. Extra obstacles may or may not be placed behind the beacon.
 3. Obstacles will be placed no closer **than XXX** from the beacon location.
 4. The Obstacles will as described above.
 5. The position of each object will be marked with a small marker such as tape. Markers will be designed to allow the judges to determine if and how far an obstacle has been moved.
5. **Timing and Scoring:**
 1. Robots will have a 5 second delayed start. Time starts when robot starts moving and ends when it touches the beacon.
 2. A 10 second time penalty will be applied for every obstacle moved by the robot more than 1/4 inch.
 3. Robots have a maximum of 90 seconds to complete this task. Failure to complete the course within the allotted time will result in a score of zero.

Rule 5.c) 4.3
Contestant input
is called for. 2
feet is proposed.

e) Navigation by dead reckoning

1. **Goal:** Travel 3 legs of an equilateral triangle in a clockwise direction and arrive back at the starting point. The robot must accurately measure distance traveled and angle of turns to succeed.
2. **The Course:** The triangle sides are 4 feet. There are no lines. ~~A small 1/2 inch diameter rod 24 inches high will be placed 6 feet from the starting point along the first leg to allow initial manual alignment of the robot.~~ The Start/Finish will be marked in such a way that the point is easily discernable. The first and second way points will be marked with 8.5 inch diameter circles at the intersections of the 4 foot sides.
3. **Running:**
 1. The contestant must define, to the judges, a reference point on the robot, which will be placed over the starting point and used to measure the offset distance when finished. It can be a wheel or other easily observed part.
 2. The contestant places the robot on the start point and the judges verify the

Rules 5.e)
Clarified rules
2,3 & 4

reference point coincides with the start point. The robot then attempts to traverse the course.

3. **Some part of the robot must pass over 8.5 inch diameter** circles at the first and second way points. Failure in this will result in a score of zero.
4. Robots have a maximum of 120 seconds to complete this task. Failure to complete the course within the allotted time will result in a score of zero.
5. It is prohibited to attempt to detect the markings on the floor.
4. **Scoring:** The judges will measure the distance of the robot to the original start position. In **the event of a tie the robot with fastest time will prevail.**

f) Bulldozer

1. **Goal:** Push 5 objects off a surface in the least time without driving off the edge.
2. **The Playing Surface** will be table **approximately 30" X 96"**. Table height is **between 3.75" and 5.5"**. There will be no line marking the edge. Robots must detect the drop-off to avoid falling off. Robots may use optical, mechanical, sonar or other sensors to detect the edge. A line that is 18 inches from the end of the table defines the starting zone.
3. The Target Objects will as described above.
4. Judges will determine the placement of the Target Objects. Target Objects will be placed standing on end. No Target Objects shall be in the starting zone. Locations shall be marked so that for a given round the target objects are placed the same for each contestant.
5. **Second and Third Rounds:** The judges must relocate at least one obstacle for each round of attempts. It is the Judge's option to reveal or conceal obstacle locations prior to the start of a round.
6. **Starting:** Robots may be placed anywhere in the starting zone. **Robots must be oriented at least 90 degrees from the direction of the Target Zone.**
7. **Scoring and Timing - Time Starts when the robot crosses the starting line.** Time stops when all objects are pushed off. Robots have a maximum of 90 seconds to complete this task. If a robot runs off the table before pushing off all objects the time defaults to 90 seconds. A time penalty of 10 seconds is imposed for each object left on the table after time expires or the robot falls off.

Rule 5.f) 2.
Clarified

Added
Rule 5.f) 5.

Changed
Rule 5.f) 6. To
prevent "bowling
with straight line
robots"

Polyathlon Scoring

Version 1.0 3/7/09

by Dale Heatherington

Individual events are scored on time and/or distance with some events adding time penalties for moving obstacles or missing goal objects. The scoring formulas are designed to equally weight all events and are normalized to the best score in each event.

100 points are awarded to the best performer in each event while the lesser performers will get a proportionally lower score. Failure to compete in an event yields a score of zero in that event. Failure to execute a task can also generate a zero score. For example, a line follower fails to complete a full lap.

If a bot is the only bot competing in an event it will receive a score of 100 if it properly executes the task. If the judges determine it failed to complete the task (beacon finder completely misses the beacon) they may award zero points instead.

When all events are complete each contestants over all score is computed by totaling the event scores and dividing by the number of events.

Here are the formulas for each event.

“Fastest time” is the lowest time recorded for everyone competing in the event. ie: First place.

“Time” is the recorded time of the contestant.

Basic line follower

score = $100 * \text{fastest time} / \text{time}$

Advanced line follower

score = $100 * \text{fastest time} / \text{time}$

Beacon Killer

score = $100 * \text{fastest time} / \text{time}$

Beacon Killer plus obstacles

time = time + penalties.

Penalty = 10 seconds per obstacle moved

Score = $100 * \text{fastest time} / \text{time}$

Navigation by dead reckoning

Distance can be any units, inches, mm, cm etc.

Score = $100 * \text{least distance} / \text{distance}$

(Time will be recorded to break ties)

Bulldozer

Penalty is 10 seconds for each target not pushed off before time expires.

Score = $100 * \text{fastest time} / \text{time}$

Examples

Line follower.

Bot 1 = 7 seconds Score = $100 * 7 / 7 = 100$

Bot 2 = 12 seconds Score = $100 * 7 / 12 = 58.3$

Bot 3 = 14 seconds Score = $100 * 7 / 14 = 50$

Beacon Killer plus obstacles.

Bot 1 = 4 seconds + 10s penalty = 14 Score = $100 * 14 / 14 = 100$

Bot 2 = 15 seconds + 0 penalty = 15 Score = $100 * 14 / 15 = 93.33$

Bot 3 = 12 seconds + 20s penalty = 32 Score = $100 * 14 / 32 = 43.75$

Bulldozer

Bot 1 pushes off 3 targets then drives himself off after 20 seconds. Max time imposed, 90 sec.

Bot 2 pushes off all targets in 30 seconds

Bot 3 pushes off 4 targets before time expires at 90 seconds

Bot 1 = 90 seconds + 2x10 penalty(90+20=110) Score = $100 * 30 / 110 = 27.27$

Bot 2 = 30 seconds Score = $100 * 30 / 30 = 100$

Bot 3 = 90 seconds + 10 penalty (90 + 10 = 100) Score = $100 * 30 / 100 = 30$

Final Scores

If these 3 events were all we had, the final scores could be computed.

Bot Name	Line Follower	Beacon Killer	Bulldozer	Total	Average
Bot 1	100	100	27.27	227.27	75.75
Bot 2	58.3	93.33	100	251.63	83.87
Bot 3	50	43.75	30	123.75	41.25