GENERAL RULES
Advanced Robotics Challenge

The rules of competition at WORLD ROBOT OLYMPIAD are constituted by the WORLD ROBOT OLYMPIAD Advisory Council (“the council” in the Following paragraphs).

Important note: There is no kit & controller restriction for the National Championship. Participants can use any of the kit they want. However for International Championship as per the norms of WORLD ROBOT OLYMPIAD Council, the teams has to use Tetrix/Matrix kits which will be provided by India STEM Foundation.

1. Qualification for participation and team composition
   1.1. Age of participants – 17-25 years old in the year of competition
   1.2. Team composition– 2-10 participants
   1.3. Team coach – The minimum age of a coach in an international WRO is age 20 at the time of registration for the wro final. Coaches may offer students advice and guidance prior to the competition, however during the actual Olympiad competition, all work and preparation must be performed by the student members of the team.

2. Materials
   2.1. Autonomous robot can be built using any one controller only.(like Myrio, Arduino, raspberry pi etc.)
   2.2. Control software may be LabVIEW from National Instruments or any text-based language (like C, C++, C#, Robot C, Java, python etc.
   2.3. Robot can be built using any building system.
   2.4. Teams are not allowed to use hydraulic pressure, barometric pressure or pneumatics system.
   2.5. Teams can use any electrical motors and servos of their choice –there are no restrictions on brand or number of motors and servos used
   2.6. Teams can use any sensors of their choice – there are no restrictions on brand, function or number of sensors used. Cameras are considered sensors
   2.7. Teams can use any battery of their choice – there are no restrictions on brand, function or number of batteries used
   2.8. Teams should prepare and bring all the equipment, software and portable computers, they need during the tournament
   2.9. Teams should bring enough spare parts. Even in the case of any accidents or equipment malfunction, the council (and/or organizing committee) is not responsible for their maintenance or replacement.
   2.10. Coaches are not allowed to enter the court to provide any instructions and guidance during the competition
   2.11. Robots may be assembled before the tournament
   2.12. Contestants may make the program beforehand
   2.13. Safety Glasses must be worn in the Competition Area at all times
3. Regulations about the robot

3.1. The maximum dimensions of the robot before it starts the “mission” must be within 450mm × 450mm × 450mm. After the robot starts, the dimensions of the robot are not restricted maximum dimensions of the robot before it starts the “mission” must be within 450mm × 450mm × 450mm. After the robot starts, the dimensions of the robot are not restricted

3.2. Robots are autonomous. Participants are not allowed to interfere or assist the robot while it is running (performing the “mission”). This includes entering data to a program by giving visual, audio or any other signals to the robot during the match. Teams that violate this rule will be disqualified at that match

3.3. The playmat is vinyl sticker which will be pasted on wooden playfield. So only Non spike tyres are allowed. Tyres or movement of robot must not damage the playmat at any cost otherwise team will be disqualified

3.4. The weight of the robot must not greater than 12kg.

3.5. Robot action must not damage the playfield & playmat otherwise it will be disqualified from the match.

3.6. A robot must be autonomous and finish the “missions” by itself. Any radio communication, remote control and wired control systems are not allowed while the robot is running. Teams in violation of this rule will be disqualified

3.7. Any Bluetooth or Wi-Fi function on the controller must be switched off at all times

4. COMPETITION

4.1. Each team must prepare for the match in their specified place until the “checked Time”, when the team’s robot must be placed in a designated area.

4.2. On the day of the competition, there will be a minimum of 60 minutes of practice time before the start of the first round

4.3. The contestants may use this time to perform Practices in their places, or may queue with their robots to have one practice game, or may take measurements in the competition site in so far as this does not interfere with other teams’ practice

4.4. Teams cannot touch the designated competition lanes before the start of the practice time is announced

4.5. All robots must be placed on the reviewing table for preparatory review after the end of the Practice period. No mechanisms or programs may be modified after this time

4.6. Robots may take part in the competition only after they have passed review by the judges

4.7. If the robot does not pass the review by the judges, the robot may not be used in the competition

4.8. The competition consists of a number of rounds and testing time

4.9. Preparation time before each game may not exceed 90 seconds, and, once started, individual games may not exceed the match time specified in the Game Rules

4.10. The robot will have the amount of time to complete the challenge that is mentioned in the Game Rules. Time begins when the judge gives the signal to start. The robot must be placed in the starting area so the projection of the robot on the game mat is completely within the start area. The robot is switched off. The participants are allowed to make physical adjustments to the robot in the starting area. However, it is not allowed to enter data to a program by changing positions or orientation of the robot parts or to make any sensor calibrations of the robot. If a judge identifies this, the team could be disqualified from the competition.
4.11. Once physical adjustments have been made to the satisfaction of the participants, the judge will ask the team about the way to run the robot. There are two possible cases
   a) The robot starts moving immediately after turning on the power;
   b) If the robot starts moving after pressing a button on the controller

   If option a.) is used the judge provides a signal to start and the team member switches on the robot.

   If option b.) is used the team member is allowed to turn on the power for the main controller and motor drivers. No changes in position of the robot or its parts are allowed. Then the judge provides the signal to start as well and the team member presses the button to start the robot.

4.12. If there is any uncertainty during the task, the judge makes the final decision. They will bias their decision to the worst outcome available for the context of the situation

4.13. The match will end as described in the Game Rules

4.14. The score calculation is done by the judges at the conclusion of each round. The team must verify and sign the score sheet after the round, if they have no fair complaints

4.15. The ranking of a team is decided depending on the overall competition format as described in the Game Rules. If teams still remain tied, ranking will be determined by consistency of performance by examining which team achieved the next highest score during previous rounds.

5. COURT

5.1. People, other than competing students are not allowed to enter the competition area, apart from authorized WRO Organizing Committee staff and special personnel

5.2. The standard of all competition materials and courts are according to what are provided by the committee on the competition days

6. PROHIBITED

6.1. Destruction or tampering with competition courts/tables, materials or robots of other teams

6.2. Use of dangerous items or behaviors that may create or cause interference with the competition

6.3. Inappropriate words and/or behavior toward other team members, other teams, audience, judges or staff

6.4. Bringing a cellular/mobile phone or a medium of wire/wireless communication into the designated competition area

6.5. Bringing food or drink into the designated competition area

6.6. Competitors using any communication devices and methods while the competition is in process. Anyone outside the competition area is also banned from talking to or communicating with competing students. Teams violating this rule will be considered as disqualified and should quit the competition immediately. If communication is necessary, the
committee may allow team members to communicate with others under supervision by
tournament staff or by exchanging a note under permission by judges

6.7. Any other situation which judges might consider as interference or violation of the spirit of
the competition.
World Robot Olympiad 2017

Advanced Robotics Category

Game Description, Rules and Scoring

Version: Final Version January 15th
Table of Contents

Introduction ........................................................................................................................................... 2
2. Game Rules .................................................................................................................................... 6
3. Scoring ............................................................................................................................................ 9
4. Field Specifications .................................................................................................................... 11
5. Game Object Specifications ........................................................................................................ 14
Addendum ........................................................................................................................................ 16

Introduction

The challenge is to make a robot that can score as many points as possible in a robot version of the Tetris® game called Tetrastack. The robot will locate, identify, and stack interlocking colored shapes called tetracubes within the Stacking Form – a rectangular upright box.
1. Game Description

Tetrastack is a robotic construction challenge. The mission is to gather tetracubes from sources in the Construction Zone and place them into the Stacking Form to complete as many interlocking rows as possible.

At the beginning of a match, each of the following conditions must be met:

- The robot is parked in the Robot Base
- The Stacking Form is empty
- Tetracubes are available at the source locations

There are two types of matches: qualifying matches and final matches.

During qualifying matches, the robot has 3 minutes to gather up to 12 tetracubes and place them into the Stacking Form.

During final matches, the robot has a total of 5 minutes and 28 tetracubes.

In the qualifying matches, the robot has access to 2 sets of 6 tetracube shapes. The shapes are:

In the final matches, the robot has access to 4 sets of 7 tetracube shapes – adding the shape below to the set:
The playing field is referred to as the **Construction Zone**. It is the 2.3 m x 2.3 m floor space inside the four border walls where the robot maneuvers and manipulates tetracubes.
The robot will have access to tetracubes from three distinct sources:

- **Prepared Layout** (both types of matches):
  Before the match begins, team members will place 3 tetracubes on the long segment of each Supply Line (6 total)

- **Dynamic Delivery** (both types of matches):
  After the match begins, team members may enter 6 tetracubes into the Construction Zone by sliding them down the Delivery Chute.

- **Packaged Delivery** (final matches only):
  16 tetracubes are packed into a cube called the Package Cube. Before the match begins, team members place the Package Cube on the short segment of the Supply Line closest to the Stacking Form.

The mission may end early if the robot returns to the Robot Base, and the projection of the robot is completely within the Robot Base (cables are allowed to be outside of the Robot Base).
2. Game Rules

Match Timing:

1. A qualifying Tetrastack match is three minutes in length. Final matches are five minutes in length. One minute of setup time is provided for team members to place the tetracubes and the robot.

Starting Configuration:

2. Before each round of play, cards with the 12 tetracubes printed on them are placed in an opaque box. Six cards, drawn randomly from the box, determine the tetracubes for the Prepared Layout. The remaining six tetracubes will be used for Dynamic Delivery. (Printable cards are provided in the addendum.)
3. During the setup time before each match, team members have one minute to place the tetracubes to be used in the Prepared Layout. Any orientation of a tetracube is allowed, but each must touch the long segment of a Supply Line. It may not touch other tetracubes, the Central Line, any exterior wall, or the Delivery Chute. Three pieces must be placed on each line. No measurement tools are allowed.
4. During the setup time of each final match, team members will also place the Packaged Delivery cube on the short segment of the Supply Line nearest to the Stacking Form. Any orientation of a package cube is allowed. The cube must touch the short segment of the Supply Line. It cannot touch the Central Line, but it can touch the exterior wall if desired. No measurement tools are allowed.
5. Team members are expected to wear safety glasses, and shoes may not be worn if it is necessary to walk in the Construction Zone.

Match Start:

6. At the beginning of a match, each of the following conditions must be met:
   a. The robot is parked in the Robot Base
   b. The Stacking Form is empty
   c. Tetracubes are available at the source locations
7. The robot starts from within the Robot Base, a square of 450 mm x 450 mm marked with a thin black line. The robot height must not exceed 450 mm and the projection of the robot must be completely within the Robot Base (cables are allowed to be outside of the Robot Base). The black lines are not included in the Robot Base. Once the match begins, the size of the robot is not restricted except by the borders of the Construction Zone.
8. The robot may not include tetracubes or elements that resemble tetracubes as part of its construction.
9. The match timer starts when the judge gives the signal to start.
Additional Pieces:

10. The robot may introduce additional pieces and/or constructions to temporarily aid in the collection or stacking of tetracubes. The additional pieces must meet the following conditions:
   a. They are considered part of the robot
   b. They are required to be inside the Robot Base at the start of the mat

11. The robot may leave the additional pieces in the Construction Zone when returning to the Robot Base at the end of the match.

Field Interaction:

12. During the match, one team member may enter the 6 Dynamic Delivery tetracubes into the Construction Zone using the Delivery Chute. The team member may place the tetracube on the ramp only in the Release Area: the upper portion of the Delivery Chute surrounded by the black lines. (The Release area does not include the lines.) The team member may then release or push the tetracube, allowing it to slide into the Construction Zone. (Two black lines mark the point where the ramp crosses the border of the field and the Construction Zone begins.) It is expected to slide down the ramp and not be thrown onto the field.

13. The tetracubes may be entered in any order and at any point during the match.
14. The team member may only interact with tetracubes entirely outside of the Construction Zone. For Dynamic Delivery, the team member may only interact with tetracubes entirely within the Release Area of the Chute. The robot may only interact with pieces that are at least partly within the Construction Zone.
Score:

15. Tetracubes placed in the Stacking Form are considered valid and will be included in the official score at the end of the match if both of the following conditions are met:
   a. The four cubes of the tetracube are completely inside the Stacking Form. The judge may use a ruler for validation.
   b. The tetracube is not touching the robot or any mechanism that is considered part of the robot. A valid tetracube can only touch other tetracubes and the Stacking Form.

   The light blue tetracube is completely inside the Scoring Frame. It is valid for the Piece Score - one point. The yellow tetracube will touch the ruler and is invalid, no Piece Score.

16. **Piece Score**: For each valid tetracube in the Stacking Form, a Piece Score is awarded. Valid tetracubes are allowed to touch and be supported by invalid tetracubes.

17. **Row Score**: For each horizontal row of eight cubes belonging to validly stacked tetracubes a Row Score is awarded.

18. **Parking Bonus**: If the projection of the robot is completely within the Robot Base at the completion of the match, a Parking Bonus is awarded (cables are allowed to be outside of the Robot Base). The Parking Bonus will be awarded only if points were also awarded for stacking tetracubes.

Match end:

19. A match ends and time is stopped if any of the following conditions occur:
   a. The match timer expires
   b. Any team member touches the robot or other Field Interaction rules are violated
   c. Any team member touches tetracubes in the Construction Zone or the Stacking Form
   d. The robot places a tetracube outside of the Construction Zone or drives outside of the Construction Zone
   e. The robot or team member damages the field – Delivery Chute, the Stacking Form, Flooring, or the Border
   f. The projection of the robot is completely in the Robot Base
3. Scoring

The official score will be calculated at the end of each match. The maximum score is 100 points. If teams have the same score, ranking is determined by the Row Score and then by the shortest match time.

**Scoring Table:**

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Point Value</th>
<th>Total Available</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Piece Score:</strong> A tetracube is placed into the Stacking Form such that all four cubes are contained within the interior of the Stacking Form.</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td><strong>Row Score:</strong> A completed row contains eight cubes from tetracubes that qualify for a piece score.</td>
<td>5</td>
<td>70</td>
</tr>
<tr>
<td><strong>Parking Bonus:</strong> Final robot position is completely within the Robot Base. (The bonus is awarded only if other points were scored.)</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Maximum Points</strong></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>
Scoring Examples:

0 points: 0 pieces

1 point: 1 piece

2 points: 2 pieces

8 points: 3 pieces and 1 row

9 points: 4 pieces and 1 row

10 points: 5 pieces and 1 row

16 points: 6 pieces and 2 rows

2 points: Light blue and green each score 1 point. The orange piece has only three cubes inside the stacking form.
4. Field Specifications

Construction Zone:

The Construction Zone is the 2.3 m x 2.3 m floor space where the robot maneuvers and stacks. The floor of the Construction Zone is white or light in color with black 50 mm lines, as shown above. The Construction Zone is surrounded by a border 70 mm (+/- 20mm) high.
Stacking Form:

The Stacking Form is centered on the central line located on the wall opposite the Robot Base. The interior is 60 mm (+/- 2 mm) deep, 400 mm (+/- 5 mm) wide, and 700 mm (+/- 5 mm) tall. It holds 8 cubes in width and 14 cubes in height + 2 mm tolerance for per cube in each direction.

The edge border is painted black 50 mm +/- 5 mm in size except for the lower border which is 100 mm +/- 5 mm. The backing surface is solid and painted white. The form will tilt backwards at approx. 85-degree angle from the floor. This will result in the top edge of the form being approx. 7 cm behind the bottom edge.

(thesepicturesdo not meet the standard and are for illustrative purposes only)
Delivery Chute:

The Delivery Chute is a ramp 340 mm wide by 600 mm long set at a 30-degree angle from the floor. The ramp surface will be constructed of a smooth and low-friction material such as is used to construct white-boards. One third of the ramp protrudes into the Construction Zone. The edges of the upper third of the ramp are 50 mm +/- 2 mm wide areas colored black using tape or marker. A line is drawn on the surface using a marker. The line helps define the Release Area without affecting how a tetracube slides down the ramp. Two 50 mm +/- 2 mm drawn lines at the lower third of the ramp help define the end of the Construction Zone.

Tetracubes are expected to slide from the top to the bottom of the ramp in less than one second. Therefore the ramp should not contain rough areas or pits that could cause a tetracube to stop before the bottom of the ramp.
5. Game Object Specifications

Tetracubes:

The construction piece is composed of 4 cubes, 48 mm ± 1 mm on edge. Each tetracube will have a 15 mm ± 1 mm diameter hole centered in each primary cube face. They may be constructed of solid wood, or products such as plywood or high-density-fiberboard. CAD files are available to support automated construction methods. A completed piece will weigh approximately 200 g to 230 g and will be colored using paint or other commonly available materials.

<table>
<thead>
<tr>
<th>Planar Shape</th>
<th>Name</th>
<th>Color Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>Light Blue or Cyan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PANTONE 801 C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RGB 0, 154, 206</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>Green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PANTONE 802 C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RGB 68, 214, 44</td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>Red</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PANTONE 1795 C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RGB 238, 39, 55</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>Orange</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PANTONE Bright Orange C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RGB 254, 94, 0</td>
</tr>
<tr>
<td></td>
<td>J</td>
<td>Blue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PANTONE Blue 072 C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RGB 16, 6, 159</td>
</tr>
<tr>
<td></td>
<td>O</td>
<td>Yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PANTONE 803 C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RGB 254, 233, 0</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>Purple</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PANTONE Purple C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RGB 187, 41, 187</td>
</tr>
</tbody>
</table>
PANTONE colors should be the better standard for paint matching. RGB lookup is dependent on color profile of monitor and provided primarily for image processing reference.

**Packaged Delivery Cube:**

The Package Delivery Cube is built using 16 tetracubes – 2 base sets plus 4 purple T shaped tetracubes. There are many possible constructions of the cube, but the following images illustrate the one teams must use for Tetrastack:
**Addendum:**
Cards used for random drawing of six (6) Tetracubes used for the Prepared Layout: