World Robot Summit
Disaster Robotics Category
Standard Disaster Robotics Challenge
Outline of Rules

Ver. 2019.4.25

Field of Disaster Response

3: Standard Disaster Robotics Challenge

● Aim: A competition that assesses the standard performance levels of robots for disaster prevention and response.
● Robots:
- Either remote controlled or autonomous robots are accepted. Robots must be controlled without being viewed directly by the operator.
- Aerial robots that require a safety net are not acceptable. Other types are allowed.
- Maximum weight 130kg, maximum size at start position 1.2m³.
- Only 1 robot is allowed.

● Robot Operator: 1 person
● Competition Field: The basic components making up the competition field are 1.2m² pallets.
● Competition Details: We have extracted standard test methods (STM) from the World Robot Summit Disaster Robotics Category 1. Plant Disaster Prevention Challenge and 2. Tunnel Disaster Response and Recovery Challenge rules. The competition will consist of the following tasks based on these extracted for the New STM.
(MAN1) Negotiate
(MOB1) Catwalk
(DEX1) Meter/Valve
(DEX2) L-shaped obstacle
(EXP1) Large-area inspection
● Competition Time: Prep 5 mins, task 15 mins, removal from field 10 mins - total 30 mins.
● Extra points will be awarded for robots with environmental resistance. Waterproof +10% (preliminary review by video), explosion proof +10% (submit copy of certificate verifying resistance to explosions).

Acknowledgments: We would like to thank the response robot STM development team (team leader: Adam Jacoff) of NIST, US for their valuable technical advice in the development of New STMs for this challenge.

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MAN1 [Negotiate]

● Outline: Assesses ability to traverse through a narrow space, restricted by sticks positioned to emulate a disaster site. The standard length of one lap of the course is 4.8m. There are 8 sticks in total, positioned at angles to give the robot a leeway of 20% its width. The sticks have been designed so as to come into contact with the robots, and will only turn in a specific direction.

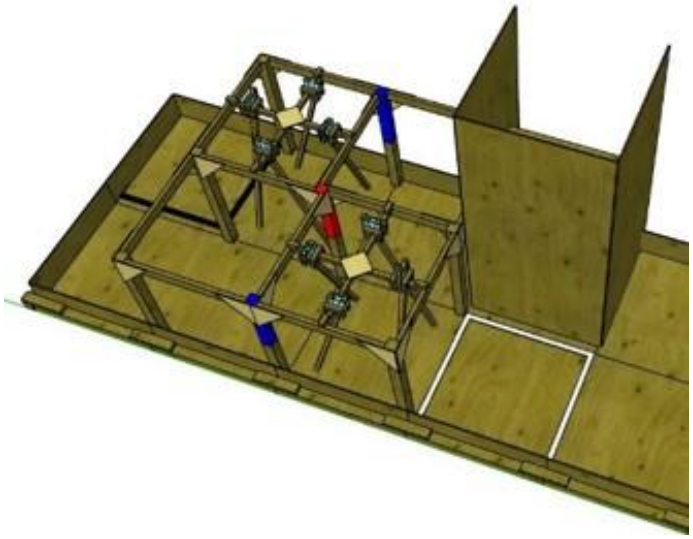
● Instructions and Scoring

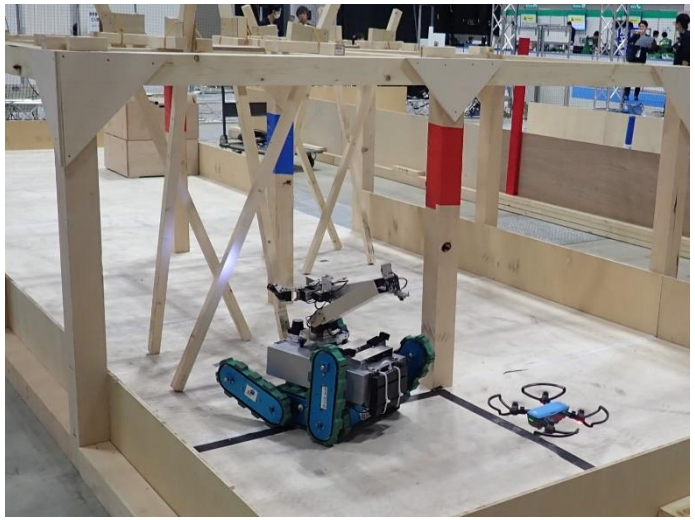
① Start from the white box

② White box->Black box: 1 lap equals 1 point. Black box->White box: +1 lap (+1 point). Repeat.

③ Move with the blue pole on the robot's left.

● Challenge: Recognition of stick-shaped obstacles. Traversing a narrow space which assumes contact with the surrounding environment.





Field of Disaster Response

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MOB1 [Catwalk]

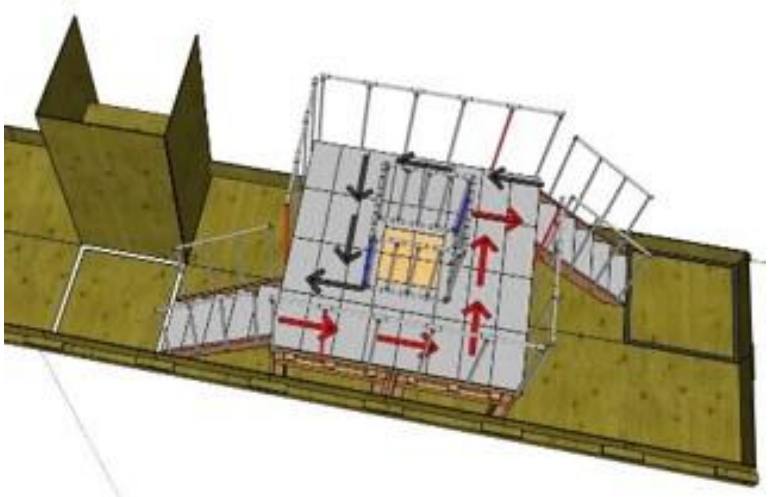
● Outline: Assesses the ability to traverse a catwalk (inspection deck), constructed with flooring typical of a plant, and a skeleton staircase. It is constructed from the following components.

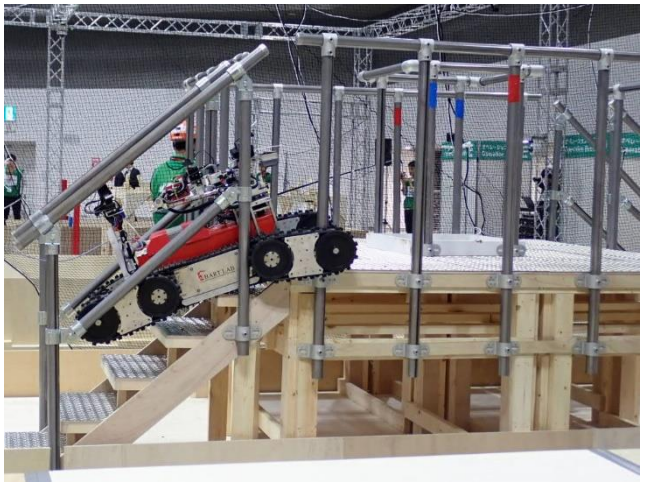
- Walkway: Width 600-1000mm, Rail: Height 0-1100mm
- Skeleton Staircase: Step 150-250 mm, Width 600-1000 mm, Incline 30-60°,
  Rail: Height 0-1100mm

● Instructions:

① Start from the white box
② White box->Black box: 1 lap equals 1 point. Black box->White box: +1 lap (+1 point). Repeat.
③ Move with the blue pole on the robot's left.

● Challenge: Move quickly and accurately in an environment that emulates a plant.





Field of Disaster Response

3: Standard Disaster Robotics Challenge
DEX1 [Meter/Valve]

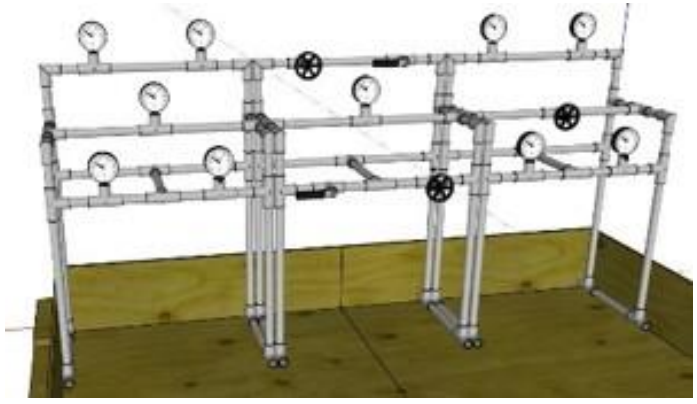
● Outline: Assesses the ability to take meter readings and operate valves. One part of the task is feedback style, where a valve must be operated to set the meter to a specified reading. Meters and valves are set at heights of less than 2.2m. It is constructed from the following components.

- Meter: JIS B 7505-1 based on “Bourdon Pressure Gauge”
- Gate Valve: KITZ Corp. Class 125 Brass Gate Valve FR 1B (25A). Torque required to rotate 0.8Nm.
- Ball Valve: KITZ Corp. Type 600 Brass Ball Valve TK 1B(25A). Torque required to rotate 2.0Nm.

● Instructions

① Start from the white box.
② Read a meter: 1 point. Turn a valve handle/lever 90° : 1 point
③ Once all the meters and valves have been completed, return to the start and begin again.

● Challenge: Quickly and accurately manipulate complex targets. A feedback style task involving observation and control.



Field of Disaster Response

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DEX2 [L-Shaped Obstacle on uneven ground]

● Outline: Assesses ability to move and control an obstacle while on ground emulating a disaster site. It is constructed from the following components.

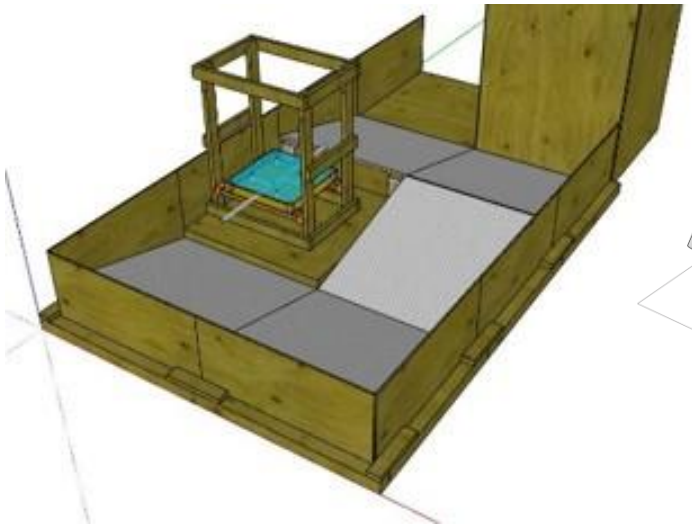
- Ground Surface: Surfaces set at 15° angles emulating a plant's floor.
- Obstacle: Pull out L-shaped, or several parts forming an L-shape, to a specified place in a specified direction. Pull along x, y, and z axes (xs, ys, zs), and rotate around the x, y, and z axes (xr, yr, zr).

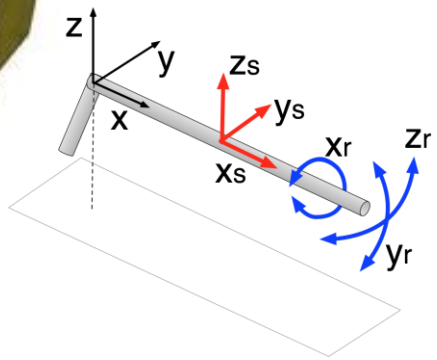
● Instructions

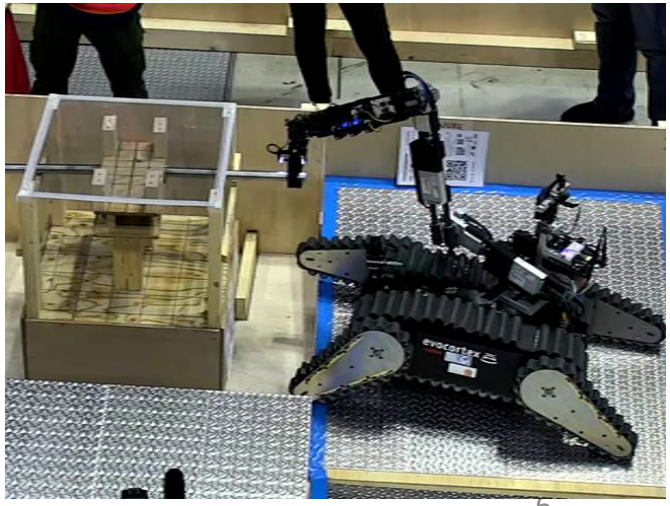
① Start from the white box.

② Move to designated area and pull the obstacle out to the edge of the white tape: 1 point. Move again to another designated area and pull the obstacle out to the edge of the black tape: 1 point. Repeat.

● Challenge: Traverse uneven ground, quickly and accurately manipulate an obstacle.







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EXP1 [Large-area Inspection]

● Outline: Assesses the ability to recognize targets* spread widely over flat or curved surfaces, and generate a map of these targets. Targets are placed at heights of less than 5m, over a an area of approx. 4m².

*Please refer to the rule book for details of targets.

● Instructions

① Start from the white box

② Investigate the arena, and create a map of the QR codes within the targets.

③ The maps quality and accuracy will be decided based on the map submitted.

● Challenge: Quickly and accurately investigate a large area.