IEEE International Conference on Robotics and Automation 2018

DJI RoboMaster AI Challenge

ICRA 2018, Brisbane, Australia

Challenge Rules

Version1.0

Dec 2017

The RoboMaster Organizing Committee reserves the right to revise and interpret the rules.
If you have any questions, please email us: robomaster@dji.com.

Background

DJI initiated RoboMaster in 2015 as an educational robotics competition for talented engineers and scientists. The annual competition requests teams who to build ground robots that use shooting mechanisms to battle with other robots, and the performance of the robots are monitored by a specially designed Referee System, converting projectile hits into Health Point deduction of robots. The competition balances technology and entertainment. Many game elements in the competition are similar to video games. In August 2017, final tournament of RoboMaster 2017 attracted over 26 million viewers from over 20 countries around globe. People can visit https://www.twitch.tv/robomaster to view game replays and introductory videos.

In recent years, deep learning technology greatly has been reshaping the frontier of computer vision and many other AI research areas. In robotics research, deep reinforcement learning allows agents to make decisions basing on deep neural networks (DNN) instead of conventional hand-engineered finite state machines and if-else branches. Many excellent research platforms emerged from standard video games such as Doom, DOTA and StarCraft.

RoboMaster also has the potential to become a deep learning platform, with robots that compete on the field fully commanded by DNN based polices. For one thing, robots also need to make complex decisions that cannot be done by conventional methods. For another, RoboMaster is a real game, so algorithms and policies developed on RoboMaster robots are more practical than those developed in virtual environments.

Organizer:

SZ DJI Technology Co., Ltd.

IEEE International Conference on Robotics and Automation 2018

Chapter 1 Introduction

1.1 About the Challenge

RoboMaster 2018 offers a platform for researchers and university students to make technological innovations and promotes exchange and dialog among researchers worldwide. In the RoboMaster arena, teams have the opportunity to showcase and push the limits of their technical capabilities within a fun and challenging environment. For the general public audience, it can be an eye-opening experience into the world of robotics and its close relationship with humans.

To encourage more participation in shaping the future of robotics, RoboMaster 2018 includes, as an individual event, the "ICRA 2018 DJI RoboMaster AI Challenge" (hereafter referred to as the "Challenge"). It requires robots to complete specific tasks automatically.

The RoboMaster Organizing Committee's (hereafter referred to as "RMOC") R&D team has developed autonomous robots that can coordinate with each other to fight opponents automatically (hereafter cited as RoboMaster AI Robot). A RoboMaster AI Robot has a built-in neural network to make decisions, especially when encountering ally or opponent robots. At this time, RoboMaster AI Robots can not defeat robots controlled by human operators, but they serve as an excellent benchmark to test the performance of new AI algorithms.

In ICRA 2018 DJI RoboMaster AI Challenge, a team has to build and program ONE or TWO autonomous robots (hereafter referred as Team Robot) to defeat TWO RoboMaster AI Robots on a 5 × 8m Challenge Field. In each Challenge Round, neither team robots nor AI robots can be controlled by human operators. The winner of the AI Challenge is the team who defeats AI robots in shortest time or less Health Point (hereafter referred to as the "HP") reduction.

Teams should submit the registration form through the official website (https://www.robomaster.com/en-US/robo/know). Along with the registration form, teams must submit a technical proposal. Qualified technical proposals will receive equipment sponsorship as reward. The teams have to submit their Technical Report before Apr 20, 2018. Teams that submit the highest quality Technical Report will receive travel sponsorship to ICRA in Brisbane.

During the Challenge at Brisbane, each finalist team has **FOUR** Challenge Rounds. During each round, a team needs to set up robots to automatically fight AI robots. The result of each round is evaluated by a score formula. The final score of a team is the highest score achieved over all rounds. Then all final scores of teams are ranked together. According to the final ranking, teams will get certificates, DJI products, and cash prize as awards.

The robots used in the Challenge must comply with the requirements specified in the challenge rules. Teams can build Team Robots by themselves, or purchase sample robots from the RMOC to shorten the preparation time. The RMOC will release purchasing channel afterward on the official website. Other than sample robots, teams can also purchase Referee System.

1.2 Schedule

Every team should correctly fill in the registration information on the official RoboMaster application system. Please visit to https://www.robomaster.com/en-US/robo/know and complete the activity requirements before following deadlines.

Teams can only be qualified to participate in the official Challenge after meeting the requirements of the Technical Report.

The RMOC reserves the rights to change schedule and rules. Rules update or related information will be announced by the RMOC on the official website.

Key date	Activity
Dec 31, 2017, 23:59	Deadline for Registration
Jan 1, 2017, 23:59	Deadline for submission of technical proposals*
Jan 8, 2018, 23:59	Announcement of qualified teams that receive equipment sponsorship.(RoboMaster Standard robot kit **$8,500)**
Apr 10, 2018, 23:59	Deadline for submission of Technical Report
Apr 21, 2018, 23:59	Announcement of finalist teams that receive $1000 travel sponsorship according to the quality of the Technical Report
May 21, 2018 - May 25, 2018	DJI RoboMaster AI Challenge @ ICRA 2018

*The time mentioned above are Beijing Time (UTC+8).

1.3 Team Requirements

The challenge is open to undergraduate students and graduate students.

General Requirements

1. Each participant is allowed to join only one team.
2. Each team must have between 1-10 members. The role and responsibility of each

member must be elaborated in the application form.

3. Each team must have 1 Captain who is responsible for the team's technologies and strategies. The Captain is the main contact point with the RMOC.
4. The team name is the university name or research organization name of team members. If team members come from more than one organizations, team must decide their primary organization as the team name.

Recommended team structure

1 person(undergraduate or graduate) - embedded system programming.

2 persons (undergraduate)- mechanical support and hardware maintenance.

3 persons (undergraduate or graduate)- software system architecture, sensor processing.

2 persons (undergraduate or graduate)- image processing, computer vision, sensor fusion.

2 persons (graduate)- decision making, trajectory generation & execution.

While not mandatory, it is recommended for a team to have a Project Manager. Project manager arranges project schedule and utilizes financial resources. Careful project management is one of the key factors to achieve the challenge.

1.4 Award

Award	Prize
1st Prize	Each team member will get one certificate of recognition and one DJI Phantom 4 Pro. Winning team will get $20,000USD (Before Taxes).
2nd Prize	Each team member will get one certificate of recognition and one DJI Mavic Pro. Winning team will get $10,000 USD (Before Taxes).
3rd Prize	Each team member will get one certificate of recognition and one DJI Spark. Winning team will get $5,000 USD (Before Taxes).
Finalist	Each team member will get one certificate of recognition. The team will get travel sponsorships $1,000 USD (Before Taxes).

*All final scores of teams are ranked together. If multiple teams have the same score, the weight of their robots will be used to decide ranking, where lighter robots have higher ranking.

1.5 Announcement on Intellectual Property

All the intellectual property developed during the Challenge is owned by the team**.** The RMOC does not claim ownership of any code, system design documents or technical report of teams. The Technical Report submitted to RMOC by teams are only used for progress checking. The RMOC will not modify, distribute to third parties or duplicate any submitted Technical Report and other materials.

The RMOC encourages and advocates technical innovation and open-source. The RMOC will not deal with intellectual property disputes between the members of a team. Team members should handle the ownership of intellectual property among members from school, companies, and other entities.

In the process of using RoboMaster Referee System and other supporting materials provided by the RMOC, teams should respect the ownership of all the intellectual properties come with Referee System and supporting materials. Teams cannot engage to do any behavior may damage the intellectual property such as reverse engineering on products, copy, translation, etc. Open source code provided by RMOC cannot be used for commercial purposes.

1.6 Rules FAQ

According to the actual situations before the Challenge event, the rules may be updated in following ways:

1. Minor adjustments of the Challenge schedule.
2. Update more detailed description of the Challenge Field and the Challenge Rundown.

If you have any question about the Challenge, please send your questions to the email address of the RMOC: RoboMaster@dji.com (Subject: “School/Company/Institution Name + DJI RoboMaster AI Challenge Question”), RoboMaster staff will reply within 1-2 working days.

Chapter 2 Robot Specifications

2.1 Technical Overview

Participating teams can purchase components and modules from the RMOC. All team robots must follow the specifications depicted in this chapter.

All team robots must operate autonomously during the Challenge Rounds. However, Robot can be operated manually during the Setup Period of each Challenge Round, as long as it has a switching mechanism to switch robot from manual to autonomous operation by the time the Challenge Round starts.

The **RMOC has following advices regarding to robot system design:**

- Robots sold by the RMOC are just basic prototypes, team must have dedicated mechanical and hardware engineers to maintain them.
- To ensure the stability, use finished components, rather than building them yourself (e.g. ultrasonic sensor).
- Read and analyze the manual carefully.
- Read Referee System specifications carefully. Referee System modules must be installed correctly before robot inspection.
- A project management plan with highlighting milestones and budgets is recommended before developing robots.
- Test robots thoroughly to make sure robots can endure multiple rounds, transportation, and unforeseen accidents.

2.2 General Technical Requirements

To ensure practical, fair, and safe competition, robots must be designed and engineered in strict accordance with following technical requirements.

Item	Description
Energy requirements	Robots can only be powered by Li-Po batteries manufactured by DJI. Fuel-powered engines, explosive substances, and hazardous chemical materials are prohibited. The power supply must consist only of intelligent batteries manufactured by DJI. The total energy storage of any single robot may not exceed 200Wh, and the voltage at any point on robot circuits may not exceed 30V.
Remote Controller	Team robots must be fully autonomous during a Challenge Round, but can be remote-controlled during the Setup Period (two minutes before

	the start of each Round).
Wireless Communication	A team can also deploy their own Wi-Fi link for wireless communication among different robots and external computing devices. The RMOC will only provide an external power source outside of the Challenge Field at one designated area. Due to environmental factors such as live steaming devices and personal devices in the audience, there will be many unknown Wi-Fi signals in the competition site. The RMOC cannot guarantee the stability of Wi-Fi connection built by teams. Note: 1. During the Setup Period of each round, competition teams can setup their own Wi-Fi network. We recommend teams utilize robust and reliable Wi-Fi solutions. 2. Wi-Fi access points can only be placed on team robots or inside the designated area. Placement in audience sections or other areas will be regarded as cheating. 3. There are different Wi-Fi frequencies in different countries or regions. Please plan according.
Optical Elements	Each Robot can use ONE laser pointers to aim target identification. Laser pointer must have a power lower than 35mW and have a projecting angle narrower than 5 °. Mounting LED lights that can illuminate lights on to the game field is allowed. No optical elements used on robots can inflict any harm to participants, referees, staff, or audience.
Decoration	There are clear visual features on the armor modules of Referee System, teams are suggested to develop imaged based target recognition algorithms to detect armor modules. It is compulsory to place sensors (e.g., LIDAR, camera, ultrasonic, infrared) in a way that does not block to interface with armor modules. Do not cast LED lights onto armor modules otherwise robot cannot pass inspection. The Challenge Field and surrounding environment is complex. Teams should take this factor into consideration when developing vision algorithms to better adapt to the changing lighting condition. The RMOC cannot guarantee that the vision features around the field will not cause any interference to robots' vision system.

	Decorate stickers on the armor modules are not allowed.

2.3 Robot Specifications

In each round, team can use ONE or TWO robots. All robots have to receive official inspection before enter to the game field.

Team robots have to comply with following specifications.

Item	Requirement	Penalty
Weight Limit (kg)	20 (Including the battery, but excluding Referee System)	A robot that does not conform to specifications will be rejected during the official inspection.
Initial size limit (length, width, height)	600 × 600 × 500mm	
Expansion size limit (length, width, height) (the maximum size of robots when they fully expand in the challenge)	700 ×700×600mm	
Projectile Speed Limit	20m/s	HP deduction decided by Referee System
Projectile Frequency Limit	10Hz	

2.4 Referee System

2.4.1Overview

All team robots must install a Referee System, which is a critical component of the challenge. It is the most distinguishing feature of RoboMaster, which consists of Main Module, Camera Video Transmission Module, Armor Module, RFID Communication Module , Speedometer Module and Localization Module.

Moreover, team who submits high quality technical proposal (A list of such teams will be announced after Technical Proposal Assessment) will get an equipment sponsorship as a reward. The team get ranked A will get one RoboMaster Standard Robot kit for free, and the team ranked B will get one set of Referee System. Those teams that have not passed the Technical Proposal can purchase the Standard Robot

kit and must purchase Referee System. And finalist team who submits high quality Technical Report (refer to Technical Report Assessment standard) will get US $1000 travel sponsorship.

Robots with Referee System installed can detect projectile hits on armors, which trigger HP deduction. Since Referee System on robots are connected to the Referee Server where all robots upload their HPs and other status, the Referee Server can calculate total HP of each team and decide the winning team instantly when a Round ends. Each robot initially has 2000 HP.

To ensure the challenge is fair and all robots satisfy robot specifications, the Referee System keeps monitoring robot status during every Challenge Round. If a robot violates certain Challenge rules, the Referee System on the robot will automatically reduce its HP accordingly. If a robot has 0 HP, its power will be cut off by Referee System.

Please read the *RoboMaster Referee System User Manual* and *ICRA2018 DJI RoboMaster AI Challenge Specification Manual for* installation instruction and detailed functionality explanations of Referee System.

Referee System consists of following components:

Module	Purpose
Camera Video Transmission Module	Video transmitter captures the live video from camera, and send video stream to video receiver and output as HDMI signal.
17mm Speedometer Module	Installed on the barrel of shooting mechanism. It can detect the shooting speed of outgoing projectiles. It will deduct robot's Health Point when the shooting speed exceed the limit.
Armor Module	Armor module has built-in pressure sensors. It can detect projectile hits and convert it to HP deduction signal within Referee System.
RFID Communication Module	RFID communication module can communicate with the function points in the game field.
Localization Module	Localization module can obtain the location on the game field of each robot.
Main Module	Main module can control the battery power supply and calculate power consumption. It indicates the amount of HP by the strength of the LED light. The color of the LED bar can use to distinguish red/blue team and the status of robots. It will cut the power supply off when the HP goes to 0.

A sample robot shown as following,

2.4.2Robot Health Point - Deduction Penalty Mechanism

During a Challenge Round, robots HP will be reduced when:

1. Projectile launching speed or frequency exceed limit.
2. Armor module being hit by projectiles or accidently hit by other robots. While violently damaging others are not permitted during Challenge Round.
3. Necessarily modules of Referee System do not properly installed.

2.3.1 Projectile Speed Limit

If the speed of 17mm projectile exceeds 20 m/s, the HP will be deducted accordingly:

Each time the referee system detects a 17mm projectile with a speed higher than 20m/s, but lower than22m/s, HP is reduced by 10% of the maximum HP.

Each time the referee system detects a 17mm projectile with a speed higher than (including) 22m/s, but lower than 24m/s, HP is reduced by 20% of the maximum HP.

Each time Referee System detects a 17mm projectile with a speed of 24m/s or above, HP is reduced by 40% of the maximum HP.

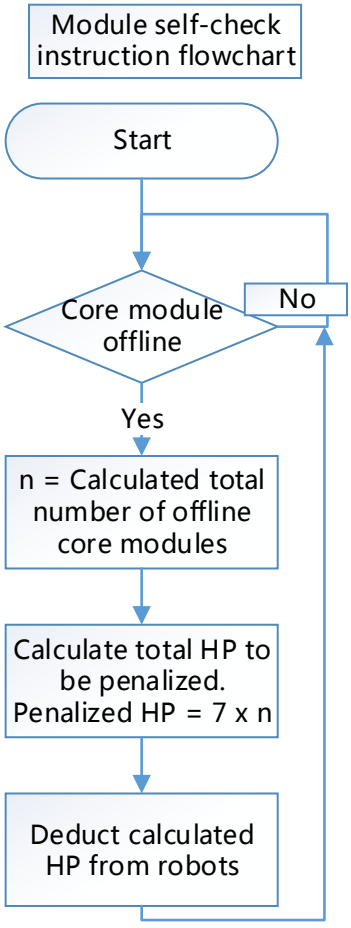
2.3.2 Projectile Frequency limit

The projectile launching frequency cannot exceed 10Hz (Within one second, at most 10 projectiles can go through the Speedometer module). Otherwise, each time Referee System detects a 17mm projectile with exceeding higher than 10Hz will cause HP deduction of 10% of the maximum HP.

2.3.3 Referee System Going Offline

According to the ***ICRA2018 DJI RoboMaster AI Challenge Specification Manual*** , Robots should ensure the stability of the connection between Referee System modules and the Server. If core modules do not correctly connects to the main module of Referee System, HP will be deducted accordingly.

The core modules include 17mm Speedometer Module and Armor Module.



2.5 Safety Guidelines

Safety is a basic principle of the Challenge. All participating teams must pay attention to and take necessary actions to ensure safety when making and operating robots.

1. During research and contest, safety must always be regarded as top priority. Captains must take the responsibility to ensure the safety of all team members involved.
2. Error in operation, software, and control, as well as malfunction of components and equipment, may lead to dangerous and unpredictable robot behaviors that may cause harm or damage to both operators and robots. Therefore, robots must have an emergency shutdown switch. During Challenge Round, the Referee will also shut down such robots through Server of Referee System.
3. The RMOC has the right to take the necessary steps to deal with defective robots in case of emergency situations during the challenge (fire, explosion, etc.)

Chapter 3 Challenge Field

3.1 Overview

The size of the Challenge Field is 8000 × 5000mm, and will be covered by a gray non-slip rubber mat on wooden floor. The Challenge Field contains Starting Zone, Goal Zone, and Bonus Zone. All zones are illustrated in the following figure.

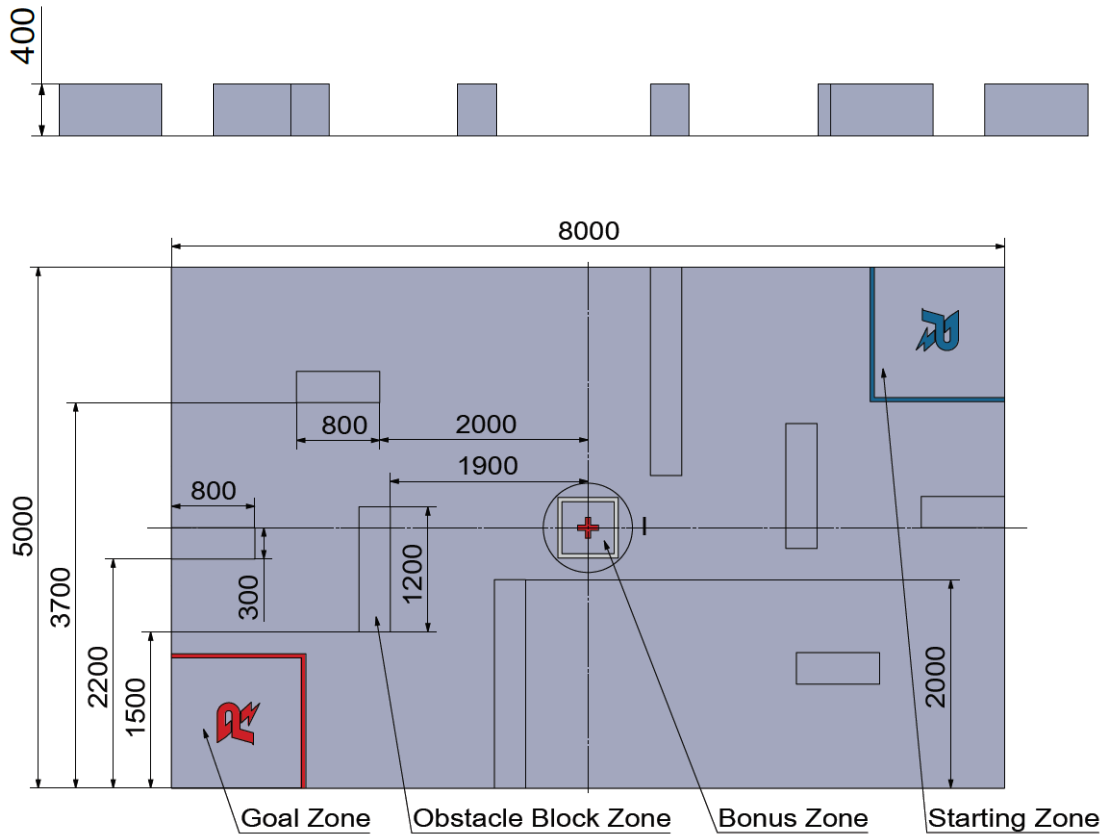


Figure 1

Note: All figures are in millimeters (mm).

3.2 Starting Zone

Starting Zone is the initial location for Team Robots. When a Challenge Round starts, Team Robots must be located within Starting Zone. After the challenge round starts, Team Robots can freely move to anywhere on the field.

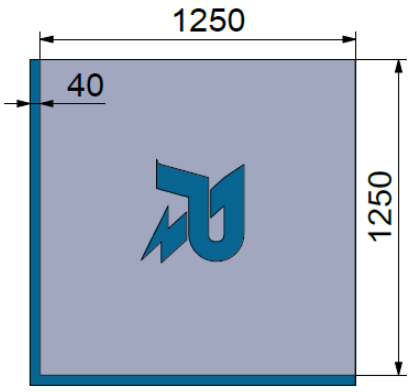


Figure 2

Note: All figures are in millimeters (mm)

3.3 Goal Zone

Goal Zone is the initial location for RoboMaster AI Robots. Similar to Team Robots, RoboMaster AI Robots can also leave the goal area after the challenge round starts.

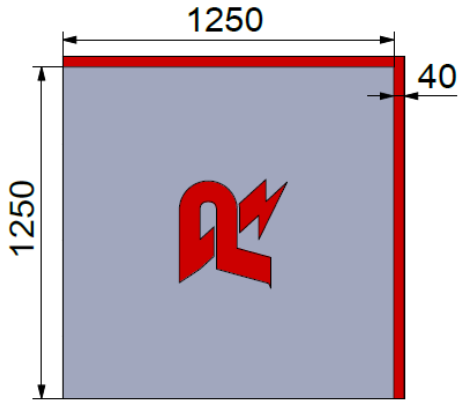


Figure 3

Note: All figures are in millimeters (mm)

3.4 Bonus Zone

There is one bonus zone that only the Team Robot can get it on the field. When a Team Robot resides completely inside Bonus Zone for more than 5 seconds, a Bonus enhancement will be triggered and added to all Team Robots. This enhancement increases damage by 50% for the rest of the Round. For example, if a robot causes 50 HP damage from a single projectile hit, it will increase to 75.

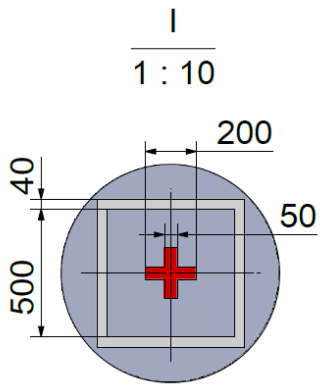


Figure 4

Note: All figures are in millimeters (mm).

3.5 Obstacle Block

There are 8 unmovable obstacles placed at certain designated locations

Please note that obstacle blocks are attached to the ground, constructed of wood are covered by a gray non-slip rubber mat.

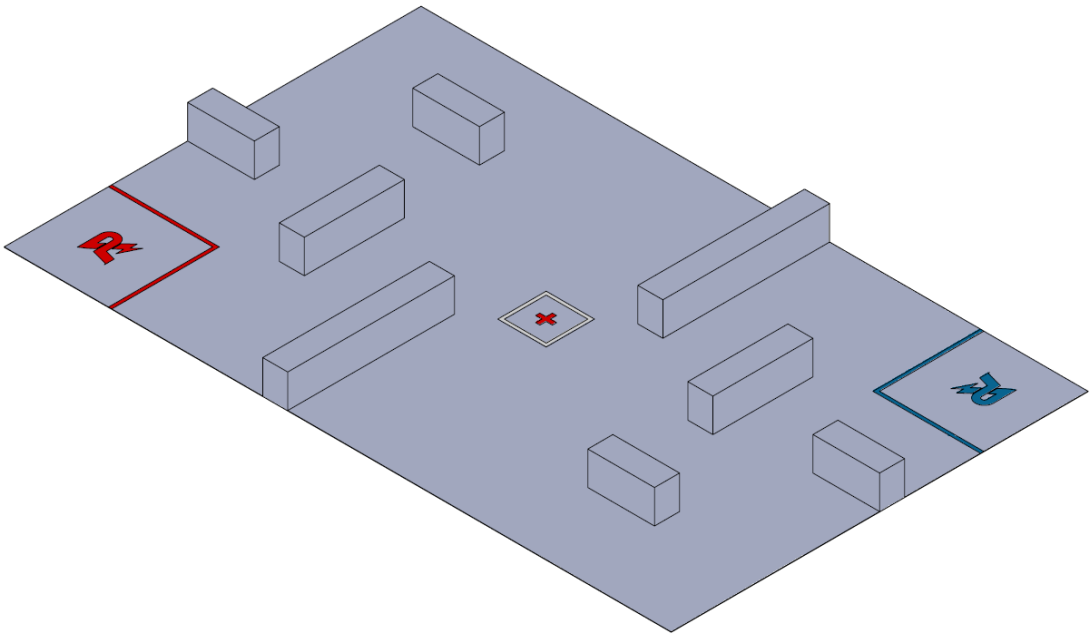


Figure 5

Note: Units are in millimeters (mm).

3.6 Protection Fence

To prevent projectiles from hitting people outside of the Challenge Field, it is surrounded by Protection Fences, which are illustrated below:

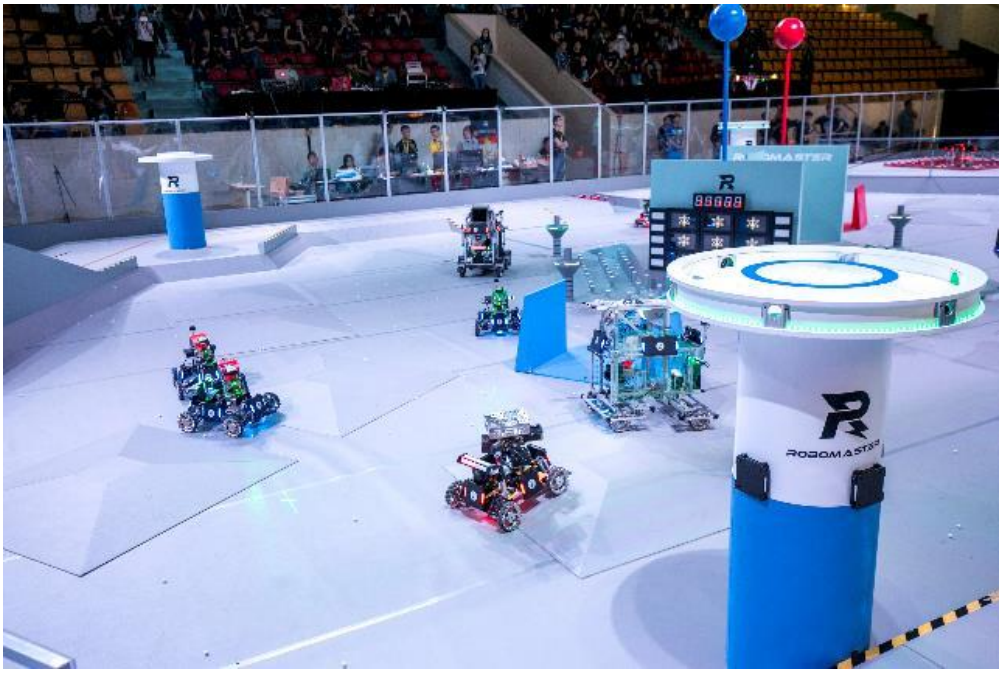


Figure 6

Note: Fences are 2 meters, for reference only.

The height of the fence is between 1800-2000mm. The bottom of the fence is attached to the ground, constructed of wood, and the height is 400mm.

However, in the actual challenge, the color, material, and exact size of the Protection Fences may be different from the figure above. Their appearance and distance to the field should not be utilized in robot localization and decision-making algorithms.

3.7 17mm Projectiles

The only legitimate means to destroy robot is by 17mm projectile hits. Projectile specifications are as follows:

Appearance	Color	Size	Weight	Shore Hardness	Material
Sphere	White	16.9 (±0.1) mm	3.4 (±0.1) g	90A	TPE

Figure 7

*All robots must use projectiles provided by the RMOC and cannot use any other

unofficial projectiles.

Chapter 4 Challenge Procedure

4.1 Overview

The entire Challenge lasts for several days. Teams are required to arrive at the designated venue within the time specified by the RMOC to check in, and place their robots and devices in Preparation Areas. Teams take turns to do Challenge Rounds, and they can modify, reprogram, and fine tune their robots between Rounds. Each team has 4 Challenge Rounds in total.

Every Challenge day has multiple Rounds. During the Challenge, each team prepares for the Challenge at the Preparation Areas, reaches the Inspection Areas for official pre-Challenge Inspection of robots, waits for the Challenge starts at the Staging Areas, and finally enters the Challenge Field. Each team is required to leave the field and return to the Preparation Areas upon the end of each Round.

Details of above mentioned Areas and latest schedule will be specified in the official manual, which will be released one week before actual Challenge starts.

4.2 Pre-Challenge Inspection

60 minutes before every Challenge Round, the RMOC will inspect the robots to appear on the Challenge Field, making sure that the weight, voltage, size and Referee System comply with specifications. Only the teams that pass Inspection are eligible to compete in the challenge.

4.3 Challenge Rundown

After the Pre-Challenge Inspection, team takes their robots to the Staging Areas next to the Challenge Field. Referee will notify team members the time when to start move their robots into the field. As soon as robots enter the field. The Setup Period of the Challenge Round starts.

Each Challenge Round consists of three phases: Setup Period, Referee System Initialization and Challenge Round.

Challenge Rundown Phases	
Setup Period	120 seconds
Referee System Initialization	20 seconds
Challenge Round	180 seconds

Referee System will count the time automatically, linking all phases.

During the Setup Period, team members can power up and setup robots. **no more than 5 team members can enter the Challenge Field. When the Setup Period ends, all team members must leave the Field.**

Each robot (both AI and Team robot) preloads 200 projectiles before each Round. The projectiles for AI robots will be loaded by the referee. The referee will also distribute projectiles – 2 bags of 100 if using ONE robot, 4 bags of 100 if using TWO robots to a team member before the Setup Period, then the projectiles can be loaded to Robots.

Referee System Initialization is for Referee System to check the connectivity of robots. During this 20s period, referees can enter the Challenge Field in case of system failure. If a system failure occurs, team members must wait for the orders given by referees to enter the Field and help referees to resolve problems; otherwise, they cannot enter the Field.

A Challenge Round starts immediately after Referee System Initialization finishs. Team members can only remotely trigger Team Robots with a remotely connected laptop or other communication devices. Afterwards, team members shall not control or communicate with Team Robots for any reason. To ensure the safety of robots, team members are allowed to continue monitor the status of robots using their own video transmission technologies, and notify referees when emergency occurs.

During the Challenge Round, if robots demonstrate abnormal behavior due to program malfunctions, team members can call for an Emergency Termination. The referee will review the situation and then shut down all robots through Referee System interface. When an Emergency Termination occurs, the current Challenge Round ends immediately, and team who called for Emergency Termination gets a Round score of **0**.

When a Challenge Round starts, each robot has 2000 HP. Each projectile hits will reduce 50 HP from the corresponding robot. Projectile hits can be augmented by Bonus (See **3.4**).

Challenge Round ends when Round time expires or when all robots of either side is destroyed.

4.4 Score Calculation

After one Challenge Round, the team score is calculated in the following scheme:

Score = $\alpha \cdot X + \beta \cdot Y - \gamma \cdot Z$

Where α, β and γ represent coefficients with the following values:

1. α = 6.0/(4.0+NUMBER OF ROBOTS);
2. β = 75.0/(4.0+NUMBER OF ROBOTS);

3. $\gamma = 2.0/(1.0+\text{NUMBER OF ROBOTS})$.

NUMBER OF ROBOTS can be 1 or 2, depending on the number of robots that enter the Challenge Round.

And X, Y and Z represent the following:

1. X is the HP reduction of RoboMaster AI robots;
2. Y is the remaining time (in seconds) when both RoboMaster AI robots are destroyed. If the challenge time ends before both AI robots are destroyed, Y is 0;
3. Z is the HP reduction of Team Robots.

In this first example, a team uses 2 robots in a Challenge Round. Their robots **destroy** RoboMaster AI Robots within 50 seconds, and after the Round ends, one robot still has 850 HP, while the other has 1000 HP. Their total round score is,

$\alpha = 6.0/6.0$

$\beta = 75.0/6.0$

$\gamma = 2.0/3.0$

$X=2000 \times 2=4000$

$Y=180-50$

$Z=(2000-850)+(2000-1000)=1150+1000$

Score $=\alpha \times X + \beta \times Y - \gamma \times Z$ **$=6.0/6.0 \times 4000 + 75.0/6.0 \times (180-50) - 2.0/3.0 \times (1150 + 1000) = 2941.6$**

In this second example, a team uses 1 robot in a Challenge Round. This robot destroys RoboMaster AI Robots within 150 seconds, and after the round ends, this robot still has 250 HP. Its total round score is,

$\alpha = 6.0/5.0$

$\beta = 75.0/5.0$

$\gamma = 2.0/2.0$

$X=2000 \times 2=4000$

$Y=180-150$

$Z=(2000-250)=1750$

Score $=\alpha \times X + \beta \times Y - \gamma \times Z$ **$=6.0/5.0 \times 4000 + 75.0/5.0 \times (180-150) - 2.0/2.0 \times (1750) = 3500$**

In this third example, a team uses two robots in a Challenge Round. After Challenge Round expires, both RoboMaster AI Robots remain 100 HP. And both Team Robots have 200 HP left. Then the total round score is,

α = 6.0/6.0

β = 75.0/6.0

γ = 2.0/3.0

X=(2000-100)+(2000-100)=1900+1900

Y=180-180

Z=(2000-200)+(2000-200)=1800+1800

Score =$\alpha \times X + \beta \times Y - \gamma \times Z$ **=6.0/6.0 × (1900+1900) + 75.0/6.0 × (180-180) - 2.0/3.0 × (1800 + 1800) = 1400**

It is recommended to use 2 Team robots for the challenge, since more launching machanism can generate damage more efficiently, and the score scheme reduces the coefficient for HP reduction of Team Robots if there are more than 1 Team Robot on the Challenge Field.

One team plays **FOUR** Rounds in total. The final score for the team is the highest among all four Rounds.

4.5 Fouls and Penalties

In Challenge Round, Referee System automatically monitors the progress of the Challenge. The referee will monitor the Challenge and issue Foul Penalties. When this penalty is issued, the Challenge Round will be terminated immediately, and a zero score is assigned to the team. The penalty will be issued if following fouls occur during the challenge round:

No.	Type of Foul
1	A robot is about to malfunction or has malfunctioned (quickly moving out of the field or bumping against one side of the competition area, causing damage).
2	One or more team members enter the Challenge Field without approval during the Challenge Round.
3	A robot starts to operate before the team members leave the Challenge Field.
4	After the Challenge Round starts, one or more team members manually control a robot, or shift from automatic operation to manual operation.
5	Other behaviors that affect the integrity of the Challenge.

All teams must abide by referee decisions. Otherwise, the score of a team in a Challenge Round will be canceled.

Other behaviors that severely violate the spirit of the Challenge will lead to the disqualification of the team.

Appendix I

ICRA2018 DJI RoboMaster AI Challenge

Technical Proposals Requirement

The Technical Proposals is an optional report for ICRA 2018 DJI RoboMaster AI Challenge. If registered teams choose to submit the Technical Proposal, they must do so by Jan 1, 2018, 23:59 (UTC+8)Registered teams can choose whether or not to submit the proposal up to January 1st (Beijing time). Teams with well-written and outlined reports will win a RoboMaster robot kit or one set of Referee System for free.

Ⅰ. Submission

Log in to the submission system with captain's account and submit online. Each team is allowed only one submission. The Technical Proposals is due between Dec 1, 00:00 and Jan 1, 2018, 23:59 (UTC+8).

Ⅱ. Requirements

1)Report Format: PDF with file name：School name + team name + ICRA Technical Proposals.

2)Font: 10 point Times New Roman.

3)Length: Max. 5000 words with figures, flow charts, and design drawings. Logic data proof and highlights are also significant.

Ⅲ.Key Sections

The following information should be contained in the main body.

1)Team Introduction

Team Captain's Bio

Each Member's Bio

2)Technical Proposal

a.Proposed perception system

b.Technical Feasibility Analysis

c.Development Schedule

d.Team Members' Responsibilities & Task Assignments

3)References (add any cited literature)


IEEE
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The Organizing Committee@ICRA2018

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