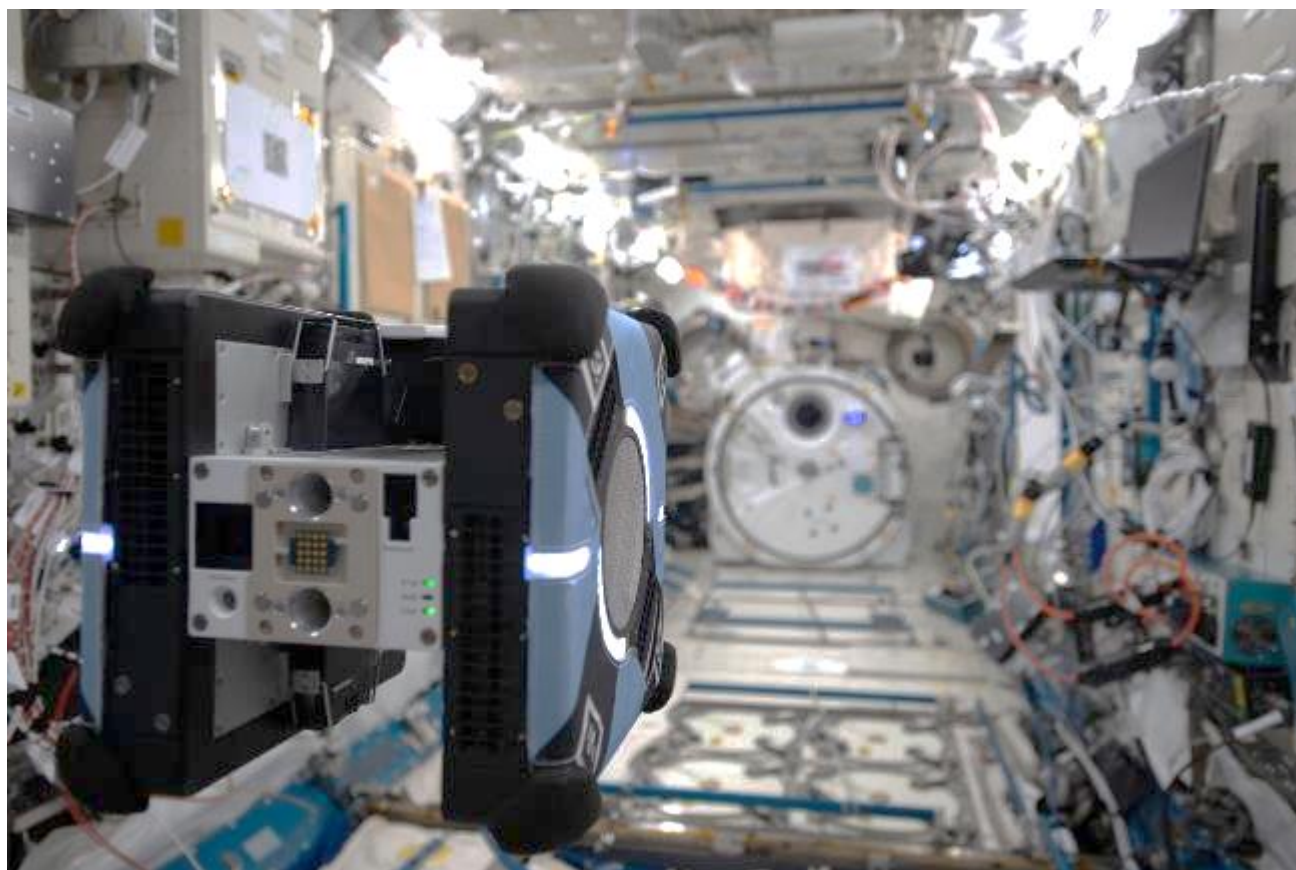JAXA

3rd Kibo Robot Programming Challenge
Rulebook

Version 2.2 (Released Date: August 15th, 2022)

Japan Aerospace Exploration Agency (JAXA)

List of Changes

All changes to paragraphs, tables, and figures in this document are shown below.

Release Date	Revision	Paragraph(s)	Rationale
April 5th, 2022	1.0	All	-
April 28th, 2022	1.1	2.2.2	Remove information of QR code
		Figure 2.2.4-1	Remove QR code
June 7th, 2022	1.2	Table 2.2.4-1	Corrected an error that KOZ No.1 and No.2 were reversed
July 15th, 2022	2.0	Chapter 4	All
August 2nd, 2022	2.1	4.1	Extend the deadline for the draft source code
August 15th, 2022	2.2	4.1	Extend the deadline for Final Round Program Submission

Contents

1. Introduction

Let's challenge your program to be the champion of 2nd Kibo Robot Programming Challenge (Hereinafter referred to as Kibo-RPC)!

In Kibo-RPC, each country/region will first decide its representative in the Preliminary Round using simulators in each country/region in which all participants will participate. The Preliminary Rounds will compete with other participants by your own programs developed before Preliminary Round using JAXA's simulation environment. Refer to Guidebook Section3 for a game content. Preliminary Round will be based on common scoring factors and game rules across the countries/regions. Since event cases of Preliminary Round vary from country/region to country/region, the details of information such as venues and schedules will be announced by each country's/region's POC. This Guidebook focuses on general rules across all the events.

The winning teams of the Preliminary Round in each country/region are able to participate in the Final Round. In the on-orbit Final Round, the world's best will compete using Astrobee, a free-flying robot installed in the Japanese Experiment Module "Kibo" on the ISS. Please refer to Chapter 4 of the Guidebook for the game details of this Round. Finalist teams compete each other for the world championship by using free-flyer robots, Astrobee, on the ISS/ Kibo module!

2. Preliminary Round

2.1. Preliminary Round period

The Preliminary Round is carried out by all countries/regions in the Preliminary Round period. Information of Preliminary Round in each country is described on the Kibo-RPC official web site (https://jaxa.krpc.jp/). Please contact your country's/region's POC for more details.

Note: Participants will not be able to run web simulations from "Preliminary Round" tab. "Preliminary Trial" tab is always available.

APK submission period: June 13th through 27th, 2022
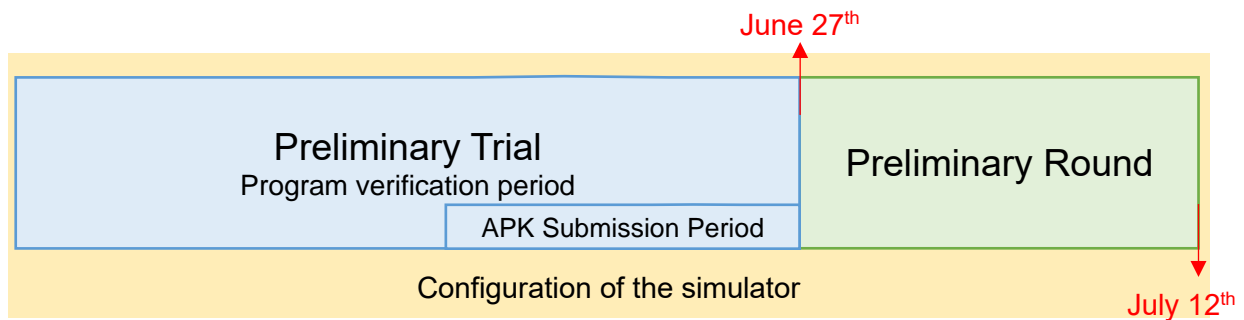Preliminary Round period: June 28th through July 12th, 2022

Figure 2.1-1 Preliminary Round Period

2.2. Game Rules

2.2.1. Game flow

All teams need to create a program such as following points to control NASA's Astrobee in JAXA's simulation environment.

1. Move Astrobee from the starting position to Point 1.
2. Using the surrounding AR tags, the laser is irradiated to the area within the green square of Target 1.
3. Move Astrobee to the area around Point 2 while avoiding the Keep Out Zone (KOZ)*1, which is a no-entry area that looks like an obstacle.
4. Using the surrounding AR tags, the laser beam is irradiated to the center of Target 2 while correcting the position.
   Note: If you want to make minor adjustments to the position for better targeting, please create your program to retry within the time limit.
5. Avoid KOZ and move Astrobee to Goal while facing Airlock direction. *2
6. Using Astrobee's functions, Report "Mission Complete" to Astronaut. *3*4

*1 Keep Out Zone is an area where Astrobee cannot move into. When Astrobee attempts to enter the Keep Out Zone, Astrobee's function denies the move request and it cannot move.

*2 You can make Astrobee turn around to move face forward instead of backward in JAXA's simulation environment. However, the accuracy of Astrobee's self-position recognition in the on-orbit Final Round is different in the simulation environment, so it increases the risk of failure in self-position estimation. (See Programming Manual for details)

*3 The time limit is 6 minutes for one run. (It ends with the mission completion command and does not include the time to report to the astronauts.)

*4 "Mission Complete" report is done by an API prepared by JAXA and visually displayed in JAXA's simulation environment. It is different from the on-orbit Final Round.
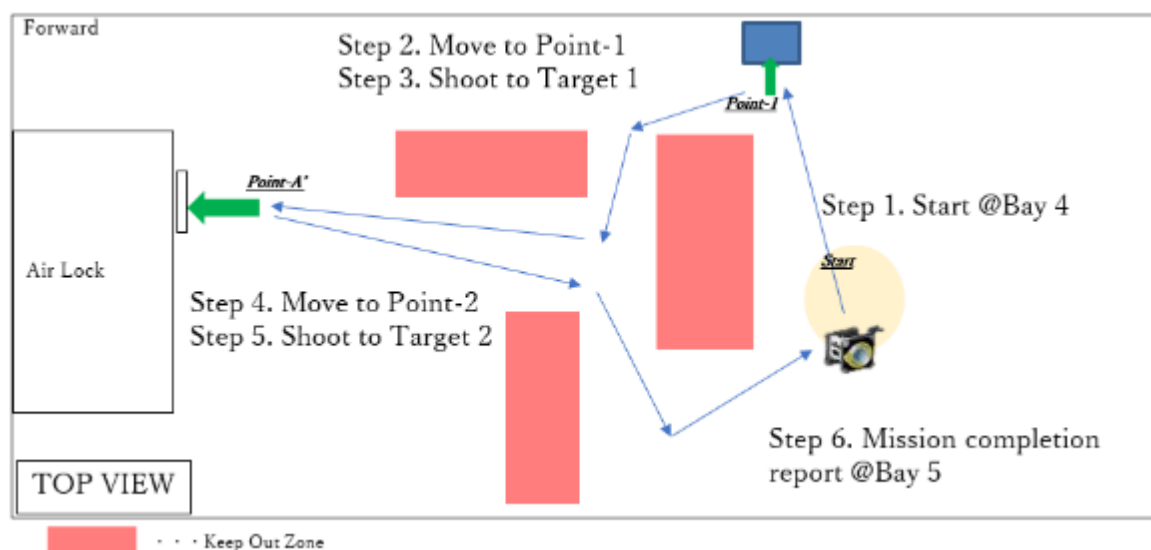

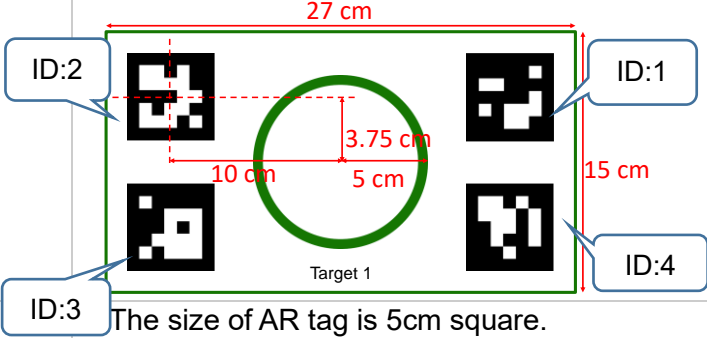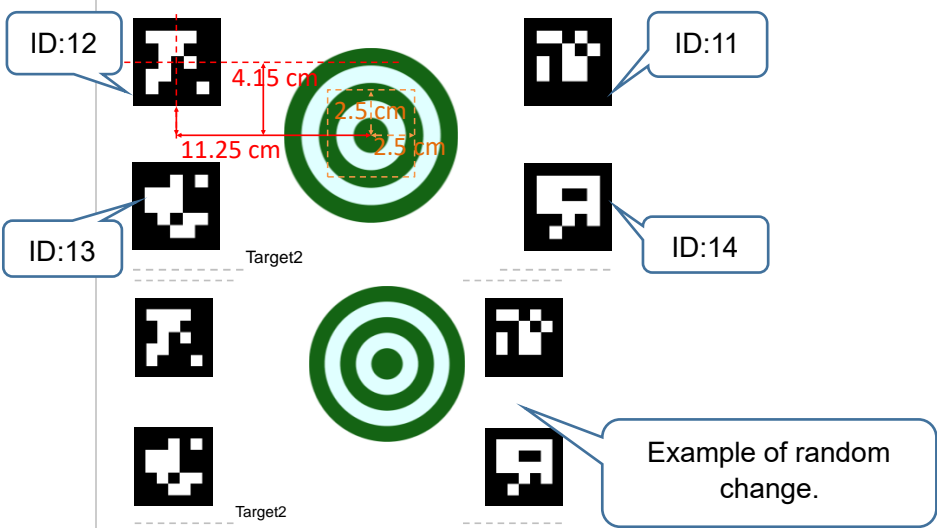Figure 2.2.2-1 Game Outline of the Preliminary Round

2.2.2. Preconditions

Table 2.2.2-1 Preconditions of the Preliminary Round

#	Content
1	The starting position is as follows: Position (x, y, z) = (10.76150, -6.88490, 5.31647) Orientation (x, y, z, w) = (0, 0, -0.707, 0.707)
2	The Point1 coordinates are; Position (x, y, z) = (10.71000, -7.70000, 4.48000)) Orientation (x, y, z, w) = (0, 0.707, 0, 0.707) It must move precisely to this position.
3	There are AR tags around the Target1. The relative distances between the target and AR tags are always the same.
4	The position of Point 2 is as follows: Position (x, y, z) = (11.27460, -9.92284, 5.29881) Orientation (x, y, z, w) = (0, 0, -0.707, 0.707)
5	AR tags exist near Target 2: The position of Target 2 changes randomly within the specified range, and the relative distance between Target2 and the AR tags also changes randomly.
6	The goal position is as follows: Position (x, y, z) = (11.27460, -7.89178, 4.96538) Orientation (x, y, z, w) = (0, 0, -0.707, 0.707)
7	About the AR tags and targets, please refer to 2.2.3 Objects.
8	Keep-Out Zones (KOZ)* simulating obstacles are set somewhere in the path of Astrobee. This KOZ is given as a precondition. About the detail, please refer to 2.2.4 Keep-In-Zone (KIZ) and Keep-Out-Zone (KOZ). * Astrobee cannot move into KOZ.

2.2.3. Objects

Table 2.2.3-1 Objects of the Preliminary Round

#	Name of object	Method
1	Target1	The size of AR tag is 5cm square. -It is located on both sides of the Target1. "Aruco.DICT_5X5_250" is used as dictionary. The size of target is 5cm radius, and the distance between the center of AR and center of target is ($|x|$, $|z|$) = (10.00 cm, 3.75 cm) The IDs of the AR tags are 1, 2, 3 and 4, counterclockwise from the upper right. * The text "Target1" will be printed in the Final Round, but it is not displayed in the simulator. * For scoring, a basic point is awarded if the laser beam point hits within the green square, and an additional point is awarded if the laser beam point hits within the green circle. 27 cm / ID:2 / ID:1 / 3.75 cm / 10 cm / 5 cm / 15 cm / Target 1 / ID:3 / ID:4
2	Target2	The size of AR tag is 5cm square. -It is located on both sides of the Target2. "Aruco.DICT_5X5_250" is used as dictionary. The size of target is 5cm radius. The center position of Target2 changes randomly within ±2.5cm. The IDs of the AR tags are 11, 12, 13 and 14, counterclockwise from the upper right. * The text "Target2" will be printed in the Final Round, but but it is not displayed in the simulator. ID:12 / ID:11 / 4.15 cm / 2.5 cm / 11.25 cm / 2.5 cm / ID:13 / ID:14 / Target2 / Target2 / Example of random change.

2.2.4. Keep-In-Zone (KIZ) and Keep-Out-Zone (KOZ)

Keep-In-Zone (KIZ) is defined as the area where Astrobee can move around, and basically set along the walls of Kibo. It is a preset boundary in Astrobee and if the destination of the moving path of Astrobee is outside the KIZ, that is rejected. You need to design each moving path of Astrobee within the KIZ.

The Keep-Out-Zone (KOZ) are set inside the KIZ as a volumetric zone and used as some obstacles inside Kibo in the Kibo-RPC. You need to design each moving path of Astrobee to avoid the KOZ.
(Figure 2.2.4-1, 2.2.4-2, 2.2.4-3, Table 2.2.4-1）
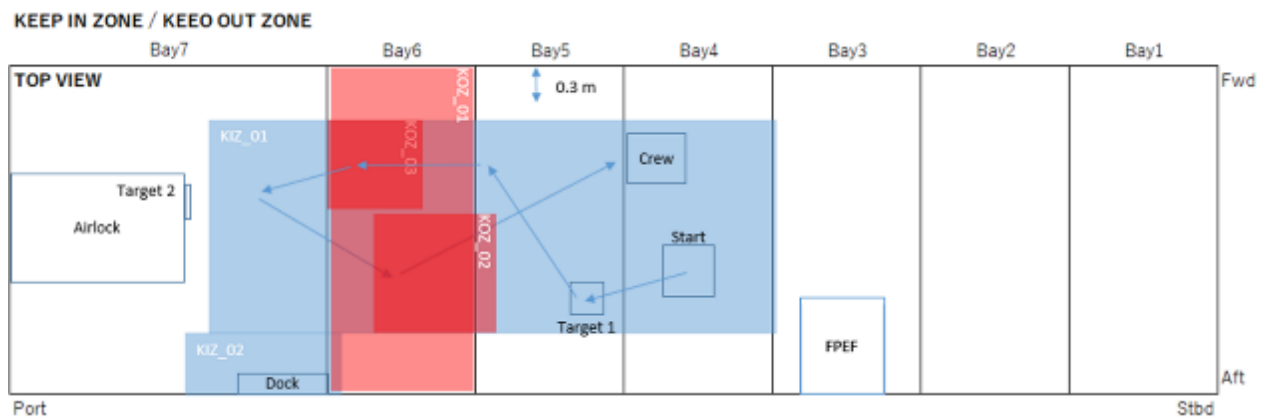
Figure 2.2.4-1 KIZ and KOZ of the Preliminary Round (Top View)
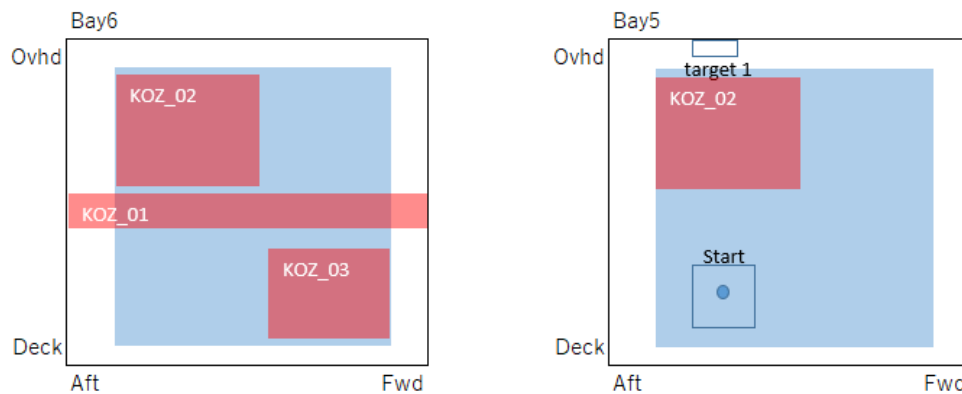
Figure 2.2.4-2 KIZ and KOZ for each country's Preliminary Round (Front View)

Table 2.2.4-1 shows the coordinates of KOZ and KIZ. Definition of the coordinates (x_min, y_min, z_min) and (x_max, y_maxm z_max) are shown in Figure 2.2.4-3.

Table 2.2.4-1 Installed Coordinate of Obstacles

Type	No.	x_min	y_min	z_min	x_max	y_max	z_max
KOZ	01	9.8585	-9.4500	4.82063	12.0085	-8.5000	4.87063
	02	9.8673	-9.18813	3.81957	10.7673	-8.28813	4.81957
	03	11.1067	-9.44819	4.87385	12.0067	-8.89819	5.87385
KIZ	01	10.3	-10.2	4.32	11.55	-6.4	5.57
	02	9.5	-10.5	4.02	10.5	-9.6	4.8

*The origin of the coordinate axis is set outside of Kibo
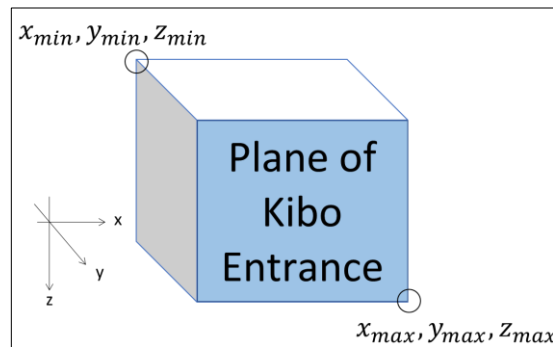
Figure 2.2.4-3 Definition of the coordinates

2.2.5. 10 automatic runs per APK

In the Preliminary Round, 10 runs are automatically executed for one APK to keep the fairness against the random elements included in the simulation. In these 10 runs, the conditions such as the position of the Target2 and other random elements are all different.

This method avoids the accidental results (good and bad results by accidents) and also prevent to rank by the environmental and disturbance conditions. All participants can challenge in the same condition.

Note: In the "Preliminary Trial," the user can choose from two patterns of simulation: one which the position of Target 2 changes randomly, and the other which the position of Target 2 is fixed at a certain position.
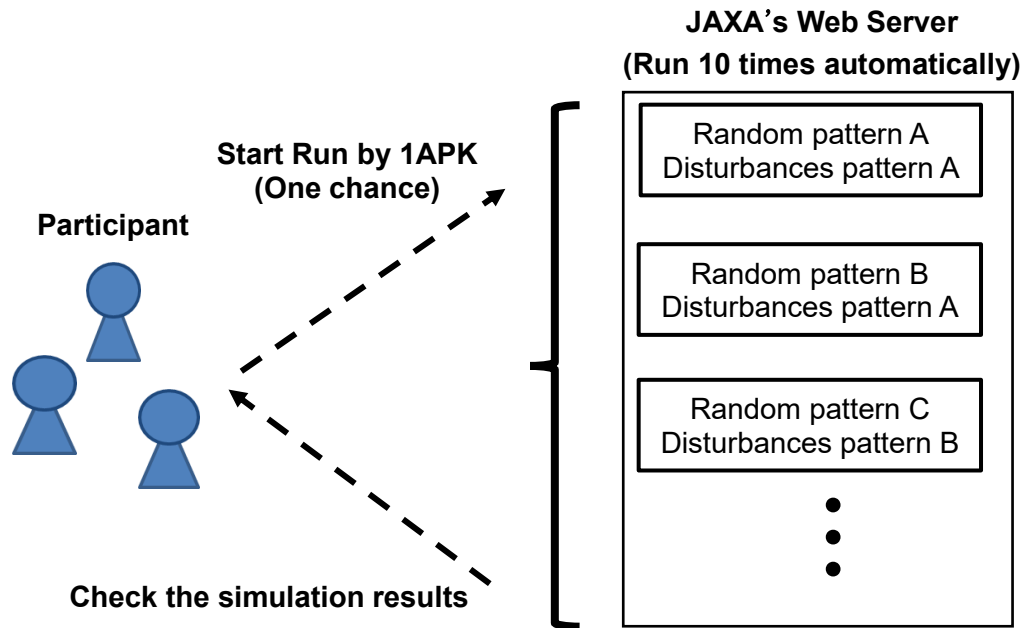
JAXA's Web Server
(Run 10 times automatically)

Start Run by 1APK
(One chance)

Participant

Random pattern A
Disturbances pattern A

Random pattern B
Disturbances pattern A

Random pattern C
Disturbances pattern B

Check the simulation results

Figure 2.2.5-1 10 times run

2.2.6. Ranked by the worst result of 10 automatic runs

The ranking will be determined by the worst score in 10 runs.

Space missions are performed under very severe conditions, such as one failure is not allowed, and malfunctions cannot be recovered directly by human hands. This mission scenario is also an important mission that cannot be failed to help the astronaut's life in the ISS crisis, so it is necessary to complete the mission even with the worst result. Therefore, in order to evaluate participant's programming that can perform well under any conditions, the worst result is used for ranking.
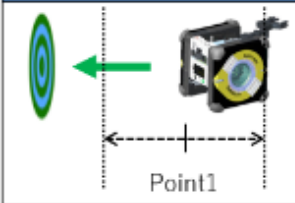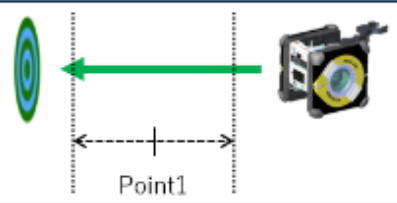
Detailed scoring criteria are provided in Section 2.3.

2.3. Scoring

2.3.1. Factors

Your class and score are calculated by the following factors.

Table 2.3.1-1 Scoring Factors for the Preliminary Round

#	Factor	Detail
1	Reaching Point1	Scoring is based on the coordinates when Astrobee arrive at Point 1. If the arrival coordinates are within a specific distance, you can get a basic point.
2	Laser irradiation to Target 1	If the laser irradiation point is within the specified square frame, you can get a basic point. In addition to a basic point, you can get an additional point if the laser hit within a circle frame close to the center of the target. The laser irradiation position is determined from a single snapshot.

#	Factor	Detail
3	Laser irradiation to Target 2 (After laser irradiation, a snapshot is taken by calling the snapshot API.)	The distance from the point of laser irradiation to the center of Target 2 is an average of 10 snapshot. Additional points are given depending on the average distance from the Target 2 center.
4	Reaching the Goal	Scoring is based on the coordinates when Astrobee reach Goal. If the arrival coordinates are within a specific distance , you can get a basic point.
5	Reporting "Mission Complete" to Astronaut	Elapsed time from Start to Report

* Taking snapshots

- During irradiating the target with the laser, Astrobee takes 10 snapshots at intervals of a second. Score is evaluated by the average of distance from irradiating point to the center of target of 10 snapshots. Taking snapshots is possible only once in each Run, for Target 1 and Target 2 respectively.

- If you program automatic re-trial for fine adjustment of Astrobee position, you can retry aiming and laser irradiation until taking the snapshots after finalizing the laser irradiation. (Refer to Figure 2.3.1-1) It might be better to consider a unique strategy such as using image processing to assess the accuracy.
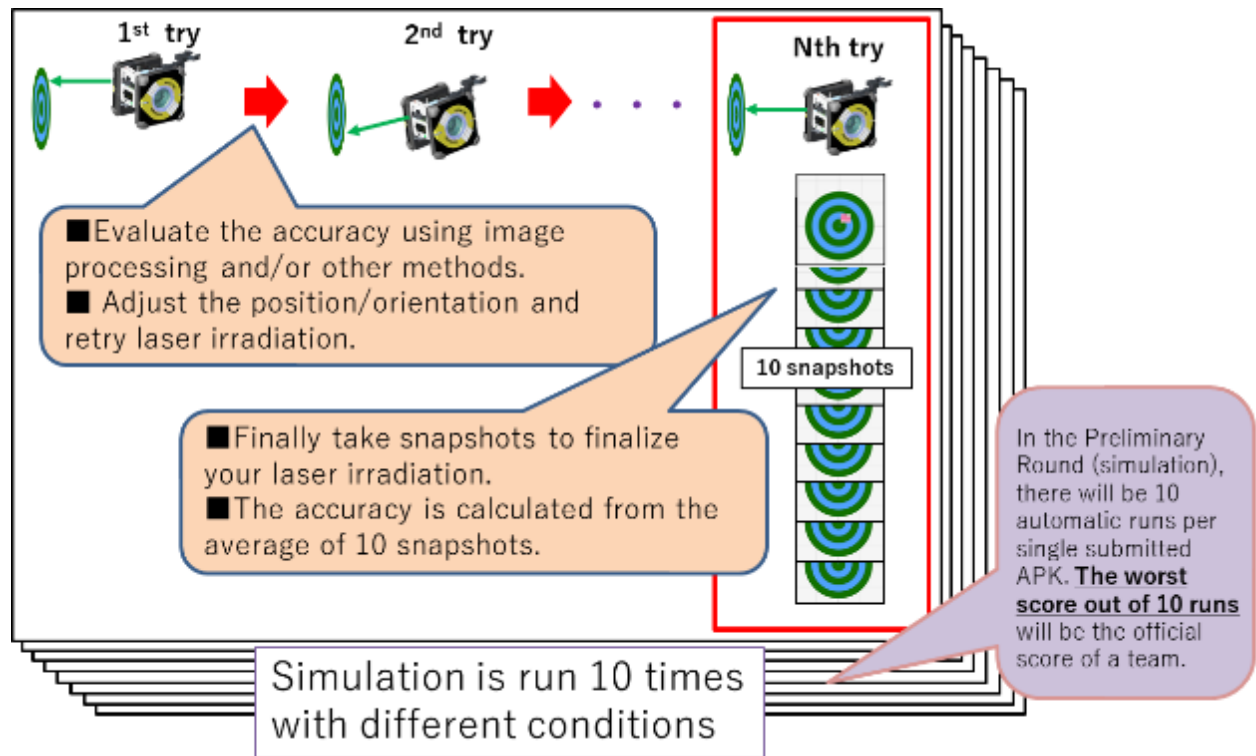
Figure 2.3.1-1 Method of repeating 10 times and scoring

2.3.2. Ranking method

In the Preliminary Round, all teams are rankedby the worst score out of 10 runs. Therefore, even if 9 runs have completed the mission, it is ranked by the worst score when you cannot reach to Goal within the time limit even once. In other words, the result of the run that you could not reach Goal is the team's evaluation.

It is important to create a program that can accomplish missions under any random conditions.

	Random pattern	Level	Score
1	Random pattern A Disturbances pattern A	Mission completed	70
2	Random pattern B Disturbances pattern A	Mission completed	89
3	Random pattern C Disturbances pattern B	Mission completed	90
4	Random pattern D Disturbances pattern F	Target1 Laser irradiation time out	10
5	Random pattern A Disturbances pattern C	Target2 Laser irradiation time out	60
6	Random pattern C Disturbances pattern E	Mission completed	75
7	Random pattern G Disturbances pattern G	Mission completed	88
8	Random pattern F Disturbances pattern A	Mission completed	65
9	Random pattern E Disturbances pattern C	Mission completed	77
10	Random pattern B Disturbances pattern G	Mission completed	68

Team score
10

Figure 2.3.2-1 Method of evaluating team scores

2.4. Joining Preliminary Round

2.4.1. How to participate in Preliminary Round

Participants need to submit the APK for the Preliminary Round by the submission deadline. (All figures below are screen shots in 2nd Kibo-RPC.)

2.4.2. Submission of Preliminary Round APK

Participants create and submit a program for Preliminary Round by the submission deadline to participate in the Preliminary Round. You may resubmit another APK as many times as you wish, even after you have submitted one APK, as long as it is within the submission deadline.
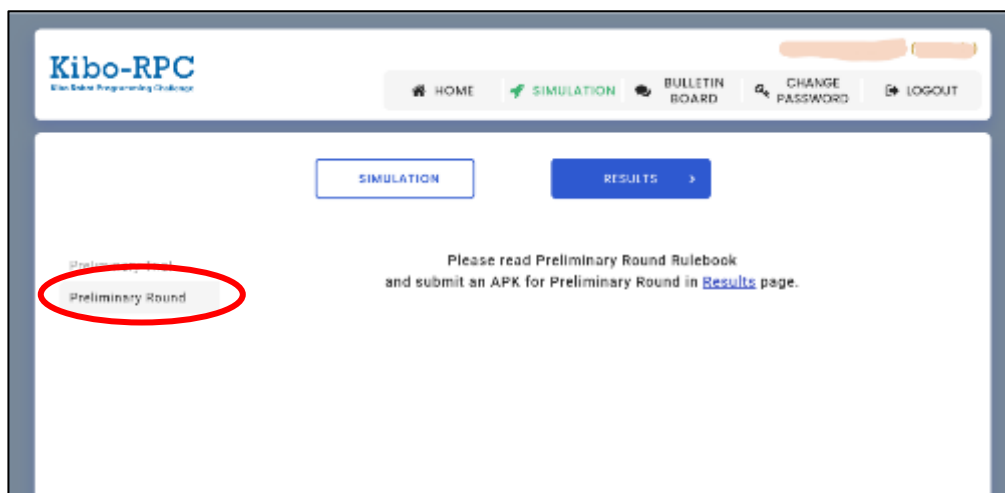
Figure 2.4.2-1   Preliminary Round

Before the Preliminary Round period, the web simulation result screen will be changed as shown in Figure 2.4.2-1. Before submitting your APK, please evaluate the performance of your program using Preliminary Trial simulator. After that, you select your best program from the result list of "Preliminary Trial" on "RESULTS" screen, and press the "SUBMIT" button that is newly added. And then the APK is submitted. Once press the "SUBMIT" button, it is changed to the "CANCEL" button. Therefore, you can resend the other APK by clicking the "CANCEL" button before the deadline.

Note: "SUBMIT" button can only be pressed when you subumit the APK that is "Finished" status in the "Preliminary trial". If you have only "Failed" APK, you cannot participate in the Preliminary Round. Please make sure to create an APK that is "Finished" in the "Preliminary trial".
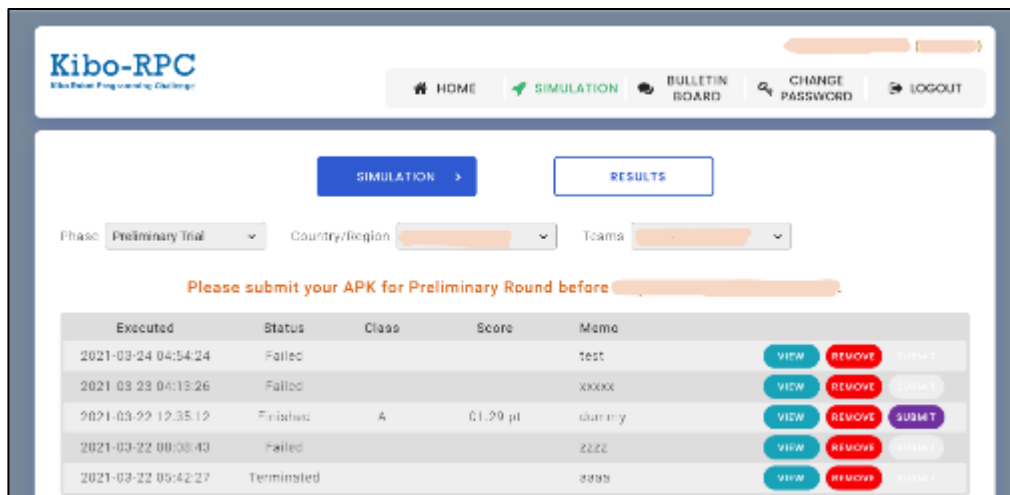
Figure 2.4.2-2 Preliminary Trial after change

The submitted APK can be confirmed from the "Preliminary Round" tab as shown in Figure 2.4.2-3. You can cancel to submit the APK on RESULTS screen, but be careful about the submission deadline because you cannot press the "SUBMIT" and "CANCEL" button over the deadline
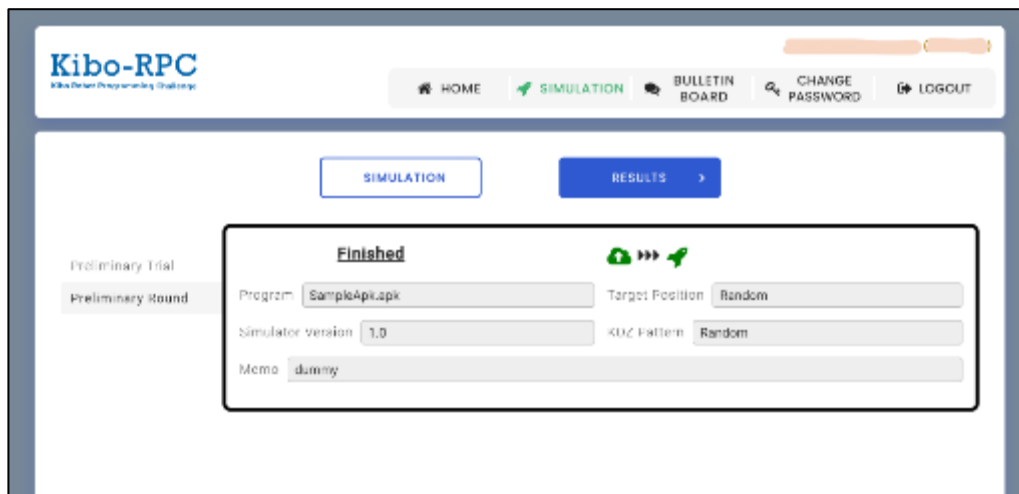
Figure 2.4.2-3 Preliminary Round

2.5. Event methodology

This section explains three typical Preliminary Round styles which are carried out in each country/region. Please confirm how Preliminary Round event will be held at the ACTIVITY tab on the Kibo-RPC official web site or contact your country's/region's POC.

2.5.1. Real Event

Real Event means the Preliminary Round event is held at a venue in your country /region. Participants must submit the APK on the web by the deadline and go to the venue on the day. If it is difficult to go to the venue, each team's leader should talk to your country's/region's POC and participate in an alternative way (typically through Social Media). Figure 2.5.1-1 shows the general flow.
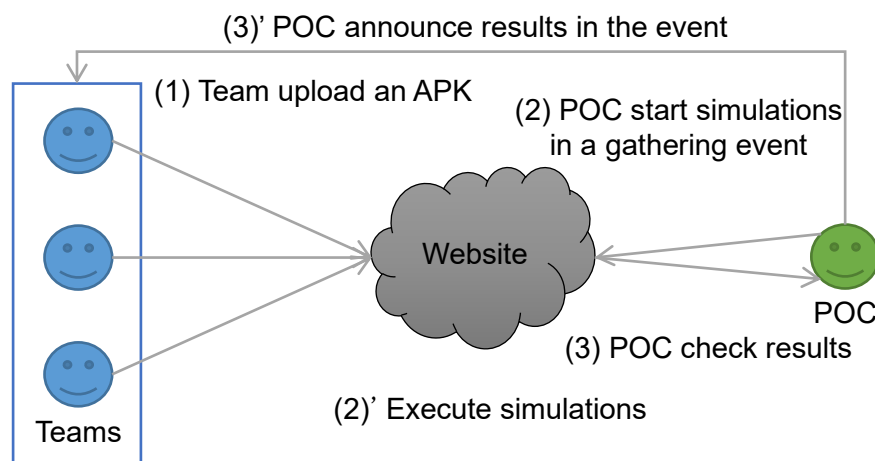
Figure 2.5.1-1 Real Event flow

2.5.2. Virtual Event

Virtual Event means the participants take part in the Preliminary Round through Social Media. Therefore, participants can participate from your school and home. The basic Preliminary Round procedure is the same as in Section 2.5.1. Participants must submit the APK on the web by the deadline.

2.5.3. E-mail Notification

E-mail Notification is a method that done without gathering with other participants, and the result is notified by e-mail from your country's/region's POC later. Therefore, participants do not need to participate in the Preliminary Round on a particular day. However, as in 2.5.1 and 2.5.2, participants must submit the APK on the web by the deadline.

*Please confirm with the POC in each country/region which style they will carry out.

3. Bonus Round

3.1. Submission for Bonus Round

Bonus Round is a preliminary round held after the completion of each country's Preliminary Round and is open to Worldwide Teams only. For details on the Worldwide Teams and how to form a team, please refer to the Entry Description. In addition, if the Worldwide Teams win the Preliminary Round in each country/region, that Worldwide team cannot participate in the Bonus Round.

3.2. Result

The Bonus Rounds will be held after the completion of each country/region's Preliminary Round, but no special events will be held. After the Preliminary Round in each country/region, the Kibo-RPC Secretariat will re-rank the results of the Preliminary Rounds in each country/region for only teams that meet the requirements, and select one representative team. Therefore, participants do not have to resubmit your program for the Bonus Round. As soon as a representative team is selected, the Kibo-RPC Secretariat will notify the team concerned by e-mail.

4. Final Round

4.1. Preparation for Final Round

Only each representative team can participate in the Final Round. In the Final Round, the participants will be able to refine your program from the Preliminary Round. Please create a program for the Final Round and submit an APK and source code by the submission deadline. Refer to "Submission of Final Round APK" in Section 4.4.

1) Draft Source Code Submission Deadline: August 1st (your time zone)

2) Final Round Program Submission Deadline: August 22nd (your time zone)

* For 1), JAXA will check your source code in advance whether there is any code that adversely affects Astrobee on ISS. If necessary, JAXA will ask the participants to modify the code.

4.2. Game Rules

4.2.1. Game Flow

In the Final Round, each team will create a program to move Astrobee on the ISS from starting position to the target point while avoiding KOZ, irradiate lasers to two targets, and report back to the astronauts. Basically, the same game flow with the Preliminary Round, but please note that "Mission Complete" report is a little different from the Preliminary Round. "Mission Complete" report is done by playing a pre-recorded audio file submitted by the finalist teams. When the "Mission Complete" API prepared by JAXA is issued by APK, Astrobee will automatically play the audio file. Please refer to the Programming Manual for the detailed information about audio files.

4.2.2. Preconditions
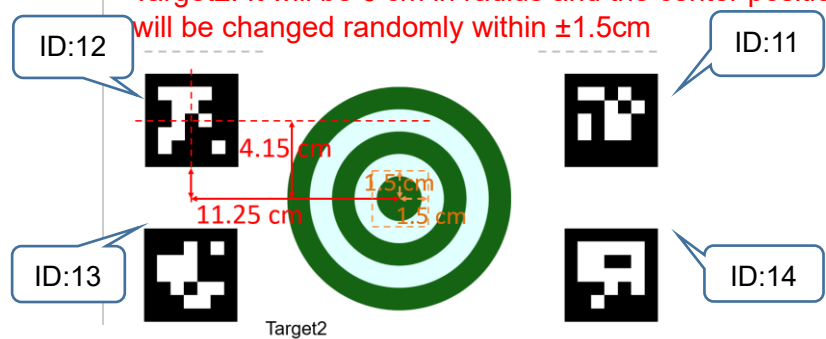
Table 4.2.2-1 Preconditions of the Final Round

#	Content
1-4	The starting position, the Point1 position, and the Point2 position are the same as the Preliminary Rounds. See Table 2.2.2-1 for details.
5	Different from the Preliminary Round, the position of Target 2 will not change, but the participants will not be notified of Target 2 position.
6	For AR tags and targets, please refer to 4.2.3 Objects.
7	Information of KOZ/KIZ has been partially changed since the Preliminary Round in each country/region. See 4.2.5 Keep-In-Zone (KIZ) and Keep-Out-Zone (KOZ) for details.

Since the environmental conditions are different from the simulation and on-orbit, it is important to create a program that can show high performance even in the real environment.

4.2.3. Objects

Table 4.2.3-1 Objects in the Final Round

#	Object name	Method
1	Target 1	The objects of Target1 are the same as those in each country/region's Preliminary Round. See Table 2.2.3-1 for details.
2	Target 2	It is basically the same as the Preliminary Round. The part that differs from the Preliminary Round is that the size of Target2. It will be 6 cm in radius and the center position of Target2 will be changed randomly within ±1.5cm

4.2.4. Mission Complete Report

The supported formats of the audio files are described at following URL;

https://developer.android.com/guide/topics/media/media-formats

Please create an audio file within 20 sec. You need to record your voice and place it in the specified folder to report mission completion on the ISS. The detail is written in Section 3.1.

The opening and closing words of the mission completion report should be as follows.
==================
Hi Koichi.
XXXXXXXXX. (Contents of completion report)
Over.
==================

The XXXXXXXXX part can be used in any format you wish. The team that gives the astronaut the most impressive mission completion report will receive the Crew Award.

When the "reportMissionCompletion" API is executed, the flashlights in the front and rear of Astrobee will blink, and then the audio file will be played.

4.2.5. Keep-In-Zone (KIZ) and Keep-Out-Zone (KOZ)

Information of KOZ/KIZ has been partially changed since the Preliminary Round in each country/region. See Figure 4.2.5-1, Figure 4.2.5-2 and Table 4.2.5-1.
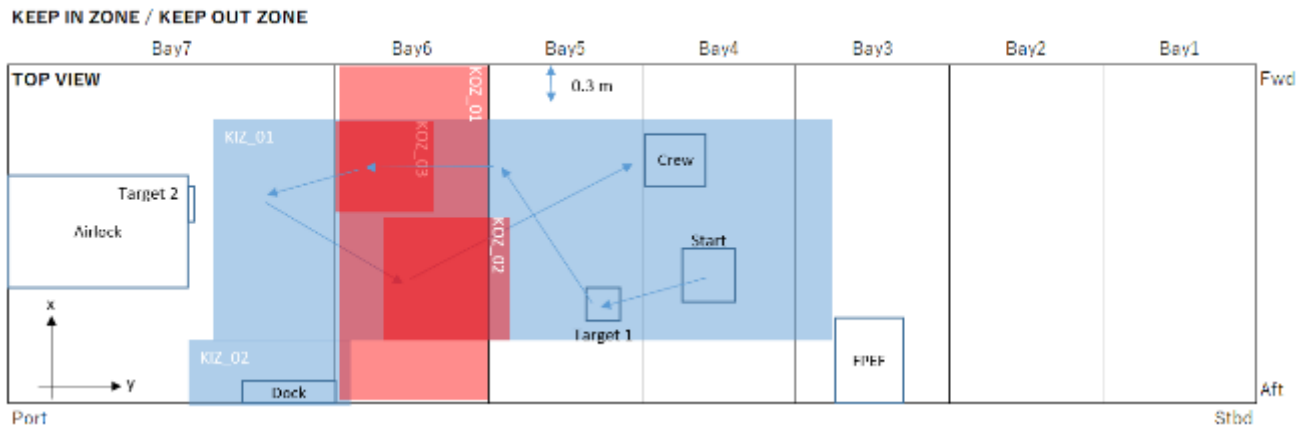
Figure. 4.2.5-1 KIZ and KOZ in on-orbit Final Round (Top View)
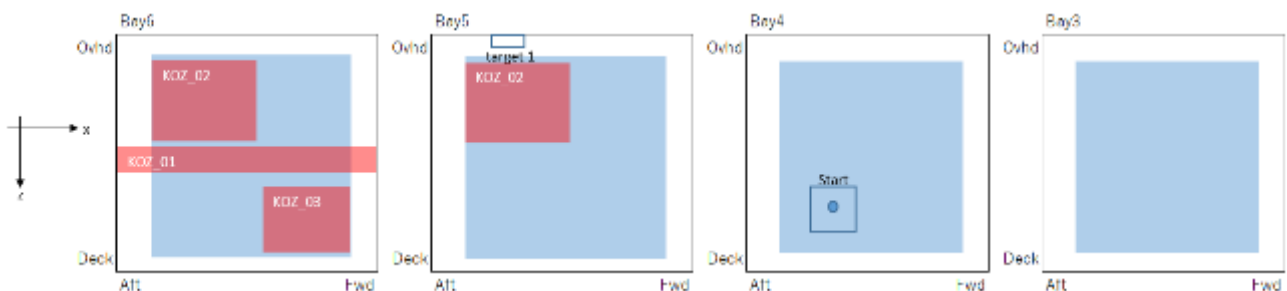
Figure 4.2.5-2 KIZ and KOZ in on-orbit Final Round (Front View)

Table 4.2.5-1 Coordinate information of KIZ/KOZ

Type	No.	x_min	y_min	z_min	x_max	y_max	z_max
KOZ	01	9.8585	-9.4500	4.82063	12.0085	-8.5000	4.87063
	02	9.8673	-9.18813	3.81957	10.7673	-8.28813	4.81957
	03	11.1067	-9.44819	4.87385	12.0067	-8.89819	5.87385
KIZ	01	10.3	-10.2	4.32	11.55	-6.0	5.57
	02	9.5	-10.5	4.02	10.5	-9.6	4.8

※Modified only y_max of KIZ01

4.2.6. Only one APK, only one run

Each team submits one APK like the preliminary round. However, it only runs one-time on ISS. Since we will use Astrobee in the Final Round on ISS, you cannot be redone or interrupted. It is a one-time shot.

However, if the Astrobee itself stop due to a malfunction, the participants will be offered the opportunity to re-run your program according to the rules described in 4.2.10.

4.2.7. The Time limit 5 minutes per team

If it exceeds time limit, APK will automatically shut down. Please make sure that you have to complete the mission within time limit. And even before the time limit, if Astrobee gets stuck or its self-position is lost, it is automatically judged as a game-over. The system may also terminate without waiting for the time limit when it is judged that no further operation can be expected, such as when Astrobee stop for a long period of time for reasons other than image processing for laser irradiation of the target.

4.2.8. Operation of the APK on the day of the Final Round

Participants may NOT operate the APK on the day of the Final Round.

The submitted APKs are code-reviewed by the technical team of JAXA/NASA and installed to Astrobee on ISS in advance. The APKs are started with the execution command sent from ground operators.

4.2.9. Judging method

On the ISS, the speed and accuracy of the mission are judged by the following methods. Details of the scoring criteria are written in Section 2.3.

Speed: Time from APK execution start to send Finish command (Mission Complete Report) is recorded as the time stamp in Astrobee, which is available to the ground as telemetry.

Accuracy: Judged by the exact movement to the Point1 position and the position of laser irradiation to Targets1 and 2. The moving position is recorded on the ground as telemetry. Irradiations are recorded in Astrobee on the ISS and accuracy is determined by snapshot images. Target 1 has two snapshots (one is used for judging and one is a spare). Target 2 is calculated with 11 snapshots (10 are used for judging and 1 is a spare).

Besides, the level of mission achievement is judged with the same way as the Preliminary Round, using APIs (startMission, reportMissionCompletion, etc.). See also the Programming Manual.

4.2.10. Final Round run order

In the Final Round, the teams are divided into 3 tiers according to the Preliminary Round results, and the runs are performed in this order. The results of the Preliminary Round in each country/region are summarized and the representative teams are listed in order of their scores. An example of a team assignment in a Tier is shown in Table 4.2.10.

Table 4.2.10. Team Allocation

Tier in the Final Round	Preliminary Round results
1st Tier	1st Place
	2nd Place
	3rd Place
	4th Place
2nd Tier	5th Place
	6th Place
	7th Place
	8th Place
3rd Tier	9th Place
	10th Place
	11th Place
	12th Place

The run order in the Final Round is prioritized in the order of tier as outlined above.

If a team gets stuck due to Astrobee's failures on ISS, that team will run again before moving to the next tier, as long as there is enough time. No re-runs will be performed by stacks caused by participant's APK. Please note that the time to conduct the competition on orbit is limited, so the lower ranked teams in the Preliminary Round may not be able to run the program on the on-orbit Final Round. See Figure 4.2.10 for details.
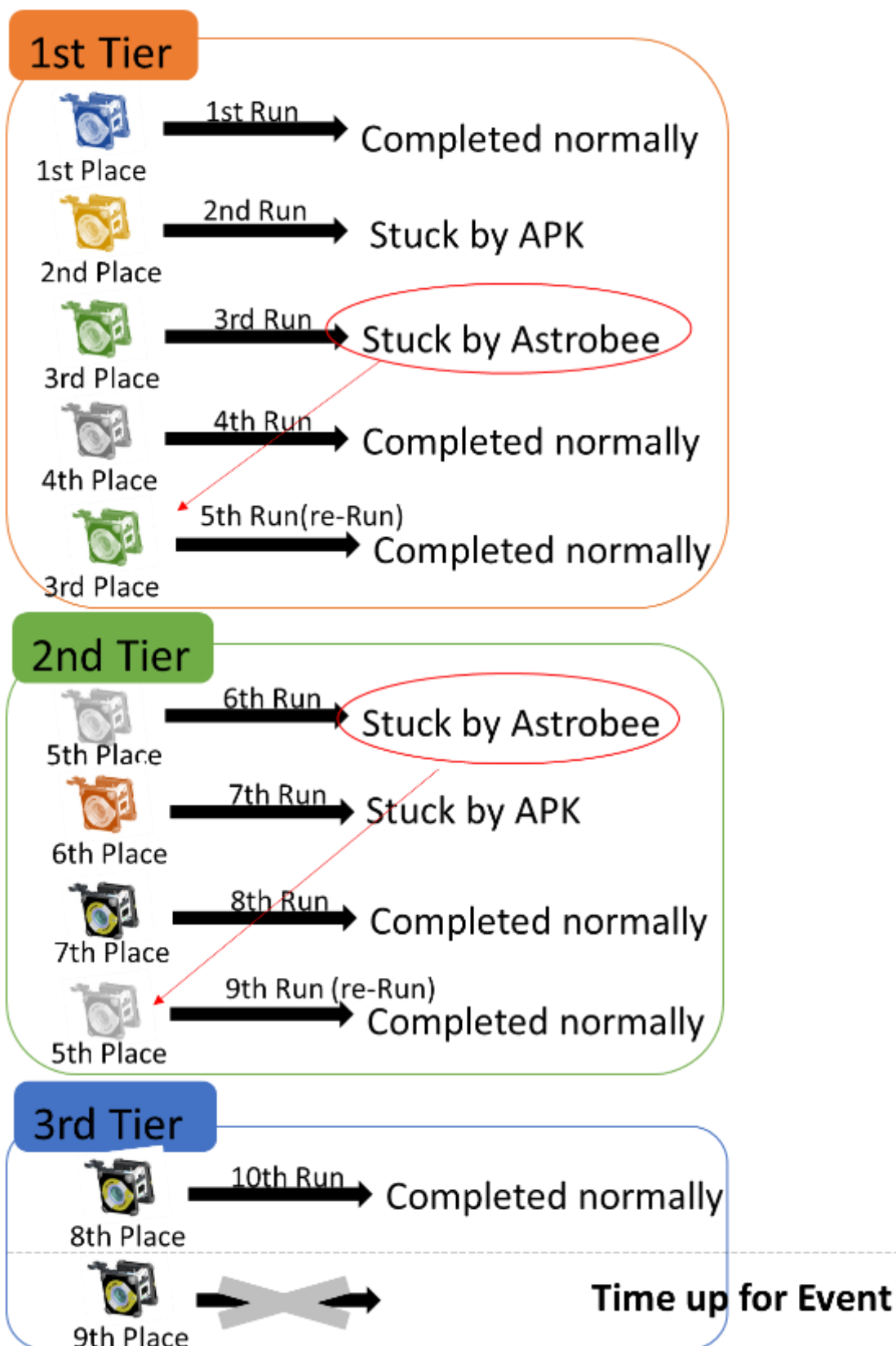
Figure 4.2.10 Example of the Final Round run order

4.3. Scoring

4.3.1. Factors

The scoring factors are the same as the Preliminary Round. See 2.3.1 for detail. However, in the Final Round, your APK will be run only once on ISS.

4.3.2. Ranking Method

Only one run is performed in the Final Round. Therefore, the one result is the team's score. Your voice message of "Mission Complete" will be evaluated for Crew Award as well.

4.4. Joining the Final Round

What the finalists need to do is followings. Details will be released at a later date.

(1). API updates

Please refer to Chapter 7 and Appendix 1 of the Programming Manual for the details of the update.

(2). Change APK application ID and APK name

You must name your application ID and APK as shown in Table 4.4-1 with the country name included. When you submit your APK, confirm that you have made the name change before uploading it to the Web Simulator. The Kibo-RPC Secretariat identifies the file based on these names. Please refer to section 3.3.3 of the Programming Manual for details on how to set up the application ID and etc.

Table 4.4-1 File name regulations

Country	Application ID	APK name	APK file name	Short name
Australia	jp.jaxa.iss.kibo.rpc.australia	australia	australia.apk	australia
Bangladesh	jp.jaxa.iss.kibo.rpc.bangladesh	bangladesh	bangladesh.apk	bangladesh
Indonesia	jp.jaxa.iss.kibo.rpc.indonesia	indonesia	indonesia.apk	indonesia
Japan	jp.jaxa.iss.kibo.rpc.japan	japan	japan.apk	japan
Malaysia	jp.jaxa.iss.kibo.rpc.malaysia	malaysia	malaysia.apk	malaysia
Nepal	jp.jaxa.iss.kibo.rpc.nepal	nepal	nepal.apk	nepal
New Zealand	jp.jaxa.iss.kibo.rpc.newzealand	newzealand	newzealand.apk	newzealand
Singapore	jp.jaxa.iss.kibo.rpc.singapore	singapore	singapore.apk	singapore
Taiwan	jp.jaxa.iss.kibo.rpc.taiwan	taiwan	taiwan.apk	taiwan
Thailand	jp.jaxa.iss.kibo.rpc.thailand	thailand	thailand.apk	thailand
United States of America	jp.jaxa.iss.kibo.rpc.usa	usa	usa.apk	usa
Vietnam	jp.jaxa.iss.kibo.rpc.vietnam	vietnam	vietnam.apk	vietnam
Worldwide Team	jp.jaxa.iss.kibo.rpc.worldwide	worldwide	worldwide.apk	worldwide

(3). Create and place of audio files

Please refer to Section 4.2.3 of this Rulebook and Section 3.1.1 of the Programming Manual.

(4). Send APK, source code, audio files, and message text files

Please refer to Section 4.4.1 of this Rulebook.

(5). Confirm that everything is complete

Follow the checklist in Table 4.4-2 to confirm that you have completed the items to be performed for the on-orbit Final Round.

Table 4.4-2 Checklist

No.	Item	Description	Related Section(s)
1	API Change	Change to a new game API	PG Manual, Chapter 7, Appendix 1
2	Application ID	Change the application ID of the APK	Section 4.4(2) PG Manual, section 3.3.3
3	Rename APK	Rename the APK per the regulations	Section 4.4(2) PG Manual, section 3.3.3
4	Rename APK File	Change the file name of the APK per the regulations	Section 4.4(2)
5	APK Short Name Change	Change the short name of the APK per the regulations.	Section 4.4(2) Section 3.3.3 of the PG Manual
6	Audio Files	Create an audio file for the mission completion report and place it in the APK.	Section 4.2.4 Section 3.1.1 of the PG Manual
7		Create a mission completion message in the required form.	Section 4.2.4
8	Script	Create a script of the mission completion report.	Section 4.4.1(3)
9	MD5	Create MD5 of APK	Section 4.4.1(2)
10	Submission	Submit APK	Section 4.4.1(1)
11		Submit source code	Section 4.4.1(2) Section 4.4.1(3)
12		Submit audio files	Section 4.4.1(3)
13		Submit audio file script	Section 4.4.1(3)

4.4.1. Submission of APK, Source Code and Audio File

You must submit your program by the deadline for the on-orbit Final Round. After the submission, JAXA and NASA will review the source code for safety reasons in advance. For this purpose, please submit your APK, source code, audio files, and script according to the following instructions.

(1) **APK Submission**
Select one APK in the RESULT tab and click the SUBMIT button. (See Figure 4.4.1-1 (This figure is the result tab of 2nd Kibo-RPC))
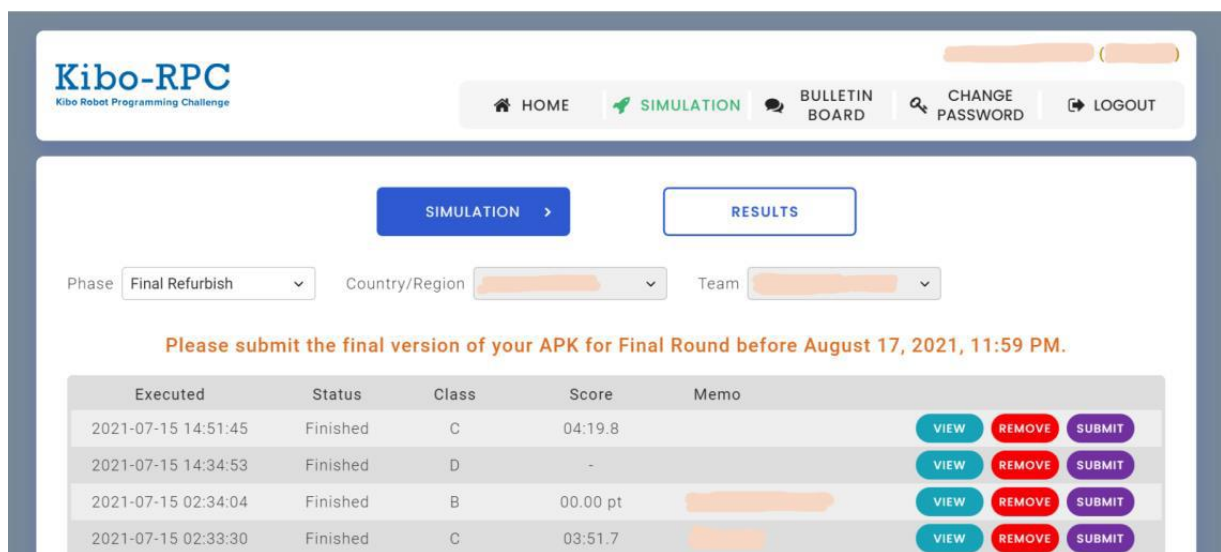* Please rename the APK file for submission as per Table 4.4-1.

Figure 4.4.1-1 APK submission screen

(2) **Submission method of Source Code**
Submit the source code to the Kibo-RPC Secretariat by e-mail following the instructions below.

1. Generate MD5 of the APK file

    The Kibo-RPC Secretariat will review the APK submitted through the Website and

    the MD5 generated here.

(A) For Windows

    Execute the following command from the command prompt.

    > cd [path to apk directory]

    > certutil -hashfile [apk file name] MD5 > apk.md5

    "apk.md5" is created and it includes 32-digit hash value.

    (e.g.)

> cd C:\DefaultApk\app\build\outputs\apk\

> certutil -hashfile app-debug.apk MD5 > apk.md5

(B) For Ubuntu

Execute the following command from the terminal.

$ cd [path to apk directory]

$ md5sum [apk file name] > apk.md5

"apk.md5" is created and it includes 32-digit hash value.

(e.g.)

$ cd ~/DefaultApk/app/build/outputs/apk/

$ md5sum app-debug.apk > apk.md5

2. Delete APK and large files/directories

Delete the APK file.

(Be careful NOT to delete the MD5 at this point.)

- [root dir]/app/build/outputs/apk/*.apk

Next, delete the following directories.

- [root dir]/app/build/generated/

- [root dir]/app/build/intermediates/

- [root dir]/app/build/tmp/

- [root dir]/.gradle/

3. Compress (zip, tar, etc.) the root directory and send it to the Secretariat.
The standard size of a compressed file is a few hundred KB to a few MB. Be sure that all files (Java source files, md5) are included in the compressed file, then send it to Z-KRPC@ml.jaxa.jp.
If sending files via email does not work, please contact the Kibo-RPC Secretariat to find out how to submit them. You may also share them via cloud storage such as Google Drive.

(3) **Sending Audio Files and Scripts**
Send the audio files and scripts of the audio files by e-mail to the Kibo-RPC Secretariat (Z-KRPC@ml.jaxa.jp).

4.5. Event methodology

For the on-orbit Final Round, JAXA will perform the runs in advance using the APKs of the finalists and the Astrobee on orbit. The video of the on-orbit runs during the competition will be live-streamed, and finalists will be able to watch the video of their APK running. An on-orbit Final Round event will be held on a later date, where experts will provide commentary while viewing recorded the competition video. The event will be held online, so finalists can participate from their own schools or homes. Refer to Figure 4.5 for the flow up to the event. The Secretariat will contact finalists by e-mail for further details.
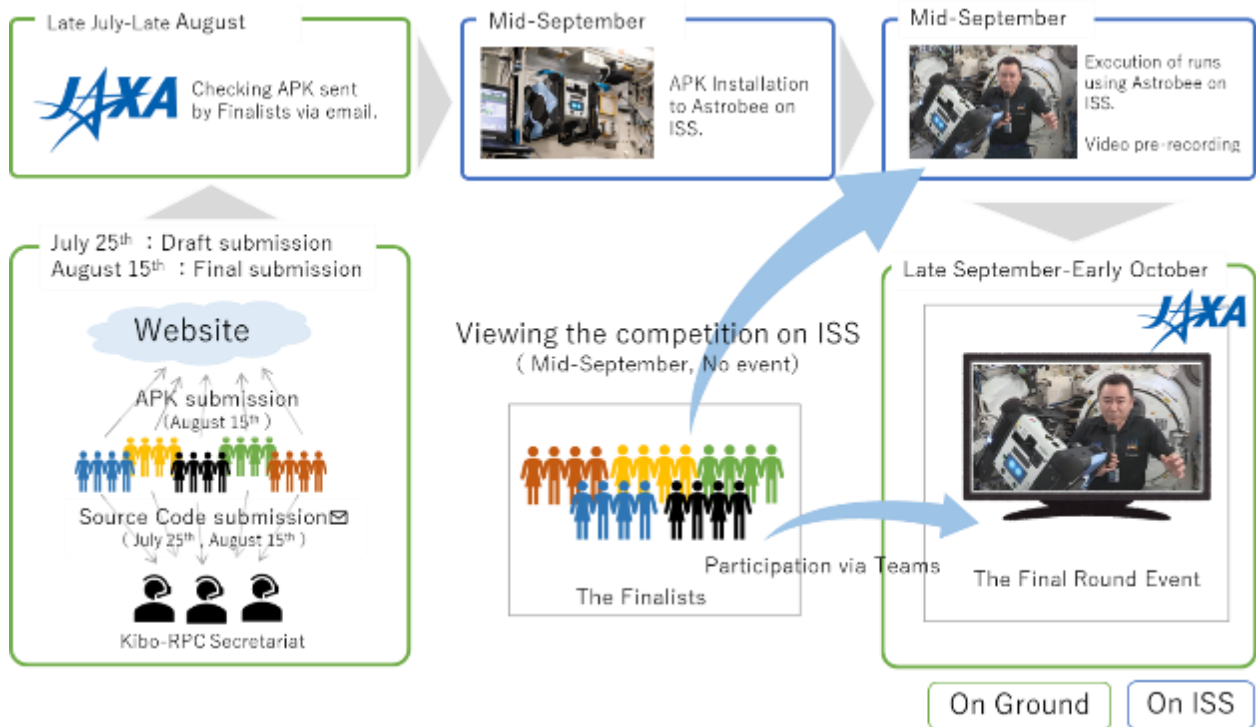

Figure 4.5 Flow up to event day