

# **The 7th Kibo Robot Programming Challenge Rulebook**



Version 1.1 (Revision date: October 15, 2026)

**Japan Aerospace Exploration Agency (JAXA)**



# Revision History

Revision history is listed below.

| Revision Date    | Version | Section | Revised Location     |
|------------------|---------|---------|----------------------|
| October 5, 2026  | 1.0     | -       | -                    |
| October 15, 2026 | 1.1     |         | Editorial correction |



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# 1. Introduction

The 7th Kibo Robot Programming Challenge (Kibo-RPC) is here. Create the best program to see if you can win.

A preliminary round will be held in each country/region to select their representatives. Participants compete using programs they have developed beforehand using JAXA's simulation environment. Game rules and scoring are basically the same in each country/region, although some have adopted their own evaluation criteria, so be sure to check your local Kibo-RPC website for details. Information regarding venue and dates will be made available by the point of contact (POC) in each country/region. This Rulebook contains general rules for all participants.

The winning teams from each preliminary round get to compete to be the best in the world in the final round where they will program and operate an Int-Ball2 (hereinafter IB2) free-flying robot in the Japanese Experiment Module KIBO, which is part of the International Space Station (ISS).

## 2. Preliminary Round

### 2.1. Preliminary Round Period

The Preliminary Round is held separately in each country/region during the period, so please participate in the Preliminary Round held in the country/region where you registered. Information on each country/region's Preliminary Round is posted on the official Kibo-RPC website (<https://jaxa.krpc.jp/>). For details, please contact the POC of your country/region.

**Question deadline<sup>\*1</sup>: January 20, 2027, 12:00 (JST)**

**Program submission period: January 20, 2027, 23:59 (JST)**

**Preliminary round period: January 21 – February 17, 2027**

<sup>\*1</sup> Any questions submitted after this date will receive a delayed response.

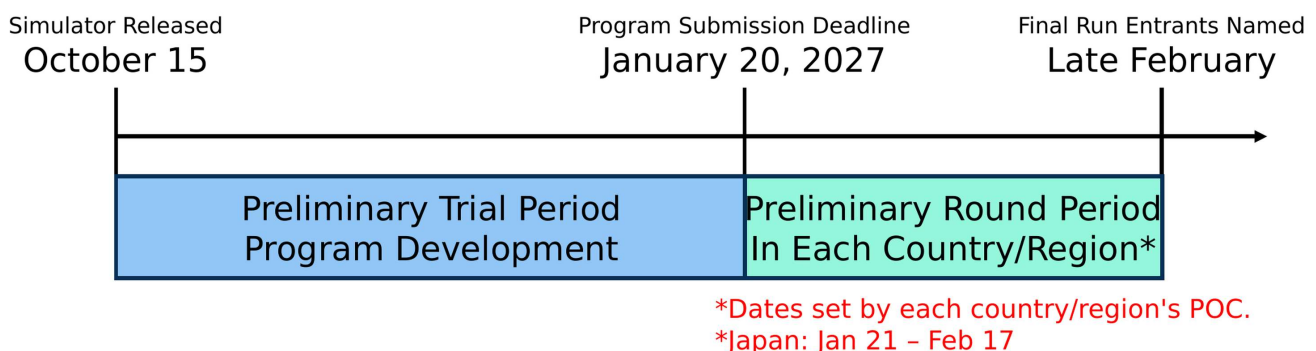


Figure 2.1-1 Schedule up to the Preliminary Round

## 2.2. Game Rules

### 2.2.1. Game Flow

To control JAXA's IB2 in the Preliminary round, please create a program to complete the following game using JAXA's web simulation environment.

Move the IB2 from the start position (Dock Station) to several CheckPoints where a leak is suspected, and read the AR marker at each location. Within the time limit,

you will read the markers and identify the cause of the pressure drop inside "Kibo."  
The mission ends when IB2 reaches the Goal CheckPoint and reports the mission result.

- (1) The game starts when IB2 automatically undocks from the Dock Station.
- (2) Read the automatically provided position and attitude information for the CheckPoints.
- (3) Visit the provided CheckPoints using an efficient route.
- (4) At each CheckPoint, read the AR marker while paying attention to the required position and attitude.
- (5) The mission is complete when IB2 has visited all CheckPoints and reached the Goal CheckPoint.

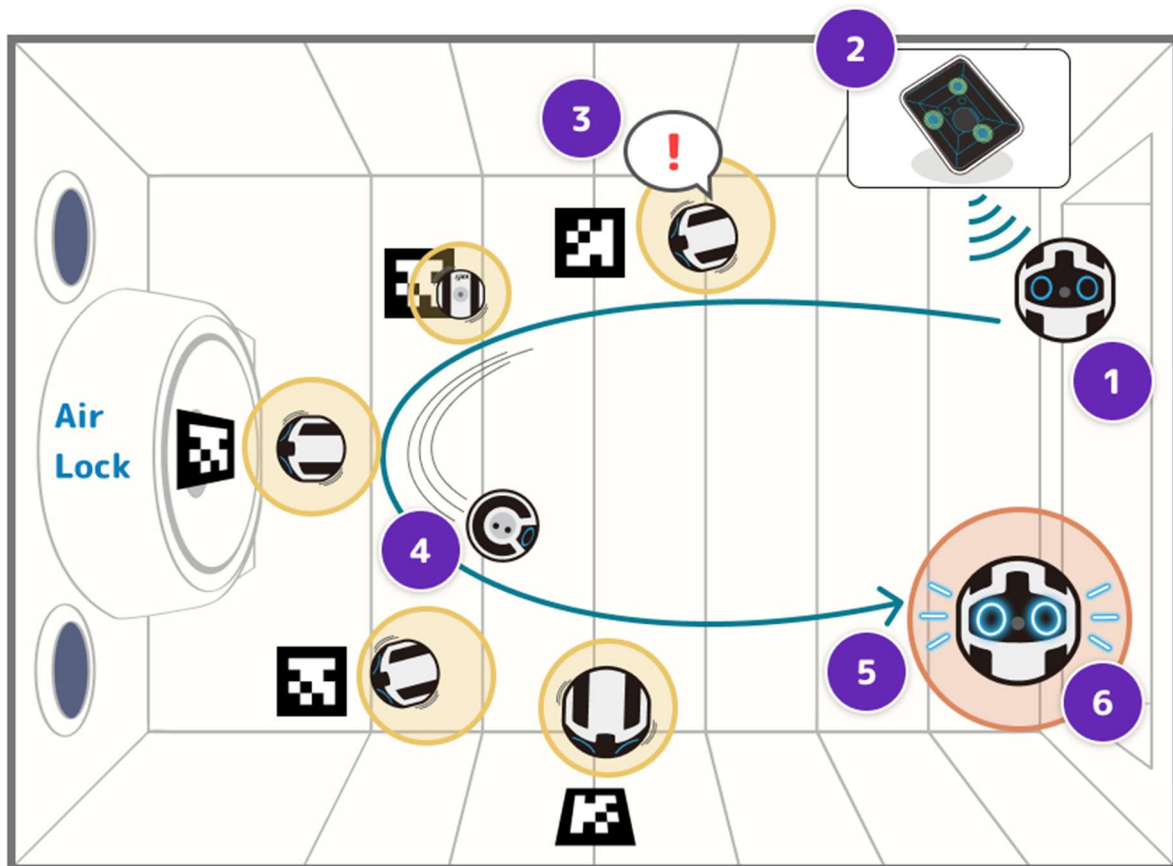


**Figure 2.2.1-1 Overview of the Preliminary Round Game**

## 2.2.2. Preconditions

Table 2.2.2-1 Preconditions for Preliminary Round

| # | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | The starting position is the Dock Station, and the timer starts once the IB2 undocks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 2 | There are 6 to 12 CheckPoints, and the number varies by difficulty level. (A passing point defined with an AR marker as its origin is called a CheckPoint.) A CheckPoint is specified as a sphere, and its position is set randomly with the AR marker as the origin.                                                                                                                                                                                                                                                                                                  |
| 3 | The following module is installed as a disturbance element. (Simulator only)<br>① Microgravity module                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4 | The following information is provided to participants in advance.<br>- Fixed values<br>① Position of the start point (StartPoint)<br>② Position and attitude of the rounding completion report position (RoundingCompletionPoint).<br>③ Total number of CheckPoints<br>④ Range of the CheckPoints (by difficulty level)<br>⑤ Position information and IDs of the AR markers<br>⑥ Position of the goal point (GoalPoint)<br>- Variable values (random)<br>① CheckPoint (passing point) with each AR marker as its origin = parameters of a specified angle and distance |
| 5 | The following information is not provided to participants.<br>① Position and attitude pattern of the CheckPoints at the time of simulation execution<br>② Gravity generation pattern of the microgravity module                                                                                                                                                                                                                                                                                                                                                        |
| 6 | The time limit is 5 minutes from the start of the timer (the completion report must be included within the time limit).                                                                                                                                                                                                                                                                                                                                                                                                                                                |



### ■ AR Marker Position and Attitude Information

The following table shows the position and attitude information of the AR markers used in the IB2 simulator. (The origin of each position is the docking station.)

**Table 2.2.2-2 Coordinate and Attitude Information of the AR Markers**

| AR Marker  | Target              | Position |        |        | Attitude (quaternion) |       |        |        |
|------------|---------------------|----------|--------|--------|-----------------------|-------|--------|--------|
|            |                     | x        | y      | z      | x                     | y     | z      | w      |
| ARmarker1  | SAIBO               | 1.451    | -1.001 | 0.681  | -0.707                | 0.000 | 0.000  | 0.707  |
| ARmarker2  | RYUTAI              | 2.973    | -1.001 | 0.718  | -0.707                | 0.000 | 0.000  | 0.707  |
| ARmarker3  | MSPR_1              | 3.313    | -1.001 | 0.523  | -0.707                | 0.000 | 0.000  | 0.707  |
| ARmarker4  | MSPR_2              | 4.181    | -1.001 | 0.523  | -0.707                | 0.000 | 0.000  | 0.707  |
| ARmarker5  | RMS_Console         | 5.754    | -1.001 | 0.838  | -0.707                | 0.000 | 0.000  | 0.707  |
| ARmarker6  | EPS1                | 1.895    | -0.282 | -0.208 | 0.000                 | 0.000 | 0.707  | -0.707 |
| ARmarker7  | MELFI1              | 1.451    | -1.001 | 0.372  | -0.707                | 0.000 | 0.000  | 0.707  |
| ARmarker8  | EPS2_2              | 4.779    | 0.112  | 1.884  | -0.707                | 0.707 | 0.000  | 0.000  |
| ARmarker9  | EPS2_1              | 2.066    | 1.046  | -0.014 | 0.000                 | 0.707 | -0.707 | 0.000  |
| ARmarker10 | ECLSS_TCS2          | 5.851    | 0.010  | 1.884  | -0.707                | 0.707 | 0.000  | 0.000  |
| ARmarker11 | Airlock             | 7.195    | 0.363  | 1.230  | 0.500                 | 0.500 | -0.500 | -0.500 |
| ARmarker12 | Bay0_Closeout_Panel | 0.000    | -0.059 | -0.102 | -0.500                | 0.500 | -0.500 | 0.500  |

### ■ Int-Ball2 Start Position

**Table 2.2.2-3 Int-Ball2 Start Position and Attitude Information**

|                |                | Position |       |       | Attitude (quaternion) |       |       |       |
|----------------|----------------|----------|-------|-------|-----------------------|-------|-------|-------|
|                |                | x        | y     | z     | x                     | y     | z     | w     |
| Start Position | DockingStation | 0.200    | 0.000 | 0.000 | 0.000                 | 0.000 | 0.000 | 1.000 |



**Figure 2.2.2-1 Docking Station Coordinate System (Conceptual Image)**

**\*Area is displayed as a plane.**

**The position information corresponds to the AR markers, and a random pattern is set. Three margin levels are set for each CheckPoint, and points are assumed to be awarded according to each level.**

## ■ Simulator Image

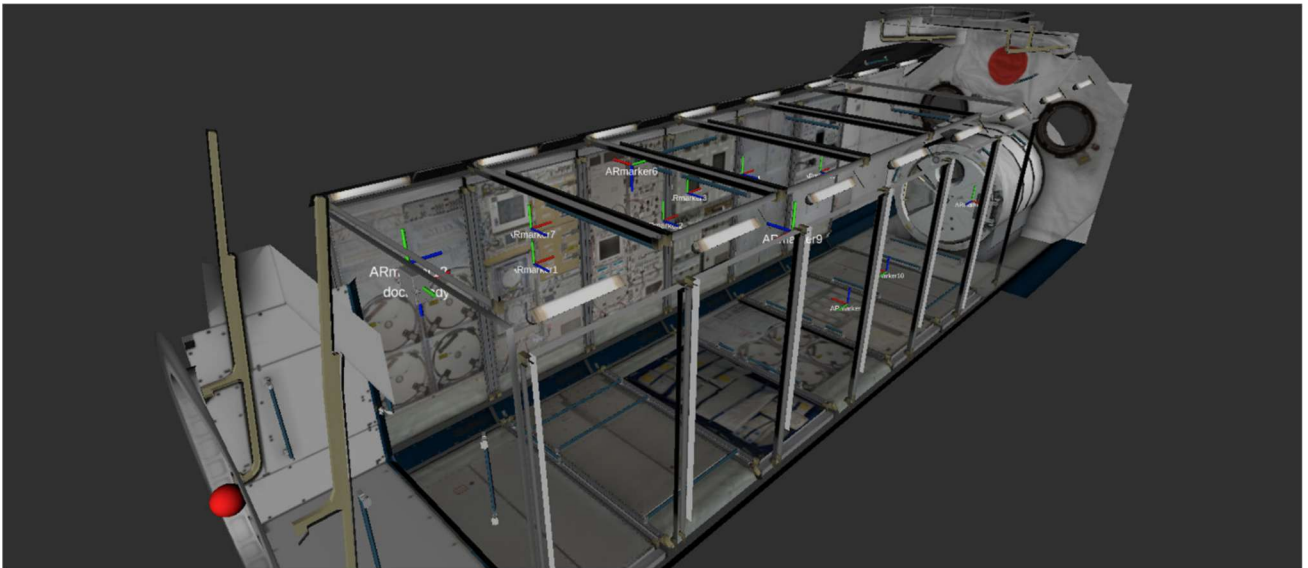


Figure 2.2.2-2 Images from Each Angle of the Simulator



## 2.2.3. Game Content

The game proceeds in the following three steps.

| Step |                                                       | Description                                                                                                                                                                                                  |
|------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Game start                                            | The timer starts when the Undock is completed.                                                                                                                                                               |
| 2    | Visit each CheckPoint                                 | Recognize the relative position and attitude with respect to the placed AR markers and visit each CheckPoint.                                                                                                |
|      | a Move                                                | Move to any CheckPoint.                                                                                                                                                                                      |
|      | b CheckPoint passing judgment (AR marker recognition) | Continuously calculate the relative position and attitude with respect to the AR marker, stay within the CheckPoint margin, and keep the AR marker in the camera view for 1 second.                          |
| 3    | Mission Complete Report                               | After visiting the CheckPoints, report to the crew that the patrol has been completed.<br>* If the report cannot be completed within the time limit, no points are awarded for the patrol completion report. |

## 2.2.4. Mission Completion Report

The mission completion report must be submitted upon arrival at the GoalPoint.

Please see the Programming Manual for the API to use in the Mission Completion Report.

## 2.2.5. Number of Program Runs

In the Preliminary Round, each program will be automatically executed 10 times to ensure fairness with respect to the random elements included in the simulation. Different random conditions will be generated for each of the 10 runs. The final score will be the average score of the 10 runs, and this average will be used to determine the ranking. This allows all participants to compete on the same terms, regardless of whether their results happen to be good or bad. Please see Section 2.3 for details regarding scoring criteria.

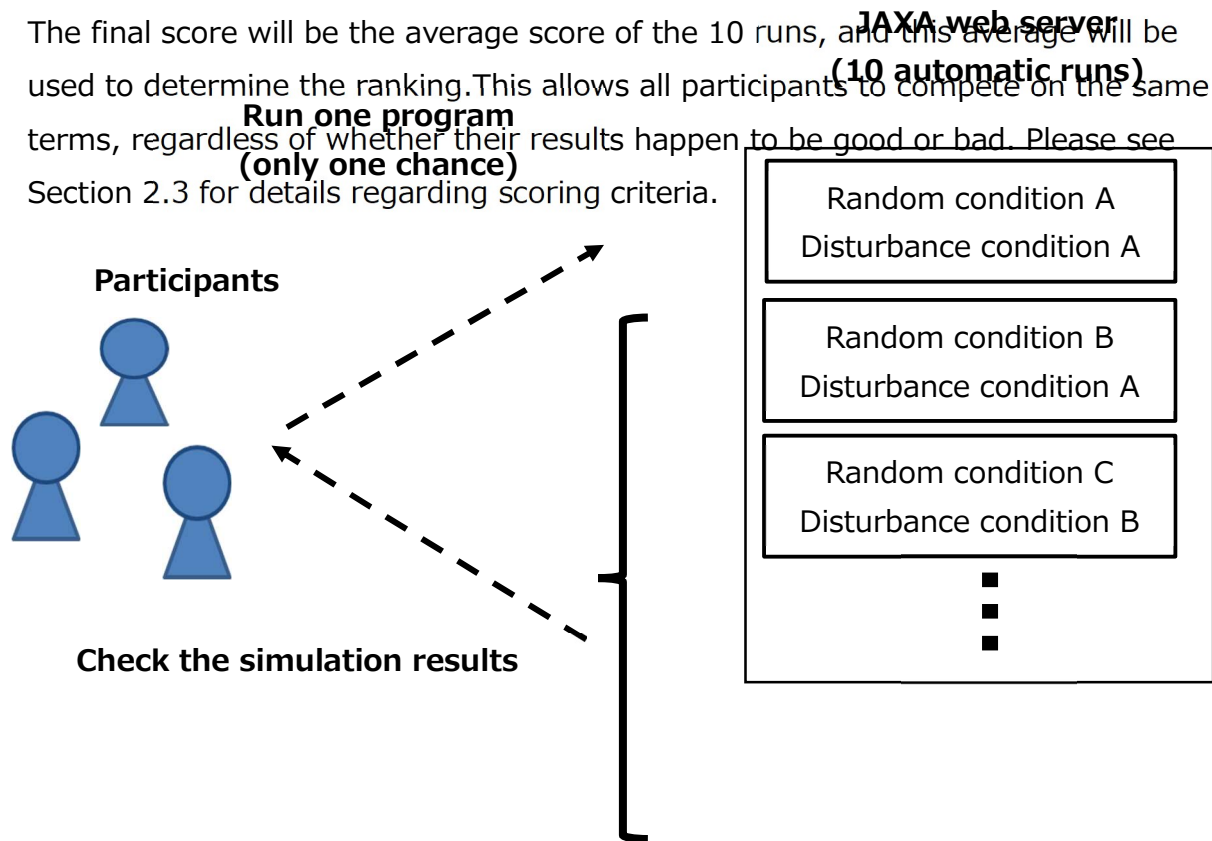


Figure 2.2.5-1 10 Runs

## 2.3. Scoring

### 2.3.1. Scoring Elements

Your team's score will be calculated based on the following factors

| Checkpoint                     | Scoring Item                                                                                                                                                 | Scoring Criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| At CheckPoint passing judgment | Points are awarded based on the passing judgment of the position and attitude (rotation/angle) sent from the game API. CheckPoint passing points are summed. | <p>Points are awarded when the IB2 stays within the CheckPoint and recognizes the AR marker for 1 second with the marker captured at the center of the camera.</p> <p>① The IB2 is within the specified position margin with respect to the coordinates of the designated CheckPoint.</p> <p>② The AR marker is captured at the center of the camera.</p> <p>③ The attitude of the IB2 is controlled to the specified rotation angle about the camera line-of-sight axis.</p> <p>* A three-level margin, Lv1 to Lv3, is set for ① to ③. The passing judgment level is the lowest of the judgment levels of the individual conditions, and points corresponding to that level are awarded.</p> |
| Mission Remaining Time         | A score multiplier is determined according to the remaining time at the time of the mission completion report and is applied to the total score (Score).     | The more time remaining at the time of the mission completion report, the higher the multiplier that is set. The final score is calculated by multiplying the total score (Score), which is the sum of all points, by this multiplier.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## 2.3.2. Checkpoint Passing Judgment Examples

### Example of Points Awarded

Points are awarded when all three conditions — the position of the IB2, capture of the AR marker at the camera center, and the attitude about the camera line-of-sight axis — are satisfied and this state is maintained for 1 second.

Example: If the position is Lv3, the AR marker capture is Lv2, and the attitude is Lv3, the judgment is made at the lowest level, Lv2, and the Lv2 points are awarded.

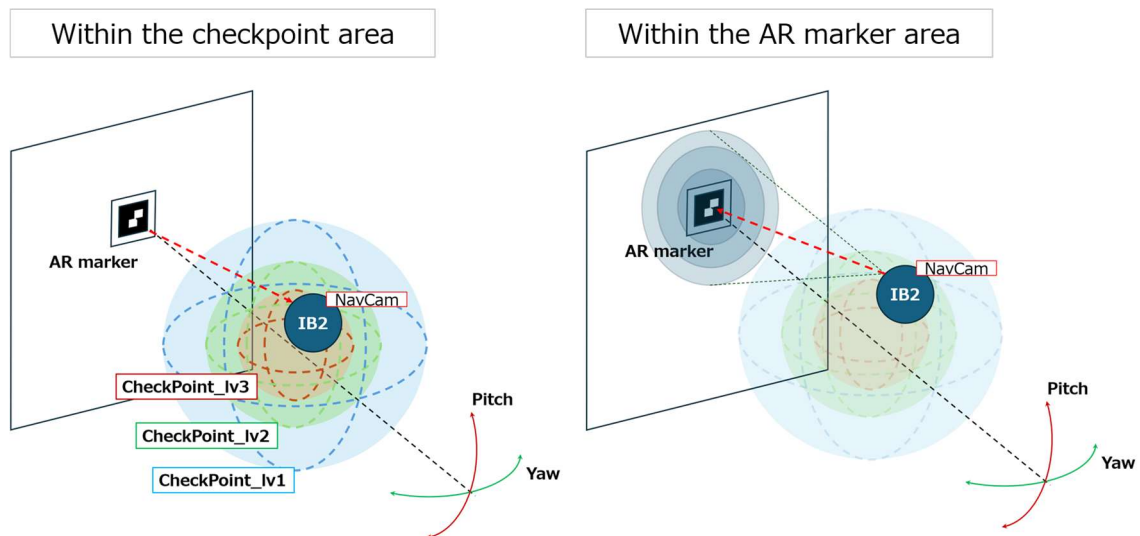


**Figure 2.3.2-1 Example of a Case in Which Points Are Awarded**

### Example of No Points Awarded

No points are awarded if any of the above three conditions is not satisfied, or if the state in which all three conditions are satisfied cannot be maintained for 1 second. Example:

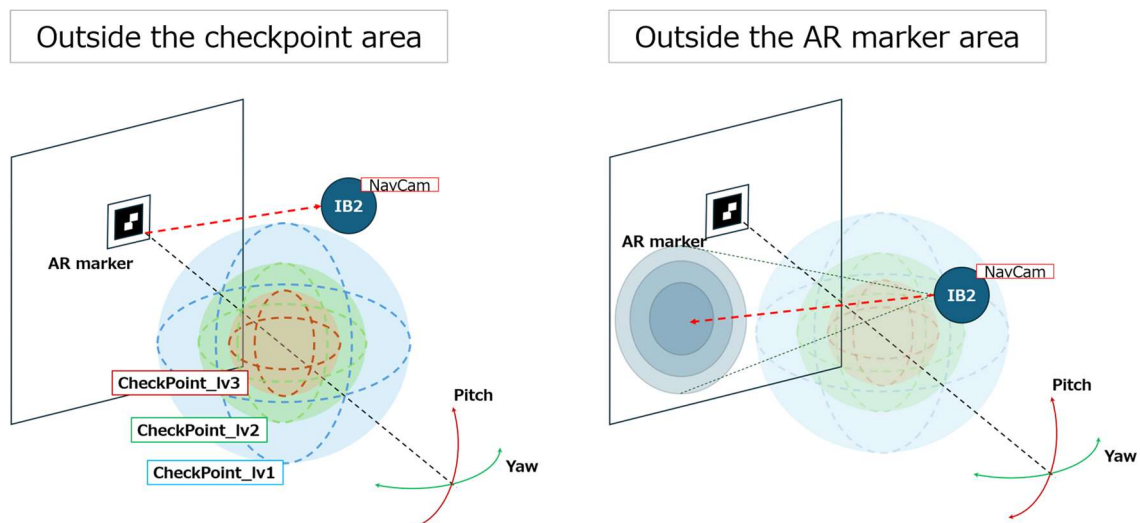


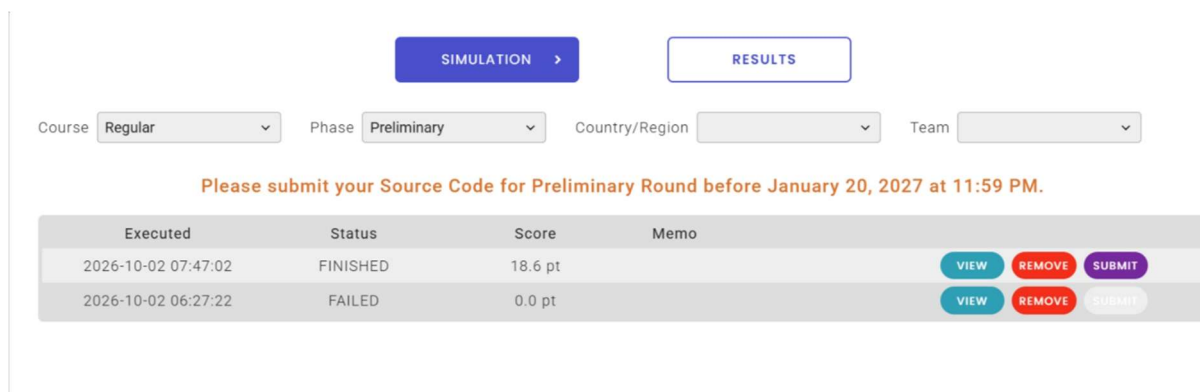
**Figure 2.3.2-2 Example of a Case in Which Points Are Not Awarded**

If the position is out of range and both the AR marker capture and the attitude are Lv3, the IB2 is not judged to have passed, and no points are awarded.

## 3. Preliminary Round Event

### 3.1. How to Participate in the Preliminary Round

Participants must submit program for the preliminary round by the submission deadline (Jan 20, 2027). Even after submitting a program once, the participants may resubmit a program anytime they want within the deadline.



| Executed            | Status   | Score   | Memo |                    |
|---------------------|----------|---------|------|--------------------|
| 2026-10-02 07:47:02 | FINISHED | 18.6 pt |      | VIEW REMOVE SUBMIT |
| 2026-10-02 06:27:22 | FAILED   | 0.0 pt  |      | VIEW REMOVE SUBMIT |

**Figure 3.1-1 Web Simulation Screen for the Preliminary Round**

Before the preliminary round period begins, the result screen of the web simulator will be updated, allowing you to run your program in the "Preliminary" simulator. The participants need to run their program in the "Preliminary" simulator before submitting your program. After that, select the program you want to submit from the "Preliminary" results list on the "RESULTS" screen and press the newly added "SUBMIT" button to submit your program. When you press the "SUBMIT" button, it will switch to the "CANCEL" button, and you can resubmit another program by pressing the "CANCEL" button before the deadline.

Please be aware that the team can cancel the submitted program on the "RESULTS" page, but the team must be careful of the deadline, as the "SUBMIT" and "CANCEL" buttons will become inaccessible after the deadline..

**NOTICE :** The "SUBMIT" button can only be pressed for programs that are in "FINISHED" status on the "Preliminary" screen. If you only have a program in "FAILED" status, the team cannot submit their program



and will not be able to participate in the preliminary round. Please make sure that the status of the program is marked as "FINISHED" on the "Preliminary" screen.



## 4. Final Round

Details of the Final Round will be announced at a later date.

### 4.1. ISS Final Round Preparation

Only representative teams can participate in the ISS Final Round. Teams may refine their programs from the Preliminary Round for the Final Run (on ISS) and submit the program and source code before the deadline.

#### 1) Draft source code

JAXA will check programs to ensure that they will not have a negative impact on the IB2 in orbit. If necessary, JAXA will ask participants to modify the code.

**For the preliminary review, please submit only the source code via email.** Instructions on how to submit the code will be provided at a later date.

**Due to the short revision period, please make arrangements in advance.**

#### 2) On-orbit final program

When submitting the final version, please submit **both the Final Round program and the source codes via the web.** We will provide instructions on how to submit them at a later date.

**Failure to submit by the deadline may result in not being able to participate in the ISS Final Round, so please be sure to submit on time.**

## 4.2. Game Rules

### 4.2.1. Game Flow

In the ISS Final Round, the IB2 on the ISS visits the checkpoints from the start position within the time limit and recognizes the placement of the Checkpoints. The flow is basically the same as in the Preliminary Round.



## **4.2.2. Preconditions**

There are no major changes from the Preliminary Round.

## **4.2.3. Mission Complete Report**

There are no major changes from the Preliminary Round.

## **4.2.4. Number of Program Runs**

Each team submits one program for the ISS Final Round Run. The ISS Final Round Run will use the IB2 on the ISS, so it cannot be re-run or stopped once the program has started. Again, this is a one-time run.

If the IB2 experiences a problem such as getting stuck, under the rules in Section 4.4.2 you will be given the opportunity for a re-run.

## **4.2.5. Time Limit**

The mission time limit is 5 minutes, the same as in the preliminary round. If the time limit is exceeded, the program will automatically shut down. Please program to complete the mission within the time limit. Even if the time limit is not reached, the game is automatically considered over if the IB2 gets stuck or loses its self-position. The system may also terminate without waiting for the time limit when it is judged that no further operation can be expected for any reason, such as the IB2 stopping for a long time.

## **4.3. Work Required to Participate in the Final Round Run**

### **4.3.1. Submitting Source Code and Programs**

You need to submit your program by the deadline for the Final Round. JAXA will review the source code in advance for safety reasons. Therefore, please submit the program and source code according to the following procedure. (At the time of the preliminary review, only the source code will be submitted.) The program used in the side event will be the same as the one used in the ISS Final Round.

**Due to the short time available for code modifications, please keep your schedule clear.**

(Many corrections have been required every year.)

Detailed submission instructions will be announced later.

## 4.4. Organizing the Event

The 7th Kibo-RPC will be held in a similar format to that of the 6th Kibo-RPC, as shown in Figure 4.3.1-1 JAXA will run the IB2 and finalists' programs in advance. The Final Round Event, featuring commentary by experts watching the pre-run footage, will be held later. Finalists will be contacted by the Secretariat via email with more details.

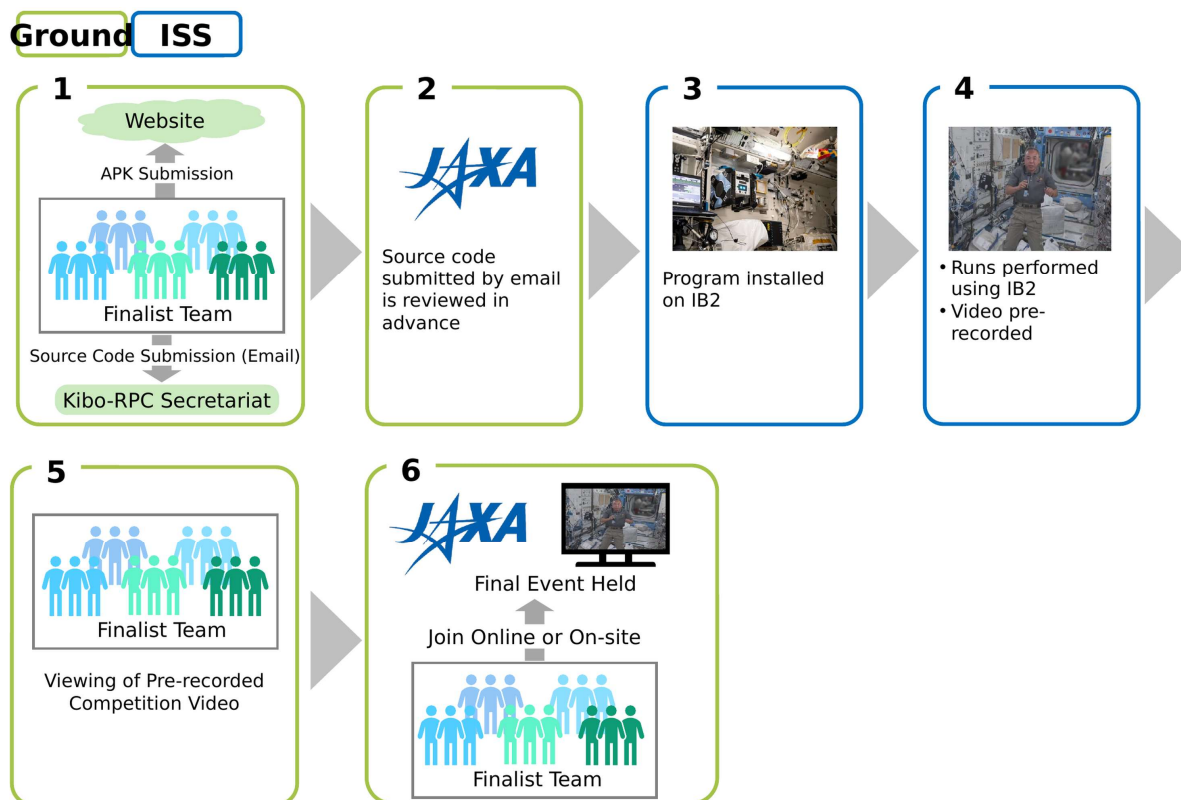


Figure 4.3.1-1 Flow up to the day of the event

### 4.4.1. Program Operation on the Day of the ISS

#### Final Round

Participants may not operate their programs on the day of the ISS Final Round.

Submitted programs will be checked by the JAXA technical team and preinstalled on the IB2 on the ISS. Programs start with an execution command from ground operators.

## 4.4.2. ISS Final Round Run Order

In the ISS Final Round, teams will be divided into three tiers according to the results of the Preliminary Round and runs will be performed in that order. An example of team tier grouping is shown in Table 4.4.2-1.

\* The way Tiers are divided may change.

**Table 4.4.2-1 Team Assignment**

| Tier     | Preliminary Round Score 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                      |
|          | 13th place                      |

If the IB2 gets stuck due to a problem in orbit, the team will be given another chance to run the mission again before moving on to the next tier as long as there is enough time left in the event. However, if the problem is caused by the program created by the participant, there will be no rerun. Please note that there is limited time to conduct the competition in orbit, and teams with lower rankings in the preliminary round may not be able to run their mission on the day of the final round. For more information, please refer to Figure 4.4.2 1.

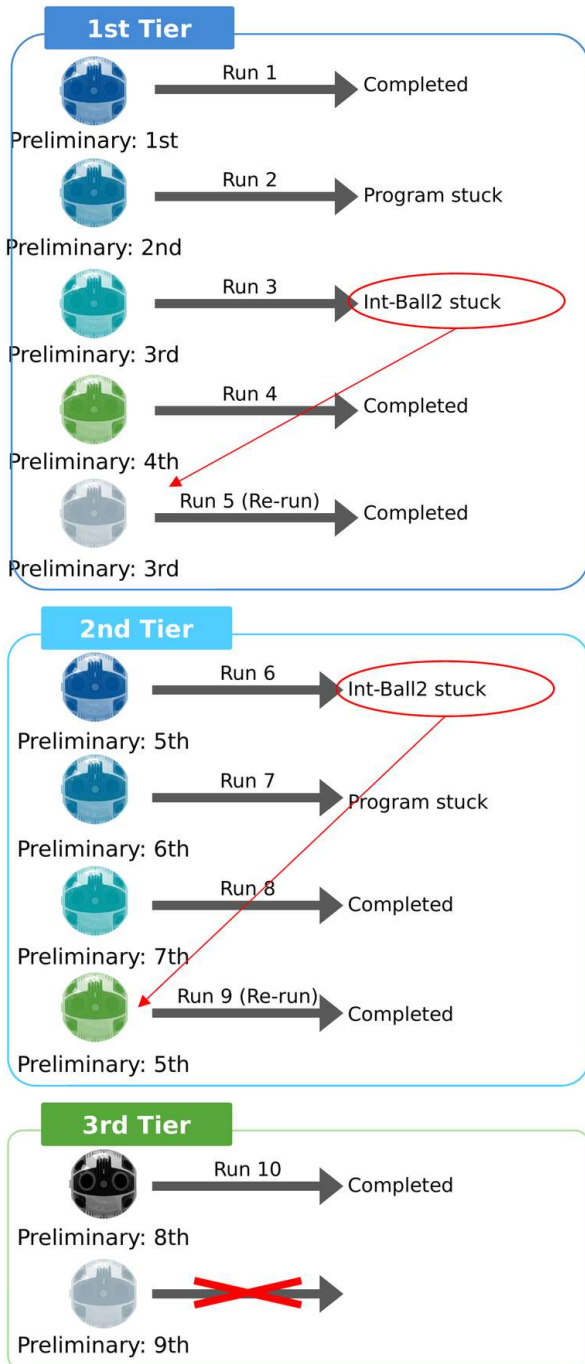


**Figure 4.4.2-1 Example of Team Order for Final Round**

## Appendix

This will be the definition of terms used in the 7th Kibo-RPC.

| #  | Term (English)            | Definition                                                                                                                                                                                                             |
|----|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Kibo-RPC                  | Abbreviation for Kibo Robot Programming Challenge, a programming competition using robots on the ISS.                                                                                                                  |
| 2  | ISS                       | Abbreviation for International Space Station.                                                                                                                                                                          |
| 3  | Int-Ball2                 | The robot used in this competition: a simulator is used in the Preliminary Round, and the actual robot in the final.                                                                                                   |
| 4  | IB2                       | Abbreviation of Int-Ball2 used in the main text.                                                                                                                                                                       |
| 5  | Kibo                      | The Japanese Experiment Module developed by JAXA. Also known as JEM (Japanese Experiment Module).                                                                                                                      |
| 6  | Dock Station              | The base set as the start position of Int-Ball2. Related terms: Dock: the vehicle is held at the Dock Station. Release: the vehicle is released from the Dock Station. The timer starts when the Release is completed. |
| 7  | Mission Start             | The timing at which the Release is completed and the mission starts. The timer for determining the mission time limit starts at Mission Start.                                                                         |
| 8  | Mission Finish            | The timing at which the mission time limit ends or the mission completion report is started. Points for actions after Mission Finish are invalid.                                                                      |
| 9  | (Mission's)<br>time limit | The maximum time from Mission Start to Mission Finish.                                                                                                                                                                 |
| 10 | CheckPoint                | A point set as a spherical passing area based on the relative position and attitude with respect to an AR marker. It has three margin levels (Lv).                                                                     |
| 11 | StartPoint                | The starting point of the mission. Under the current rules, the Dock Station is the start position.                                                                                                                    |
| 12 | GoalPoint                 | The point to which the IB2 moves after passing all CheckPoints and where the mission completion report is made. The position is defined in the game specification.                                                     |
| 13 | AR marker                 | The marker used as the origin for recognizing the relative position and attitude and for generating CheckPoints. The game specification describes 12 markers in Kibo.                                                  |
| 14 | t                         | The remaining time at the point of the mission completion report. The unit is seconds (s).                                                                                                                             |

|    |                     |                                                                                                                                                            |
|----|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15 | time_max            | The maximum time limit of the mission.                                                                                                                     |
| 16 | Score               | The total score calculated as $Pt\_all \times Mag\_clear$ in the score calculation table.                                                                  |
| 17 | Clear_time          | The mission completion time. Used to calculate the clear time multiplier (Mag_clear).                                                                      |
| 18 | Mag_clear           | The score multiplier obtained according to the clear time. A maximum of 2x is assumed.                                                                     |
| 19 | Pt_check            | The points obtained when the IB2 stays within a CheckPoint and recognizes the AR marker under the specified conditions. The points differ according to Lv. |
| 20 | Pt_goal             | The points obtained when the IB2 passes all CheckPoints within the time limit and reaches the GoalPoint.                                                   |
| 21 | Pt_all              | In the score calculation table, the value obtained by adding Pt_goal to the total of Pt_check at each Lv.                                                  |
| 22 | Microgravity module | A disturbance element installed in the simulator environment.                                                                                              |