2nd Kibo Robot Programming Challenge

Guidance Session

April 22 4:00pm (JST)～

Kibo-RPC Secretariat

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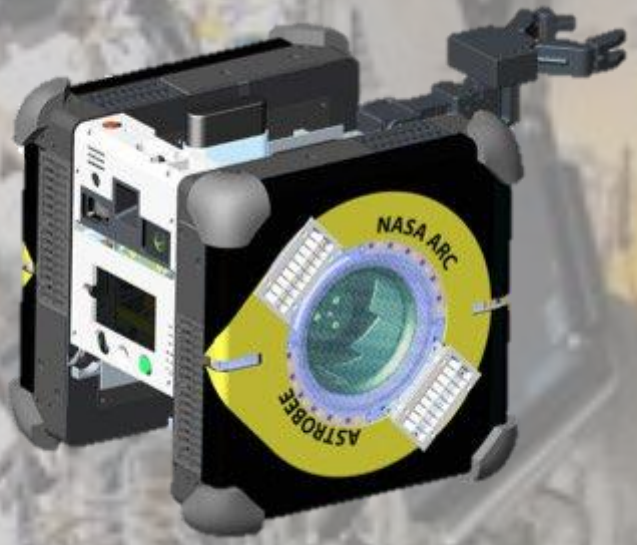

1. 2nd Kibo-RPC Overview
2. Preliminary Round
3. International Rounds
4. Important Notes for Programming
5. FAQ

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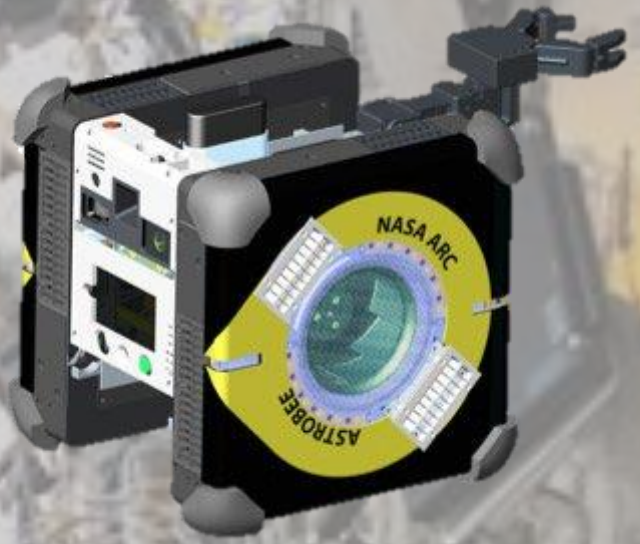

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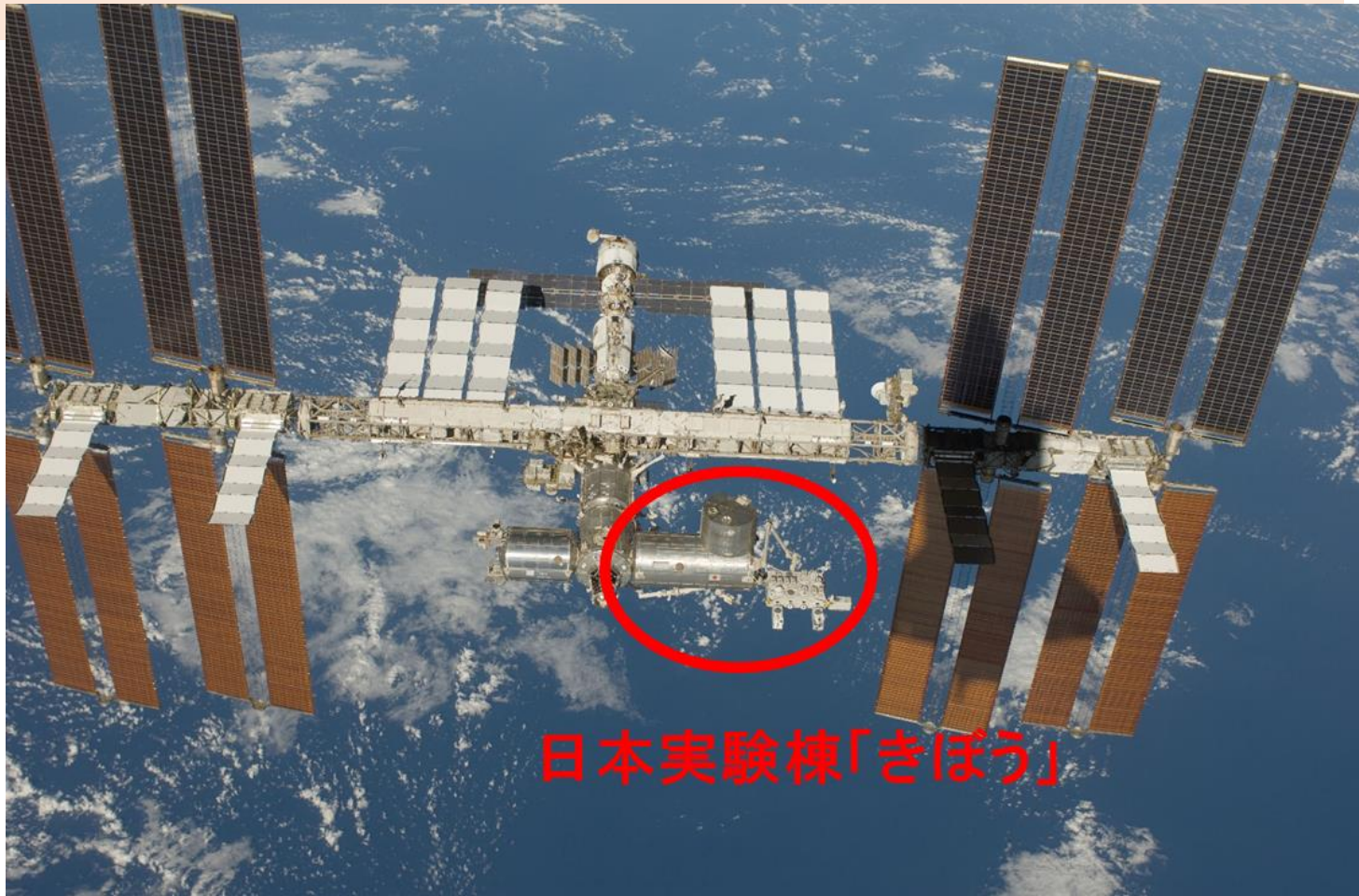
1. 2nd Kibo-RPC Overview

The Kibo Robot Programming Challenge is an educational program for students to solve problems by programming free-flying robots on the International Space Station (ISS).

2nd Kibo-RPC participation

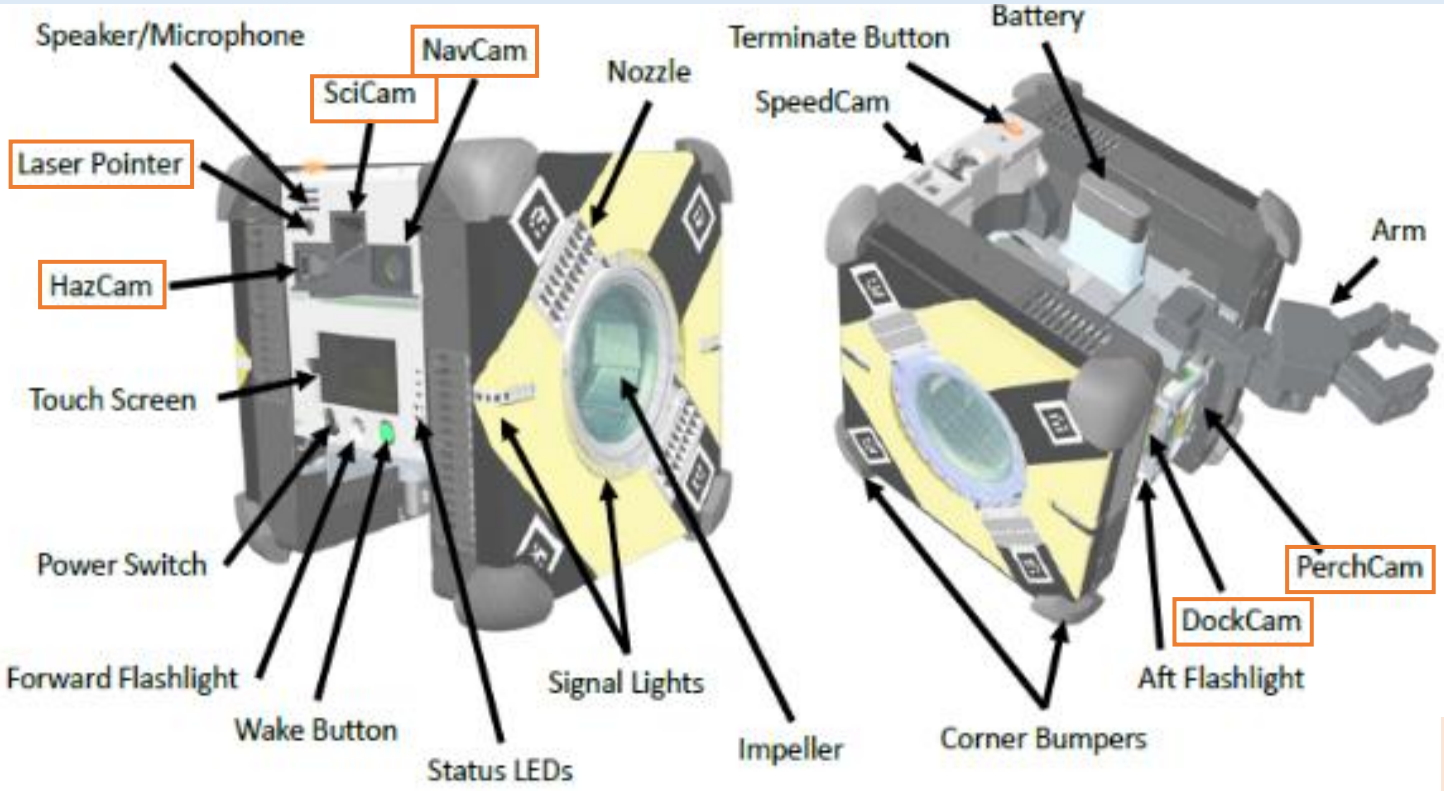


1. 2nd Kibo-RPC Overview

The ISS air leak that occurred in 2020 has been repaired by talented programmers in Asia.

Everyday back on the ISS ... Because only a first aid measure was taken, the air leak recurred in 2021.

Asian programmers, do a complete repair and report completion of the mission to the astronauts!

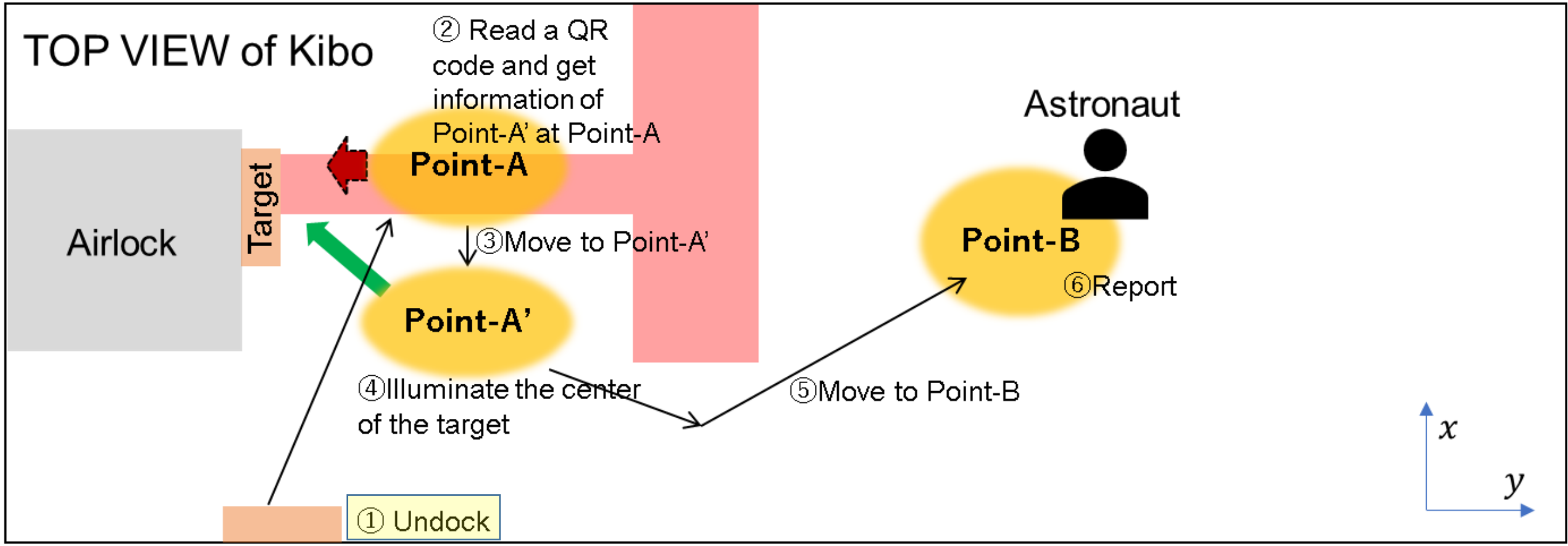


Astrobee(NASA)

This story is fiction.

1. 2nd Kibo-RPC Overview

Game Flow



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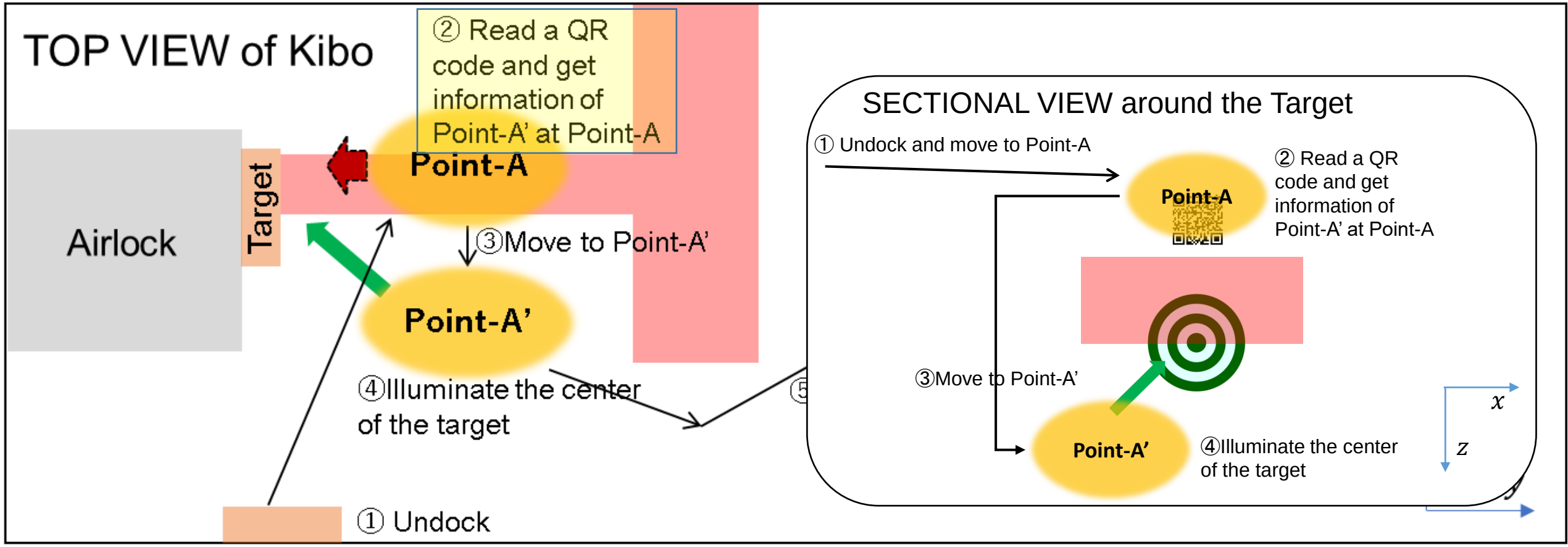
Game Flow



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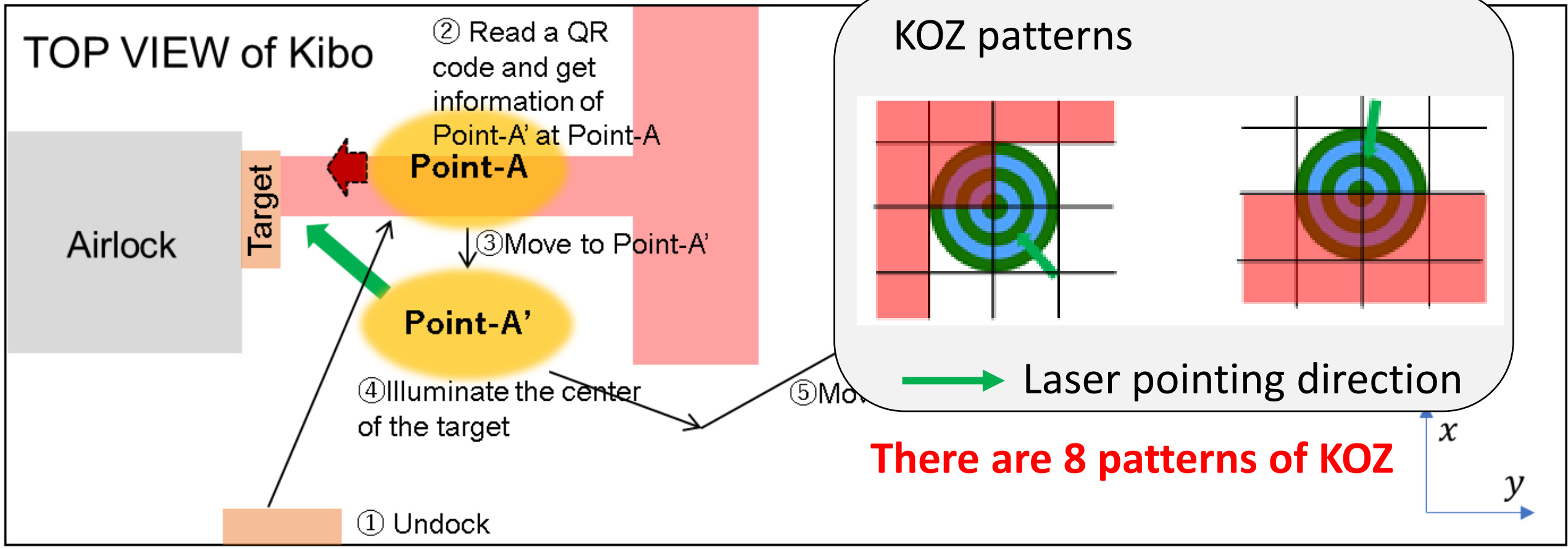

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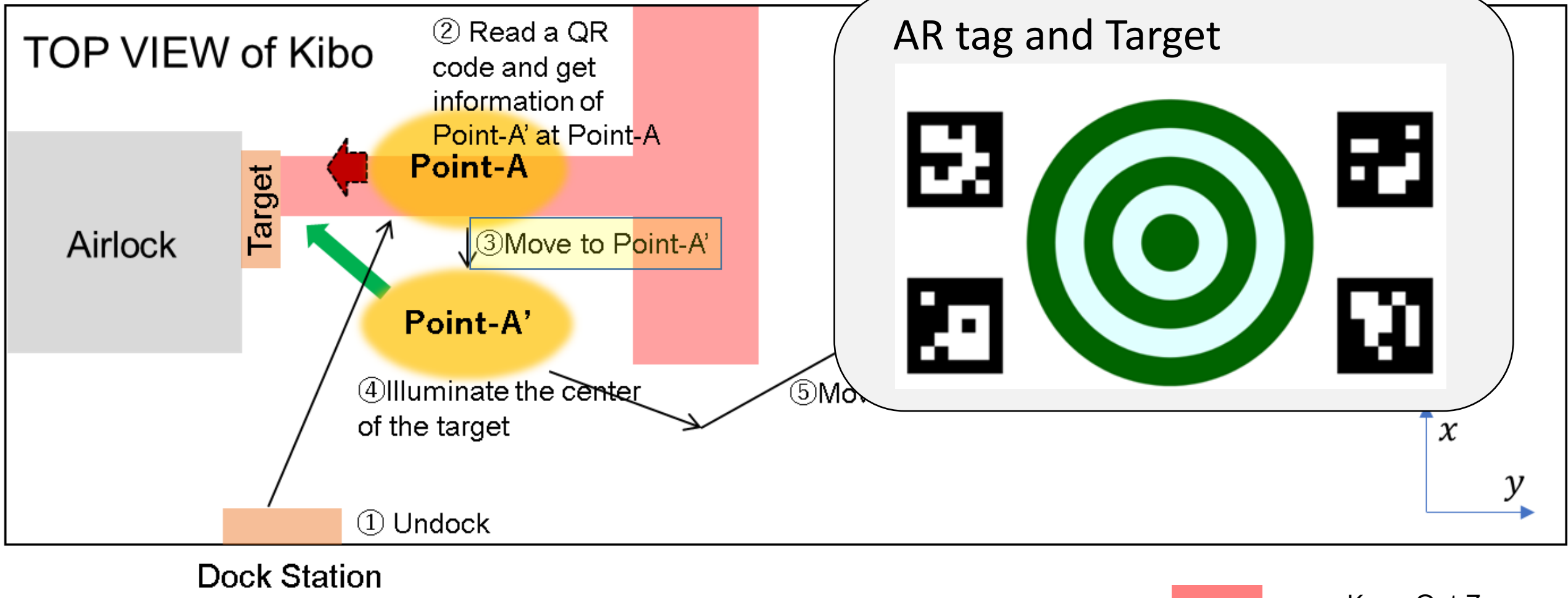

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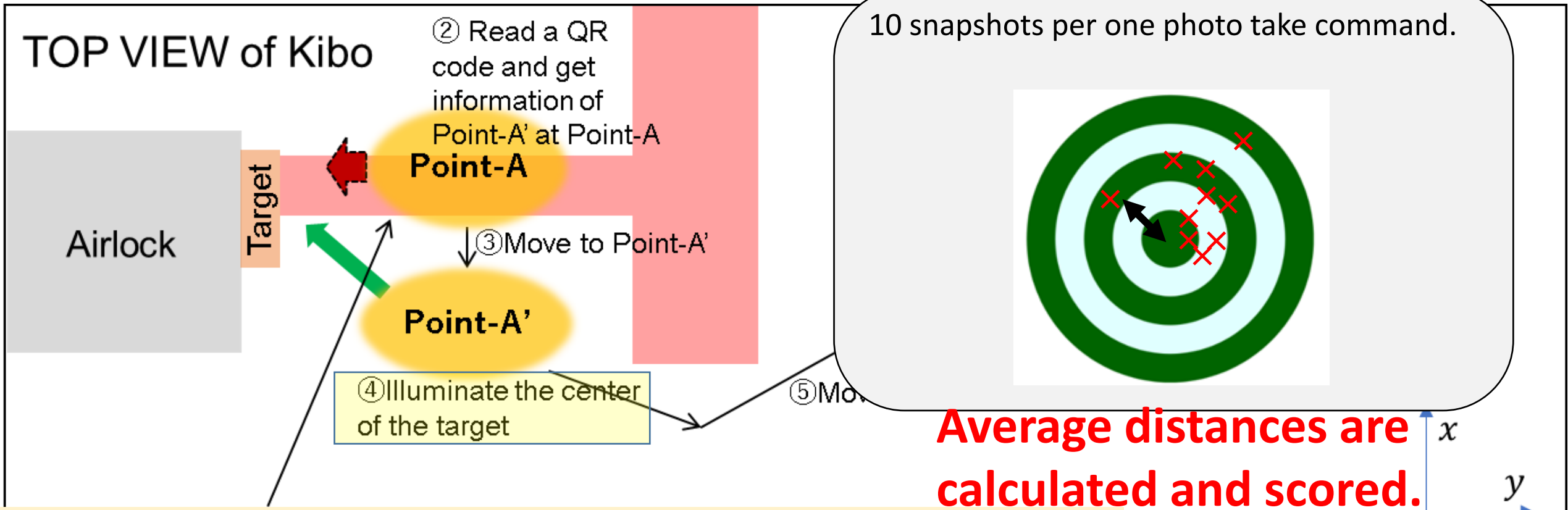
Game Flow

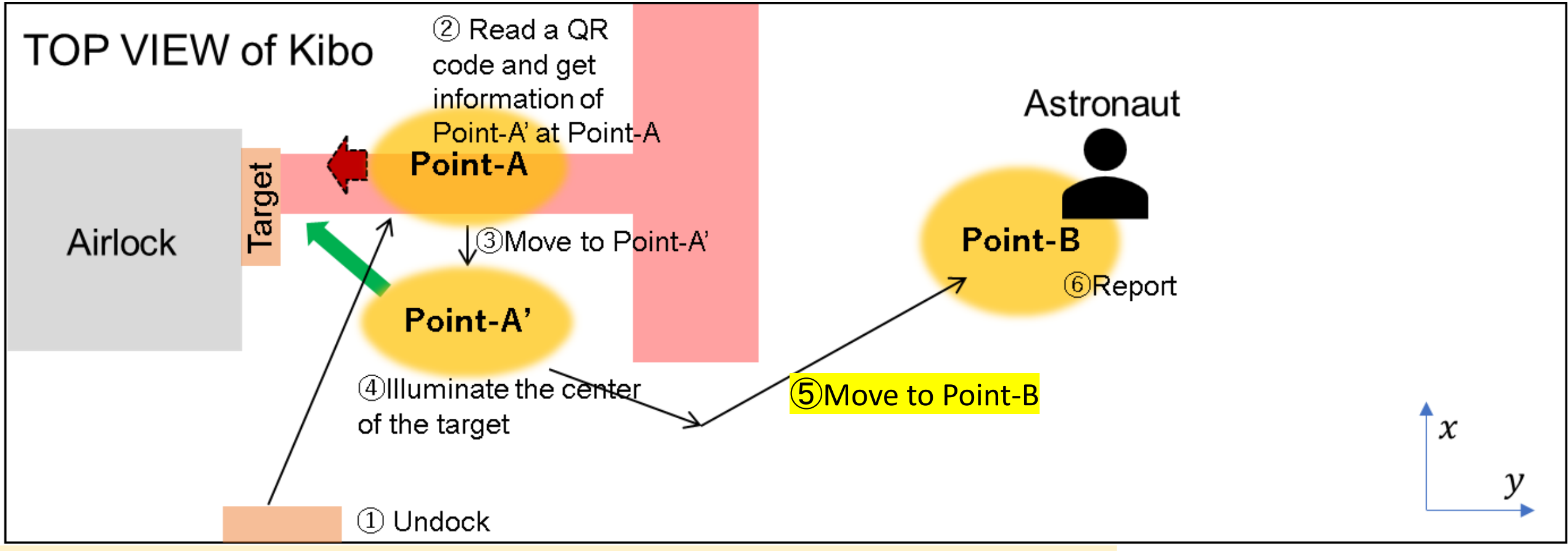


If you wish to fine adjust the position for better targeting, you can program to automatic re-try as many as you want within the time limit.

・・・Keep Out Zone

1. 2nd Kibo-RPC Overview

Game Flow

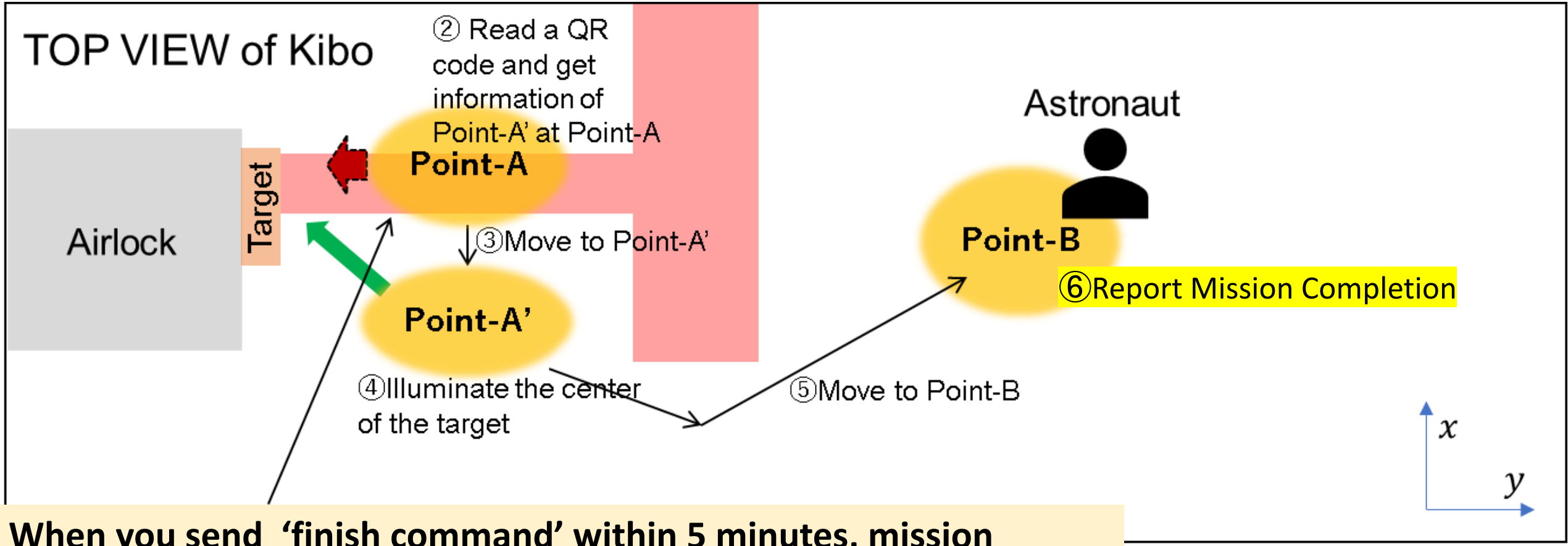


We recommend moving to Point-B in backward motion with facing the Airlock direction. Astrobee may be lost itself.

・・・Keep Out Zone

1. 2nd Kibo-RPC Overview

Game Flow



When you send 'finish command' within 5 minutes, mission completion is reported to the Astronaut.
Score is calculated from accuracy of laser pointing and time.

・・・Keep Out Zone

1. 2nd Kibo-RPC Overview

1. Application

Due: May 16th, 2021 11:59pm

2. Program Development

Program submission due
May 31st, 2021 23:59

3. Preliminary Round

July 1st ~20th,2021

4. Programming Skills Round

End of June (right after Preliminary Round)

5. Final Round

Around September 2021

Note: Schedules may be changed due to unexpected reasons.

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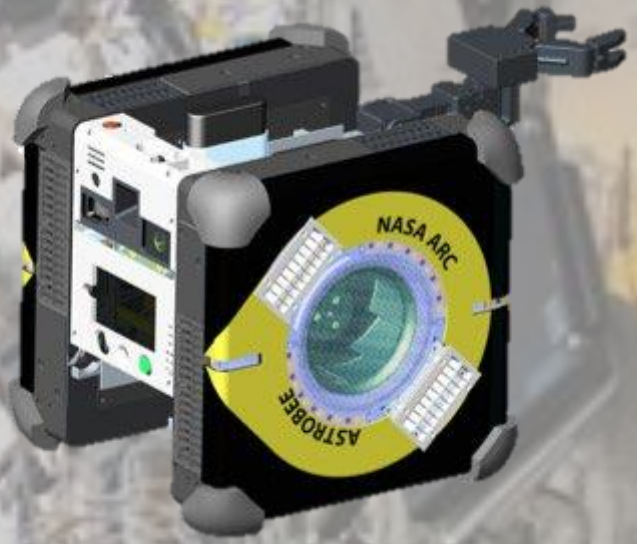


2. Preliminary Round

The purpose of Preliminary Round

Purpose

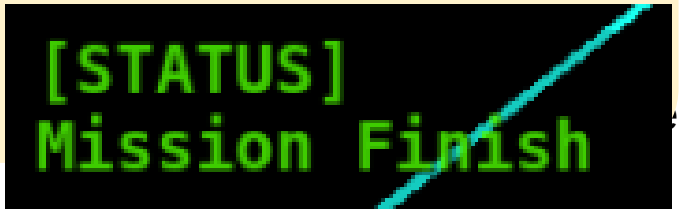
The Preliminary Round is to select representatives from each country/region, participants must take part in a preliminary competition by using the simulator organized by their country/region POC.

Please read the Rule Book for details.

Unique points of Preliminary Round

1. Target position is randomly changed
2. When the finish command is executed, following messages will be displayed on your screen.

①playback started
②playback completed
③Mission Finish

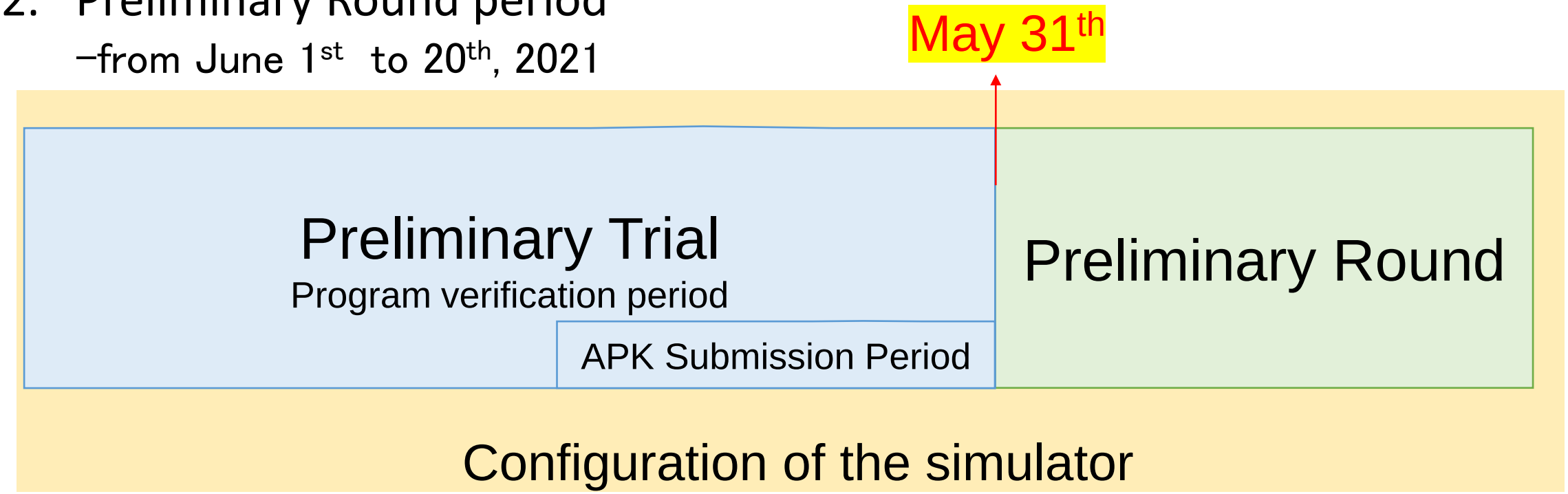


2. Preliminary Round

Rules of Preliminary Round (1/3)

APK: Android PacKage

1. **Eligibility**
   - –Teams who submitted applications by May 16, 2021.
   - –Teams who submitted APK(*) for Preliminary Round between May 17 to 31,2021.
2. Preliminary Round period
   - –from June 1st to 20th, 2021



2. Preliminary Round

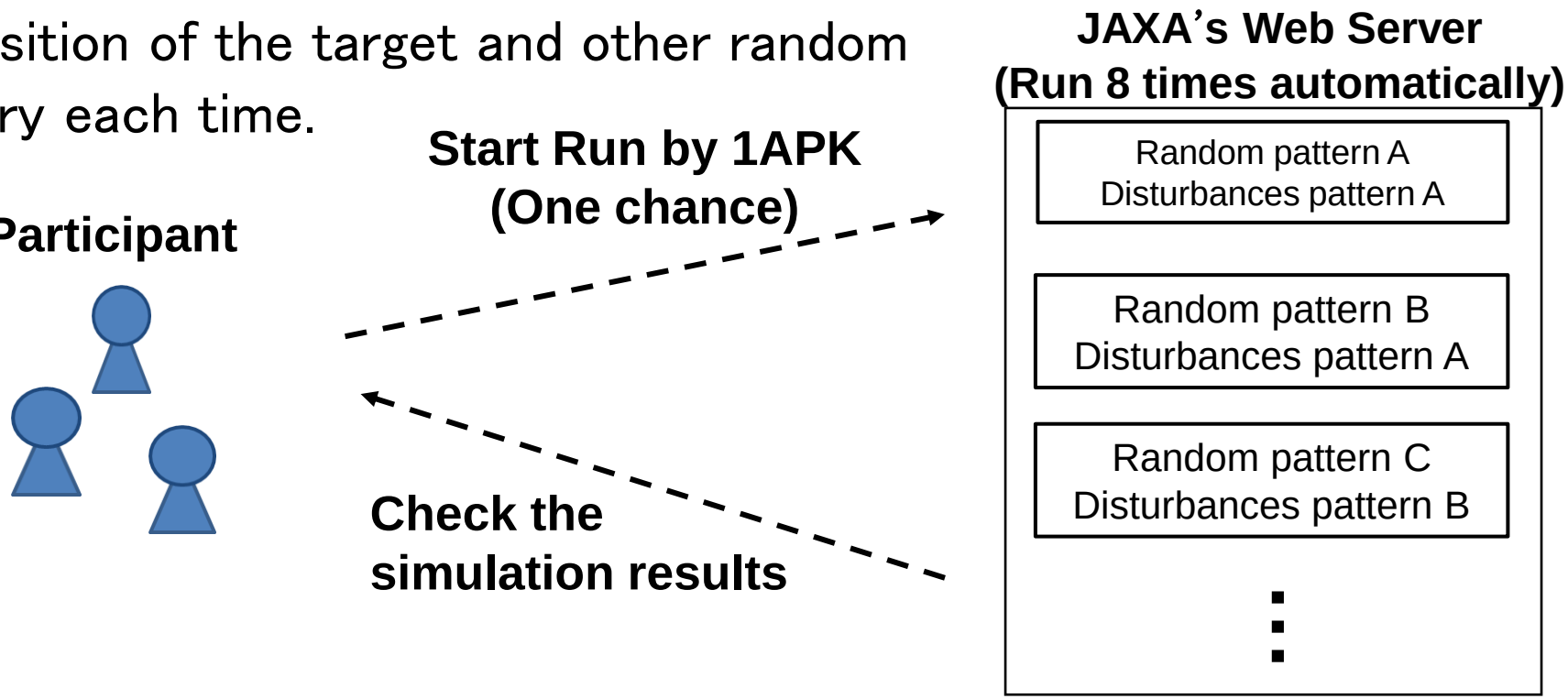
Rules of Preliminary Round (2/3)

3. **Only one APK per team is used**

   Submit your best APK.

4. **8 automatic runs per APK**

   KOZ, the position of the target and other random elements vary each time.



2. Preliminary Round

Rules of Preliminary Round (3/3)

5. Ranked by the worst result of 8 automatic runs

Space missions must be performed under severe conditions.
A program with high performance under any condition must be evaluated.

Participant

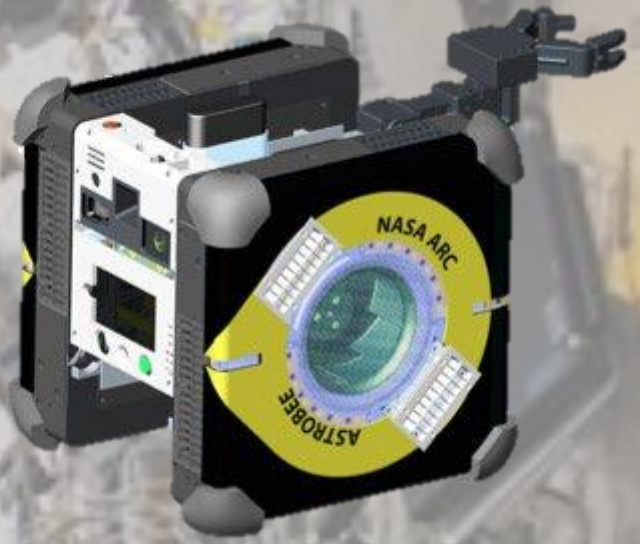
Submit one APK

	Random pattern	Class/Score
1	Pattern A	Class A/70 points
2	Pattern B	Class C/2:30
3	Pattern C	Class A/90 points
4	Pattern D	Class A/75 points
5	Pattern E	Class B/20 points
6	Pattern F	Class B/10 points
7	Pattern G	Class A/88 points
8	Pattern H	Class A/65 points

Your Team score

Class C 2:30

Contents



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3. International Rounds

End of June (right after Preliminary Round)

4. Programming Skills Round

5. Final Round

Around September 2021

2. Program Development

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May 31st, 2021 23:59

3. Preliminary Round

July 1st ~20th,2021

1. Application

Due: May 16th, 2021 11:59pm

Note: Schedules may be changed due to unexpected reasons.

3. International Rounds

Programming Skills Round

Purpose

The winners of the Preliminary Rounds of countries/regions compete in simulation environment. The winner is awarded as Programming Skills Award and can advance to the Final Round. The number of Finalist teams is TBD.

Plan

・Same as Preliminary Round

1. Only one APK per team, with 8 random runs
2. Ranked by the worst result of 8 automatic runs
3. Same APK submitted for Preliminary Round will be used. No modification after submission.

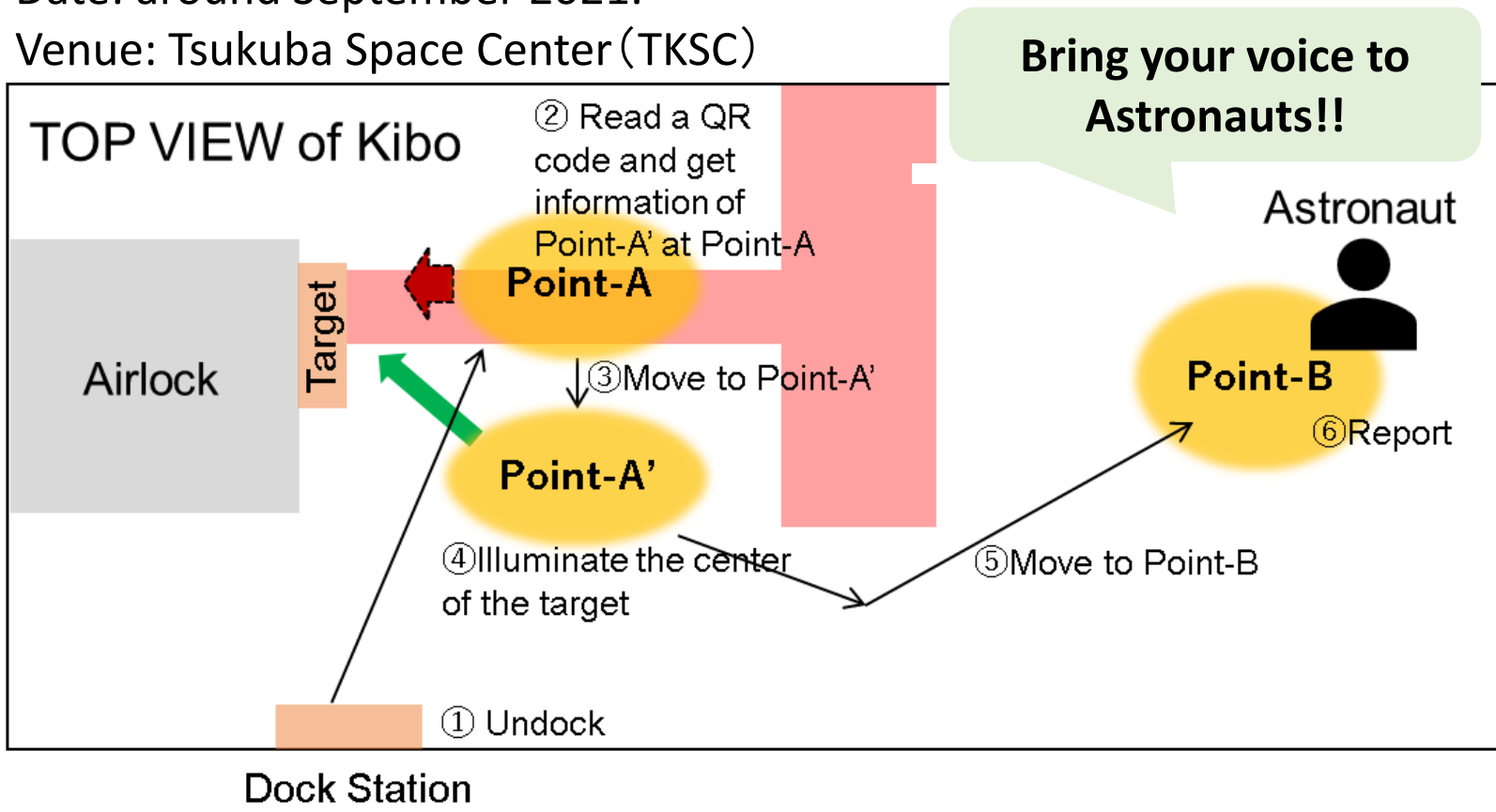
・Difference with Preliminary Round

1. Random conditions will be changed at JAXA's server.

3. International Rounds

Final Round

We will uplink and install your APK in a real Astrobee on ISS!
Date: around September 2021.
Venue: Tsukuba Space Center（TKSC）



We will notify the due date of Flight APK submission.

3. International Rounds

Difference between simulation environment and real environment

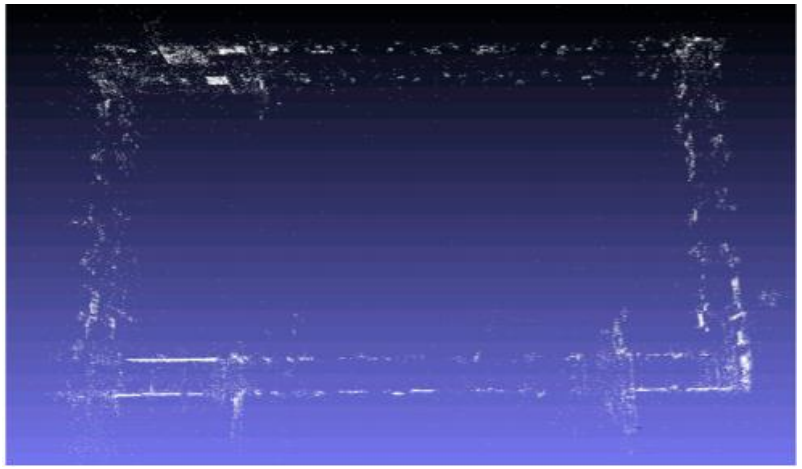
Tip for Final Round

✓ Self-localization Accuracy

<u>Sparse Mapping</u>

1. Collect images of the Kibo interior in advance and create a Map
2. Estimate self-location by comparing the image taken by the camera during flight with the map.

Cannot estimate self-location if features are too small.



https://www.nasa.gov/sites/default/files/atoms/files/coltin2016localization.pdf

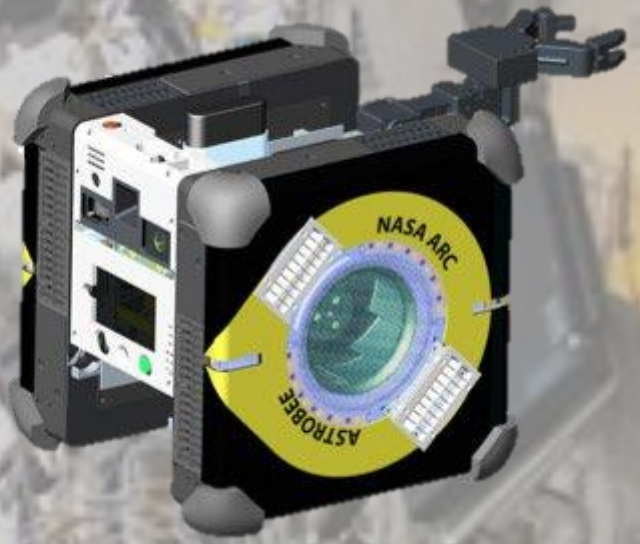
3. International Rounds

Rules of Final Round

1. **Eligibility**
   - The winners of the Preliminary Round/Programming Skills Round
   - Teams who submitted APK by the designated date.
2. **Only one APK , only one run**
   One time shot! No automatic multiple runs.
3. **The Time limit 5 minutes per team**
   If it exceeds 5 minutes, APK will be automatically terminated.
4. **Raked by one time accuracy and speed**
   Unlike previous rounds, there is no worst score out of multiple runs. The score is given by the accuracy and speed of one run. Beware of the difference of simulation–real environment.

For more detail, please refer to the Rule Book on our portal site.

Contents



4. Important Notes for Programming

Make Preparation

※APK(Android application PacKage)

1. Check the specifications of your computer

- 64bit processor
- 4 GB RAM (8 GB RAM recommended)
- Ubuntu 16.04 (64-bit version) or Windows 10 (64-bit version)

2. Install Android Studio

Install Android Studio from Android developer site
Ubuntu only【openJDK8】,【ADB (Android Debug Bridge)】,【Gradle】must be installed

3. Download additional components for Android Studio

Download additional components to build the program

4. Download the Template APK from the Kibo-RPC web page

Template APK is an Astrobee program area that participants cannot create.
It was prepared in advance by JAXA.

※Refer to the Programming Manual for details.

The simulator does not work properly without template APK.

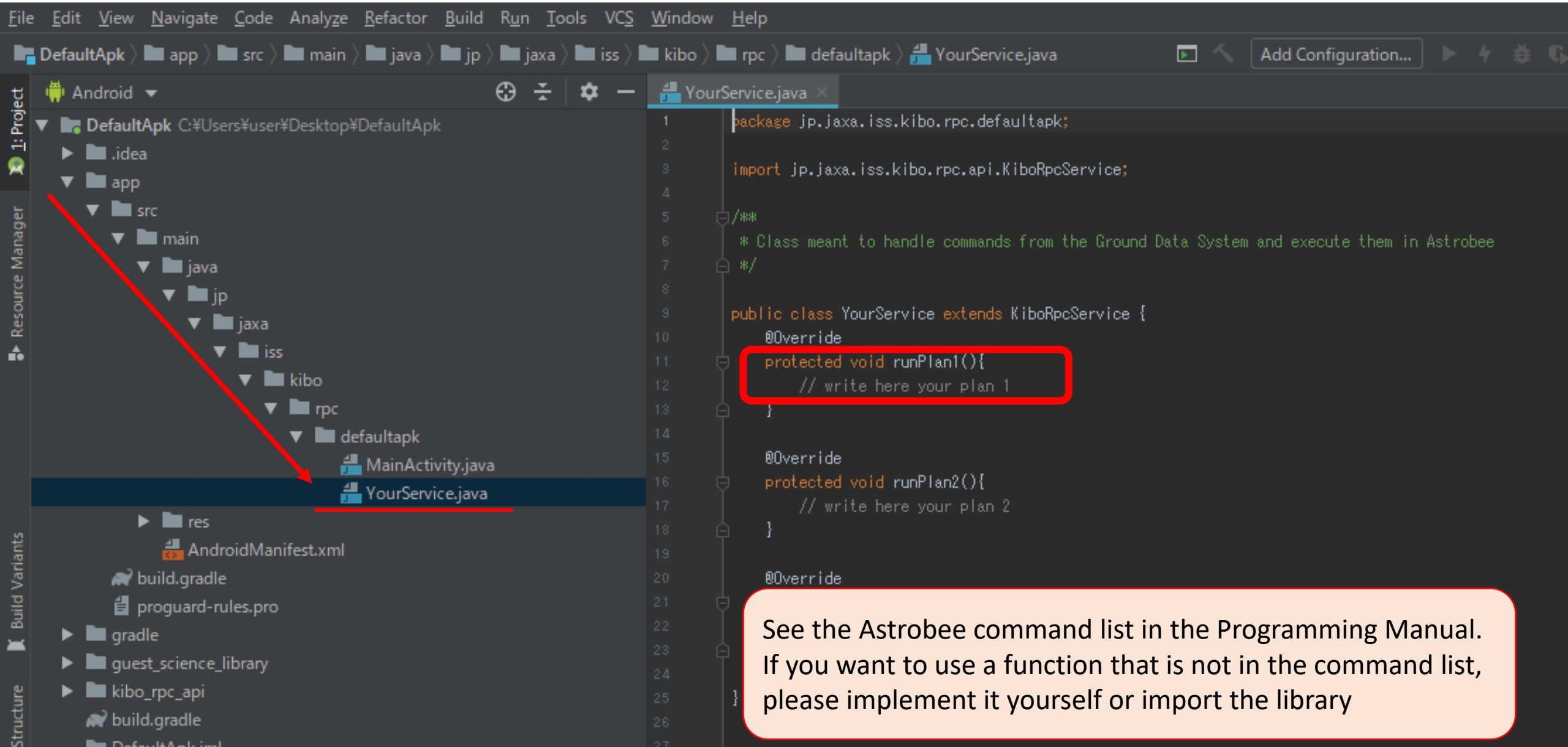
4. Important Notes for Programming

Program Creation Process

1. Create a program

Create programs on your own PC (java language)

4. Important Notes for Programming



4. Important Notes for Programming

Program Creation Process

1. Create a program

Create programs on your own PC (java language)

2. Upload APK to JAXA server

Kibo Robot Programming Challenge

What's New

HOME

Kibo-RPC
Kibo Robot Programming Challenge

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PROGRAMMING MANUAL | RULEBOOK

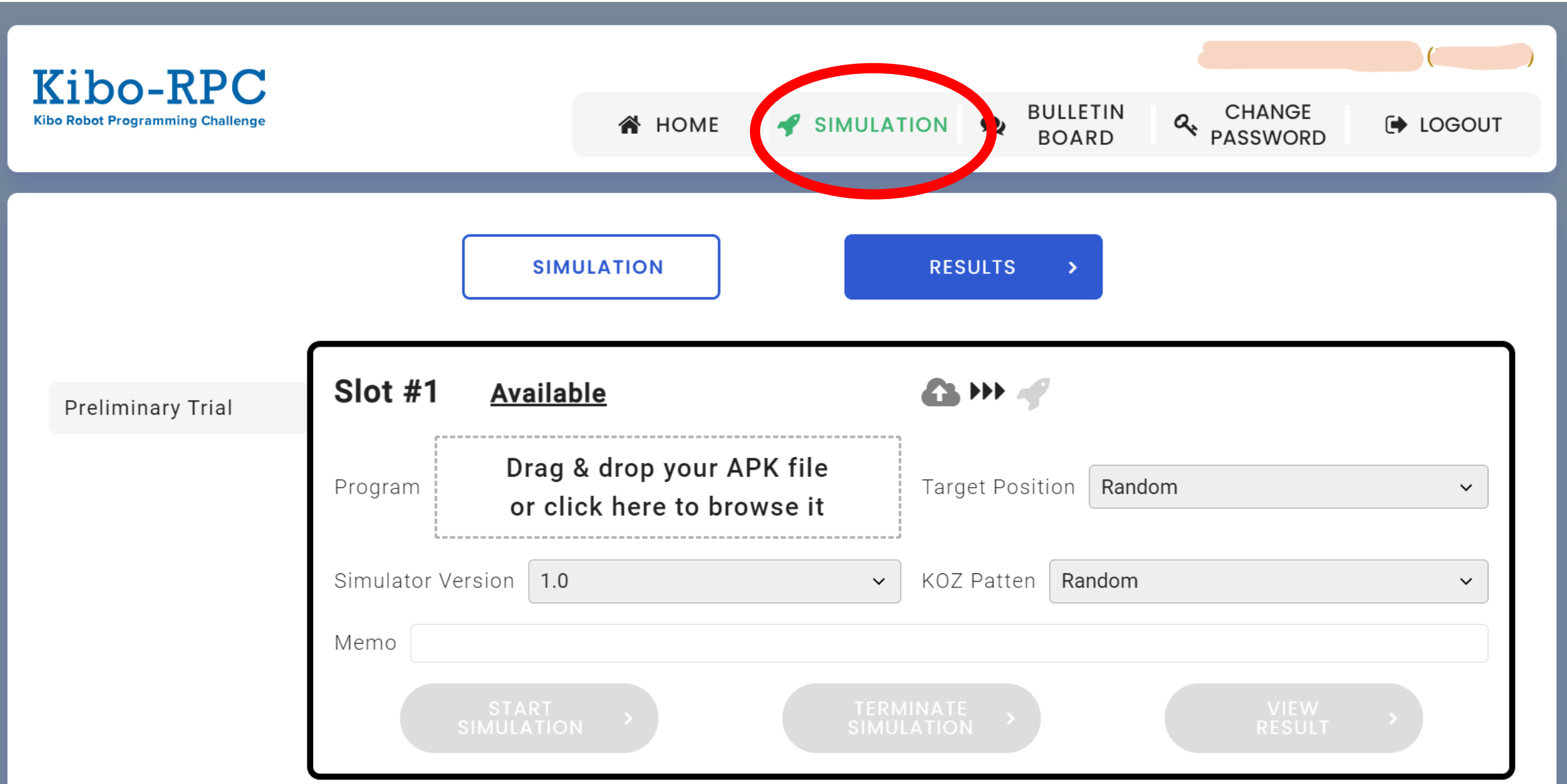
Simulator Issues

No.	Title	Details
1	[Under Investigation] Undock failure	Occasionally, Astrobee fails to undock. • [Apr 01, 2021] We are investigating this failure. If Astrobee fails to undock, Our Web Simulator automatically restarts the simulation.

Preliminary Round Info

Comming soon...

SIMULATION


Kibo-RPC
Kibo Robot Programming Challenge
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SIMULATION
BULLETIN BOARD
CHANGE PASSWORD
LOGOUT
SIMULATION
RESULTS
Preliminary Trial
Slot #1
Available
Program
Drag & drop your APK file
or click here to browse it
Target Position
Random
Simulator Version
1.0
KOZ Patten
Random
Memo
START SIMULATION
TERMINATE SIMULATION
VIEW RESULT

4. Important Notes for Programming

Program Creation Process

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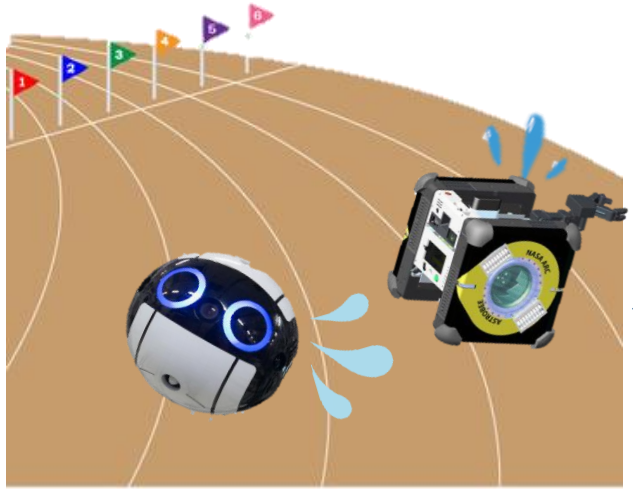
2. Upload APK to JAXA server

3. Run the program



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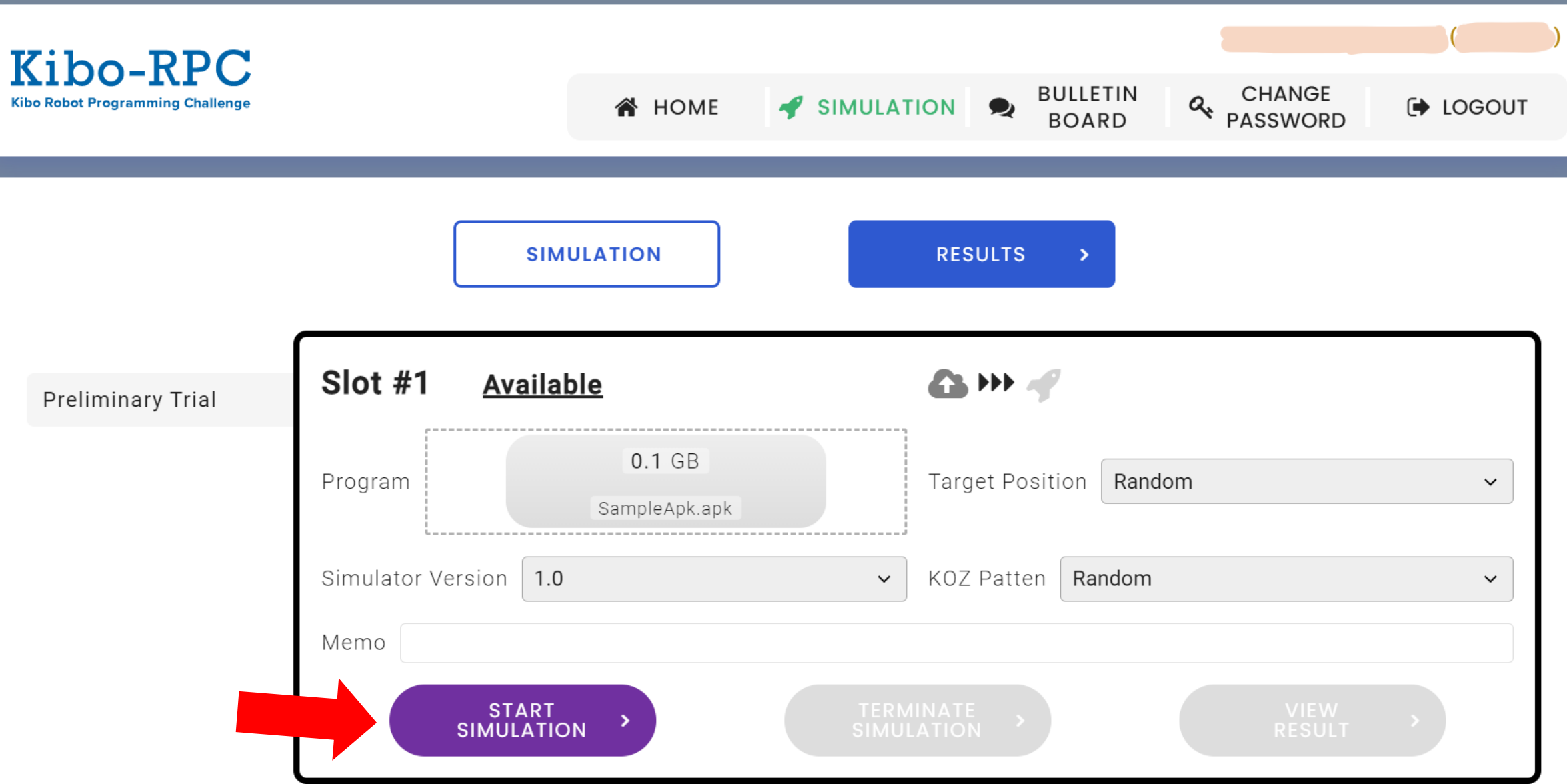

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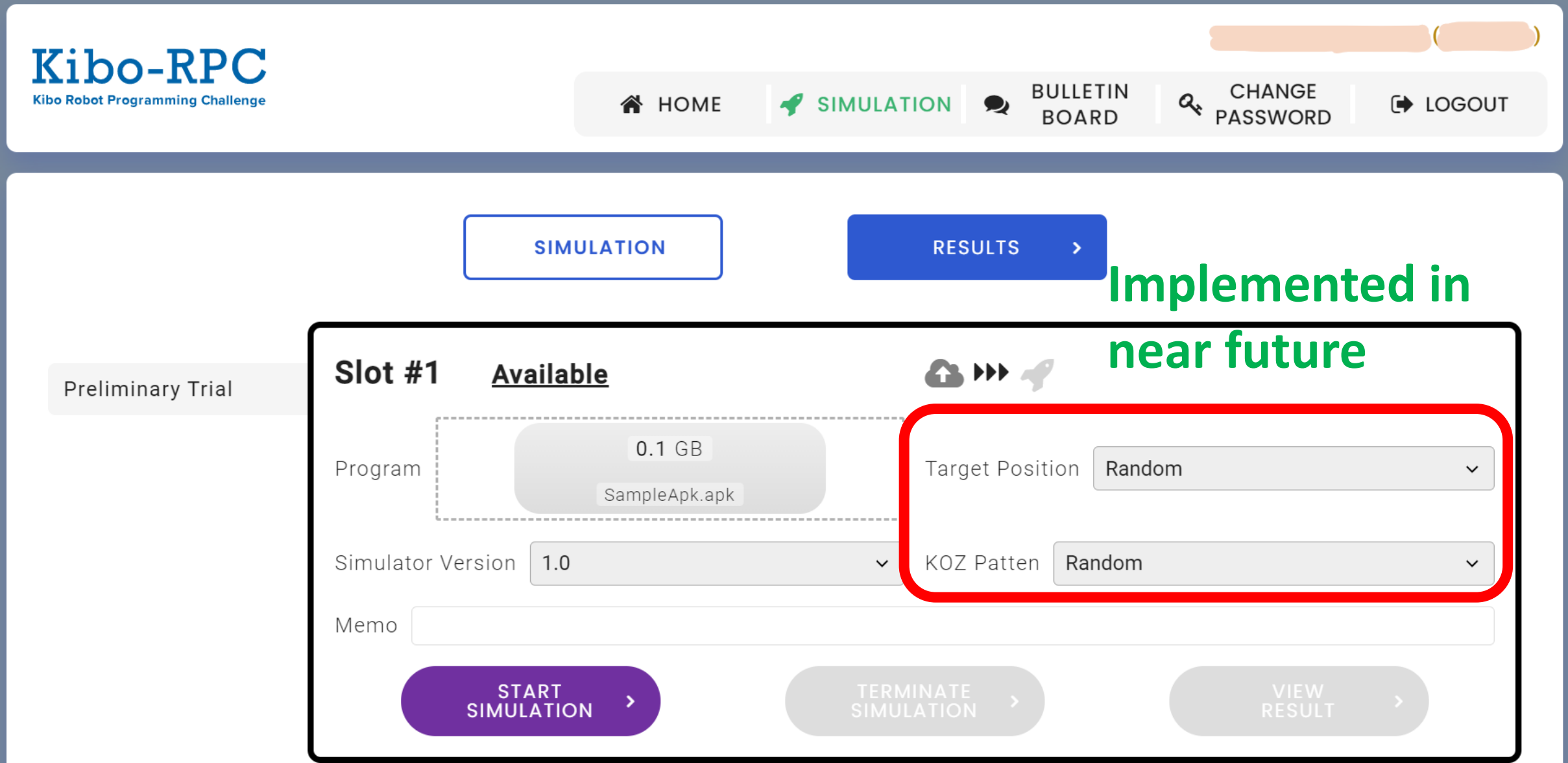

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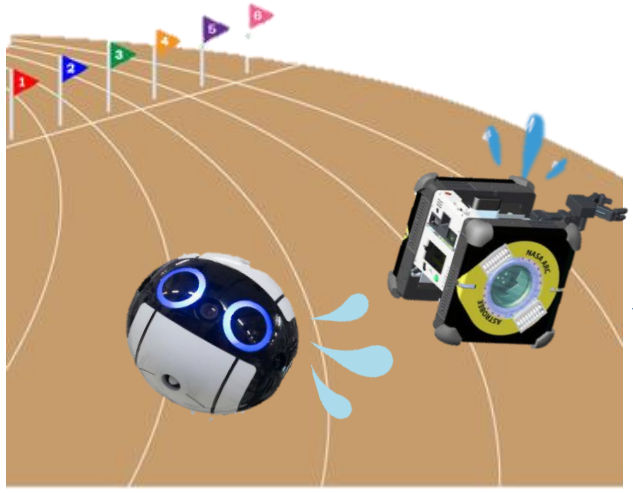
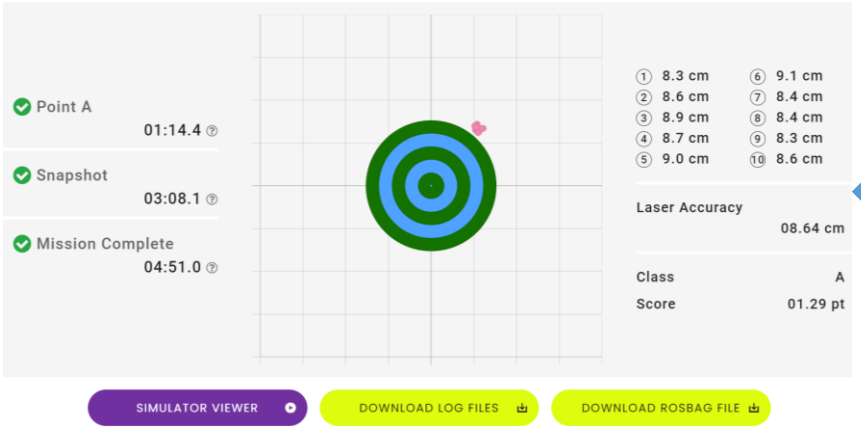


4. Check the result



4. Important Notes for Programming

Kibo-RPC
Kibo Robot Programming Challenge

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SIMULATION › RESULTS

Phase: Preliminary Trial Country/Region: Teams:

Executed	Status	Class	Score	Memo	
2021-03-27 05:20:44	Terminated	--	--	rrrr	VIEW REMOVE
2021-03-27 03:49:54	Terminated	--	--	testtest	VIEW REMOVE
2021-03-22 12:35:12	Finished	A	01.29 pt	dummy	VIEW REMOVE
2021-03-22 08:08:43	Failed	--	--	zzzz	VIEW REMOVE
2021-03-22 05:42:27	Terminated				VIEW REMOVE

※The data can only be saved for up to 20 results

4. Important Notes for Programming

Kibo-RPC
Kibo Robot Programming Challenge

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SIMULATION › | RESULTS

Phase: Preliminary Trial | Country/Region: [redacted] | Teams: [redacted]

Executed	Status	Class	Score	Memo	
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Kibo-RPC
Kibo Robot Programming Challenge

[redacted]

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BACK

Simulation Result

Status	Finished	Executed	2021-03-22 12:35:12
Team	[redacted]	Country/Region	[redacted]

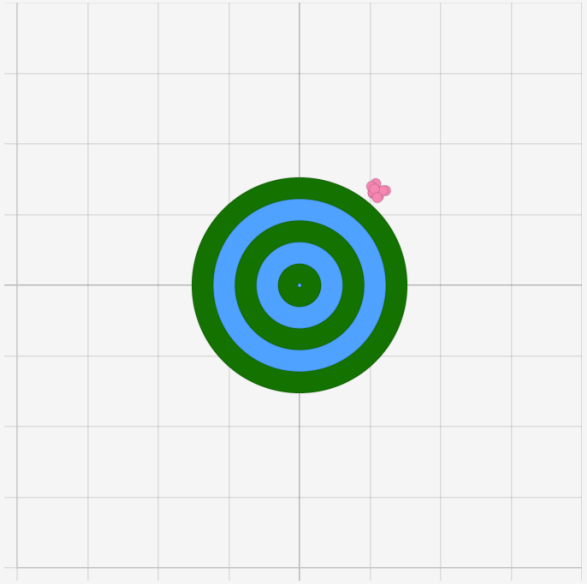
APK	SampleApk.apk		
Phase	Preliminary Trial	Target Position	Random
Simulator Version	1.0	KOZ Pattern	Random

Memo	dummy

Point A
01:14.4

Snapshot
03:08.1

Mission Complete
04:51.0



1	8.3 cm	6	9.1 cm
2	8.6 cm	7	8.4 cm
3	8.9 cm	8	8.4 cm
4	8.7 cm	9	8.3 cm
5	9.0 cm	10	8.6 cm

Laser Accuracy
08.64 cm

Class A

Score 01.29 pt

SIMULATOR VIEWER | DOWNLOAD LOG FILES | DOWNLOAD ROSBAG FILE

Kibo-RPC
Kibo Robot Programming Challenge

[redacted] ([redacted])

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BACK

Simulation Result

Status	Finished	Executed	2021-03-22 12:35:12
Team	[redacted]	Country/Region	[redacted]

APK	SampleApk.apk		
Phase	Preliminary Trial	Target Position	Random
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Memo	dummy

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01:14.4

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Mission Complete
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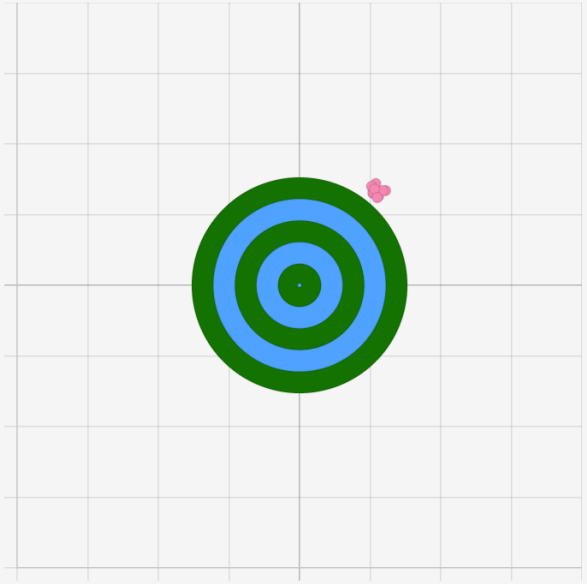


①	8.3 cm	⑥	9.1 cm
②	8.6 cm	⑦	8.4 cm
③	8.9 cm	⑧	8.4 cm
④	8.7 cm	⑨	8.3 cm
⑤	9.0 cm	⑩	8.6 cm

Laser Accuracy
08.64 cm

Class A

Score 01.29 pt

SIMULATOR VIEWER | DOWNLOAD LOG FILES | DOWNLOAD ROSBAG FILE

4. Important Notes for Programming

About scoring

Scoring results based on mission achievement

Class / Check items	A	B	C	D
Found the QR code	Yes	Yes	Yes	No
Laser irradiation	Yes	Yes	No	No
Report Mission Completion	Yes	No	No	No

Calculated by laser irradiation accuracy and elapsed time

The earlier you find the QR, the higher your score.

4. Important Notes for Programming

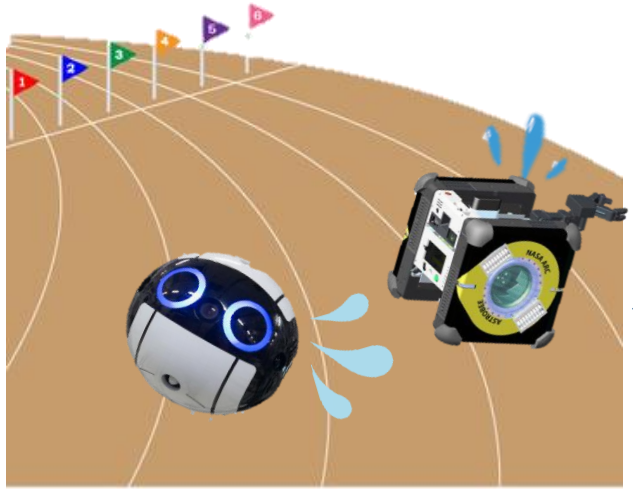
Program Creation Process

1. Create a program

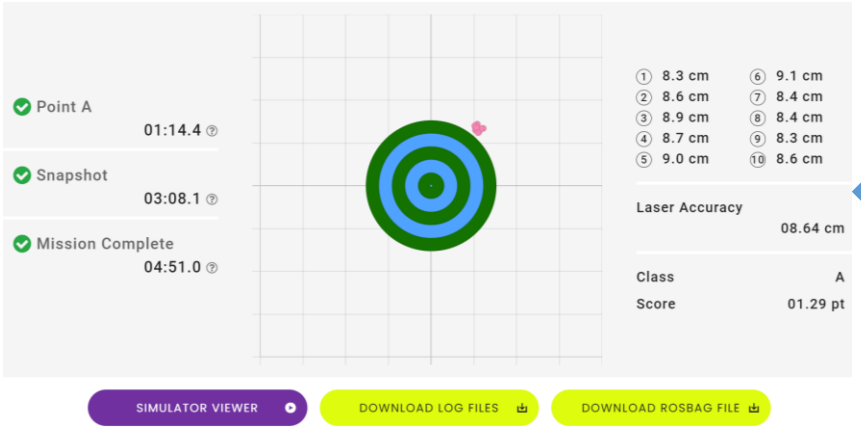
Create programs on your own PC (java language)

2. Upload APK to JAXA server

3. Run the program



4. Check the result



Trial and error

Feedback

4. Important Notes for Programming

How to submit the APK

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Kibo Robot Programming Challenge

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SIMULATION › | RESULTS

Phase: Preliminary Trial | Country/Region: [redacted] | Teams: [redacted]

Please submit your APK for Preliminary Round before May 31, 2021, 11:59 PM JST.

Executed	Status	Class	Score	Memo			
2021-03-27 05:20:44	Terminated	--	--	rrrr	VIEW	REMOVE	SUBMIT
2021-03-27 03:49:54	Terminated	--	--	testtest	VIEW	REMOVE	SUBMIT
2021-03-22 12:35:12	Finished	A	01.29 pt	dummy	VIEW	REMOVE	SUBMIT

The Submit button is enabled only for Status [Finished].

4. Important Notes for Programming

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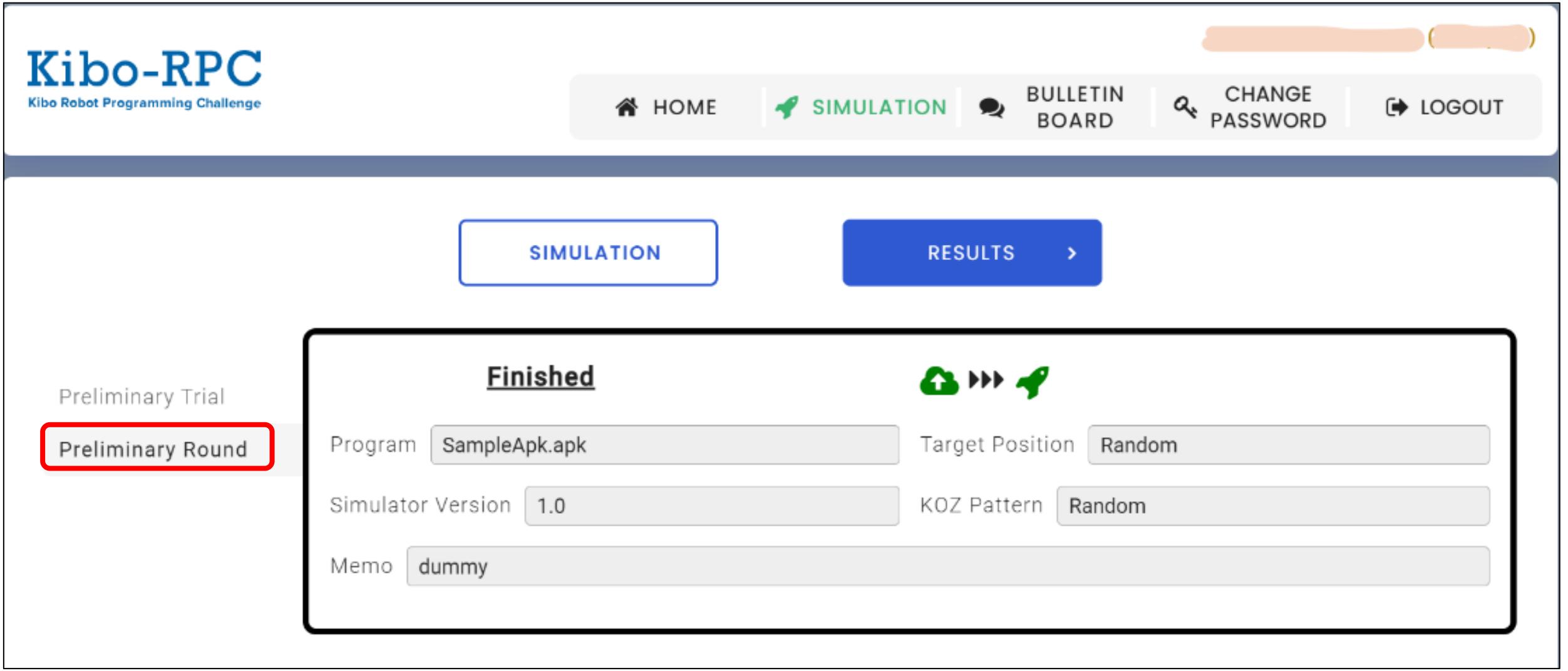

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- JAXA will not be liable for any problems that may occur in the use of the Bulletin Board System.
- You must guarantee that your post does not violate any legal rights or obligations, such as intellectual property or export control, as applicable. If a legal problem related to the submitted information arises, the applicant will take full responsibility to solve the problem.
- DO NOT use this system for purposes other than those related to Kibo-RPC.
- DO NOT post any personal information.
- If a post is deemed inappropriate, the secretariat may delete it without notice.
- DO NOT attach huge files. The maximum file size is 10 MB.

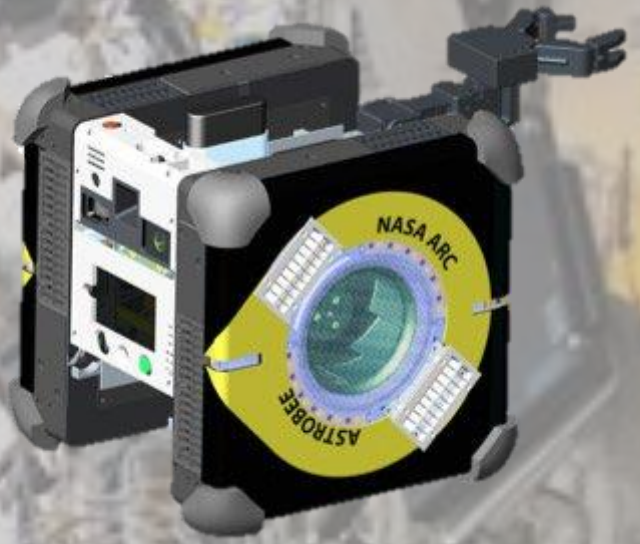
Forums

Create Forum Reload

Forum Name	Description	Topics	Created	Last Posted	
Announcement from the secretariat	Announcement and notification from the secretariat about the 2nd Kibo-RPC. Participants can view only.	1	2021-04-06 08:39 by aes_fujitaka	2021-04-06 08:43 by aes_fujitaka	Update Delete
Program creation tips	Sharing technical tips and/or questions-answers about the program creation with other participants. Basically, please try to solve the problem with each other participants.	0	2021-04-06 08:44 by aes_fujitaka		Update Delete
Misc. topics	Participants can create threads as they like and then socialize through KRPC events and/or general topics.	0	2021-04-06 08:45 by aes_fujitaka		Update Delete
Reporting simulator Issues	Please use it when participants report problems that occur in the simulator environment.	0	2021-04-06 08:45 by aes_fujitaka		Update Delete


Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
DEBUG: NavCam
DEBUG: DockCam
dock/berth2/approach
dock/berth1/approach
Reset
31 fps

Contents



1. 2nd Kibo-RPC Overview
2. Preliminary Round
3. International Rounds
4. Important Notes for Programming
5. FAQ

5. FAQ

Q1 : Can I make a good program even if I am a beginner?

A1 : Yes, you can. In the 1st Kibo-RPC, there were many participants who were new to programming itself and never used the Java language. You may ask your questions to participants from all over the world by using the participant bulletin board.

Q2 : You recommend java, what kind of programming did you use in the last competition?

A2 : The design of Astrobee requires that programs to be developed in Java language only.

Q3 : What kind of program should I focus on (image processing, actuator control, etc.)?

A3 : The program to be created is mainly for trajectory planning (3D coordinate and attitude calculation) and image processing. No control of the actuator system is required.

2nd Kibo Robot Programming Challenge

Guidance Session

Thank you for your attention.
We are looking forward to your participation.

2nd Kibo-RPC URL : https://jaxa.krpc.jp/index_ja.html

1st Kibo-RPC Final Round video : https://www.youtube.com/watch?v=UhTz_ukm1cE&t=3070s

For more videos, please search YouTube "kibo robot programming challenge“.

Kibo-RPC Secretariat : Z-Kibo-RPC@ml.jaxa.jp