# IDC Robocon 2022



# Harness the River

## Background

Throughout the world history, dealing with water bodies has always been an essential matter. For thousands of years Chinese people have been striving to prevent rivers and lakes from flooding their homes, as well as making the best use of them in irrigation, transportation and much more.

The story of "Dayu flood control (2000BC)" is well known in China. It is about his battle against flood of Yellow River. The story tells us that the flood can not be blocked but can only be guided or steered along its proper course. This ancient wisdom is also effective in today.



Figure 1. The story of Dayu flood control (2000BC)

"Li Bing flood control (256BC)" is also famous by Dujiangyan project, an irrigation project in Sichuan province of China. Dujiangyan is built by Li Bing and his son. As shown in Figure 2, "Fish mouth", "Flying-sand dyke" and "Precious-bottle-neck" are the important three parts of Dujiangyan. At "fish mouth", the Minjiang river is divided into inner and outer streams. The inner river is for irrigating the fields, which made the western Sichuan plain rich. The inner river bed is narrower and deeper than that of the outer river. Therefore Dujiangyan can automatically adjust the amount of irrigation water to outer river by 6:4 and 4:6 during the dry and rainy seasons respectively, without using a dam but balancing water not to overflow.

Dujiangyan Project is effective more than 2200 years.

The theme and the logo of IDC Robocon 2022 is inspired by Dujiangyan irrigation project.
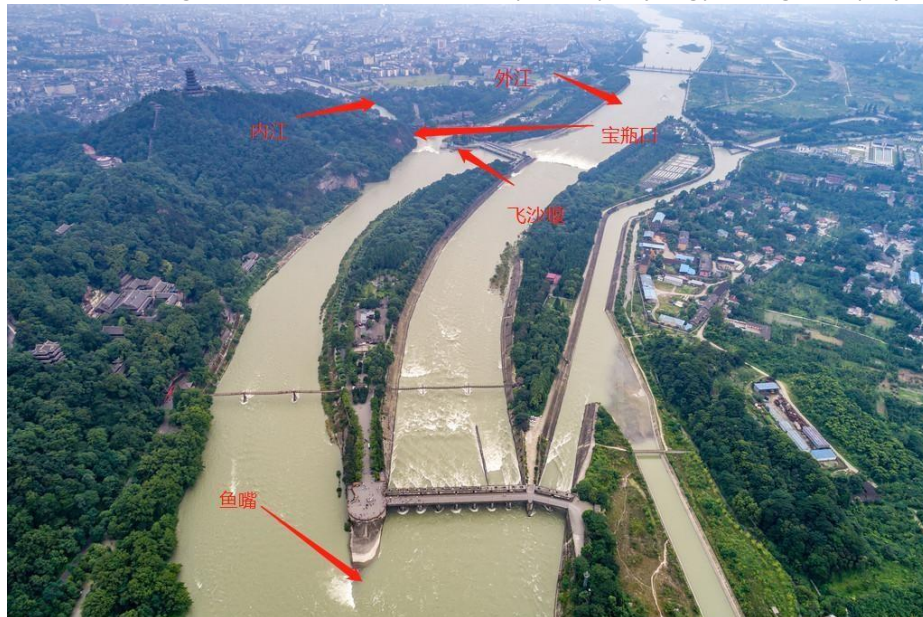


Figure 2. Dujiangyan irrigation project (256BC)

## Objective

In the contest, participants will design and build robots for two river-taming approaches: a) transporting materials for the construction of a dam; b) planting trees to prevent soil erosion, which raises river beds and increasing the risk of flooding.

The aim of the game is to harness the river.

## Game Field

As shown in Figure 3, There are 2 starting areas whose size in unity is 2 x 2(be regarded as 50cm x 50cm in reality) for each team, and there are one glass land, one planting area and one slope block on each side of the field, which is divided by the river. Your robot car can use the slope block to get onto the top of the dam.
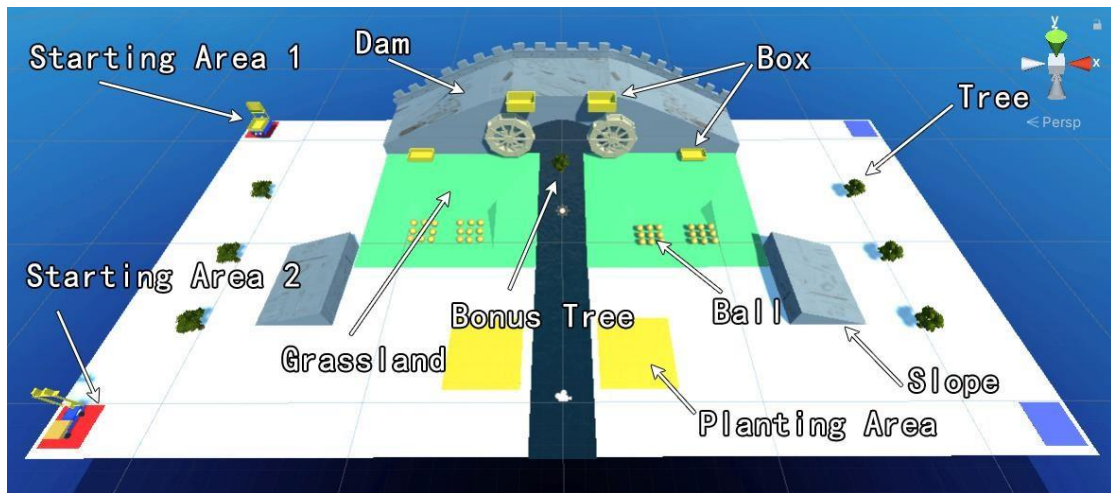
Figure 3. Game field of IDC Robocon 2022

## Scoring

Scoring rule is mainly described in two parts. Participants control their robots to delivery balls to the boxes, or plant trees onto the planting areas. For every ball put into the lower box, you get 10 points. For the higher box you get 30 points for each ball. For every tree that remains standing in the planting area, you get 30 points. You will not get any points if the tree topples over, though there are no penalties either. In the middle of the river there is a bonus tree that will start to move downstream when the match has started for 60 seconds. Successfully planting the bonus tree onto the planting area will add 30 points and double the total points of your team. The balls and trees must not touch your robot at the end of the game, otherwise it will not be regarded as a score.

For each team, initially 18 balls are set in the grassland and 3 trees are set.

## Rules & Regulations

### General Principles

a)   The rules are intended to create opportunities to learn engineering on the simulated cyber-space.

b)   The participants are expected to innovate and test new ideas on the robot design.

### Specifications of Equivalent Actuators

| Actuator | Min-Max Force [N] | | Min-Max Torque [Nm] | | Weight[kg] |
|---|---|---|---|---|---|
| Bosh Motor (1d.o.f) | - | - | -5 | +5 | 0.2 |
| Air Cylinder (1d.o.f) | -20 | +30 | - | - | 0.05 |
| DC Motor (1d.o.f) | - | - | -0.06 | +0.06 | 0.05 |
| Sky Engine (4d.o.f) | -20x4 | +20x4 | - | - | 1.3 |

## Timing and Regulation

a) Each round of the contest is 120 seconds long. After that period, you can not control robots.

b) Robots must start in starting area 1 or 2 on your own side with touching the level floor.

c) Starting area 1 is for ball transportation, while starting area 2 is for planting trees. Interfering with the tasks of other participants (including your teammate!) may cause serious lagging, so make sure that you choose the correct starting area.

d) After entering the field, you can test your robot and adjust its starting position (Your robot can't go beyond the starting area.). Click the "Ready" button when you are prepared. The match will automatically start after all participants are ready.

e) Robots are not allowed to enter the river, otherwise the robot may get stuck in the river and have to restart. Once your robot enters the river, you can no longer manipulate it to move the bonus tree, otherwise the score of the bonus tree will not be recognized and some score will be deducted.

## Winning & Advancing

a) The contest consists of seed match, group match and the final tournament.

b) Groups are determined by the scores of seed match.

c) In group match, there are three teams in each group, and the top team of the group will advance to the final tournament. For teams that tie for wins in a group, ranking will be made according to the total score.

d) The final tournament is a single elimination tournament.

e) If a match is finished in a tie, a set of tie-breaking rules will be used in the following sequence: 1) the team that has successfully planted the bonus tree in the planting area wins; 2) the team with more balls in the higher box wins; 3) the team that has successfully planted more trees in the planting area wins.

## Control

a) Players must control their own robots.

b) You can control your robot manually by devices such as keyboards and game pads, or control it automatically with your own code.

c) Contestants may not deliberately interfere with the control of opposing players.

## Robot Configuration

a) Rigidbody: the rigidbody components in your robot must be in its default settings, which means that it should use gravity, is not kinematic, and you can not freeze its position or rotation on any axis.

b) Materials: the properties of colliders and and their physical materials must not be changed.

c) Camera: Camera view can be changed.

d) Control unit: your robots must be actuated by the actuators provided, including Bosh motor, DC motor, air cylinder and sky engines. Control commands must control only the actuator output, e.g., you can not directly change the position, rotation and velocity of objects by control commands. You can use the status of objects as input for your control, e.g., using the

position of your robot as input for a feedback mechanism. You can totally use up to 8 Bosh motors, 4 DC motors, 4 air cylinders and 1 sky engine in two robots. You can not change the maximum force or torque of the actuators. Scripts for these actuators are provided. Please refer to the Instruction for more details.

e) Size and weight: the entire robot must fit in the starting area, which is 50cm * 50cm (the height is not limited). You can use approaches such as folding to fit your robot inside. Your entire robot must weigh less than 5kg.

f) Total execution time: robots should be controlled smoothly. Number of mesh colliders, faces of your mesh, and the complexity of your code will affect your execution time. In order to avoid lagging you should not make them too large.

g) Submission: prefabs of your robots must be sent to the IDC staff 2 days before the contest. If you use anything that isn't provided by the IDC staff, e.g., scripts, prefabs, materials, you need to send them with your robot. You should name your things so that they start with your team number, and A for robots in starting area 1, B for robots in starting area 2. e.g., 0A_motor_control, 0B_material1, etc. You should also send a technical document that briefly describes the scripts you have used and their position in the robot.  Please fully test your robots before submitting to ensure that they can run correctly In *Multiplayer* mode on a new project created by the provided unitypackage.

h) Program for contest: Before the contest IDC Robocon staff will send each team the same program for the contest, which includes the robots of all teams. Please fully test your robots in this program. If there is any abnormality, please contact the staff.

## Sporting Conduct & Safety

a) Damaging, overturning, pushing, pulling, lifting, and deliberately blocking an opponent's robot is not allowed.

b) Once scoring is accomplished, it cannot be reversed by defensive actions (e.g., taking a ball out of the box), but additional scoring can be prevented.

c) Using malware, making use of bugs, or any other action that causes the program to malfunction is prohibited.

d) Any person may not directly affect the motion of the robots or anything else in the field.

e) Any robot component or object that leaves the field can not be used.

f) All robots must be entirely in the starting area at starting time.

g) Net or other entanglement devices are not permitted, but other defensive devices are generally permitted.

h) Only free assets are allowed. If you use other people's scripts, you need to inform others in your code and document.

i) During the match, colliders and mass can not be changed.

j) After the time limit, the referee will judge the winner of the match according to the rules as mentioned.

k) NO POLITICAL MESSAGES ON THE ROBOTS.

l) THE JUDGES' DECISIONS ON SAFETY MUST BE RESPECTED AND OBEYED PROMPTLY.

## General Enquiries

a. General questions may be posted on the board of core-time meeting room.

b. IDC Robocon staff (please see list of Faculty and Technical Staff contacts) will answer your questions.

c. All official sanctioned rule interpretations will be made by participating faculty and referees.

d. The key decisions will be discussed daily by the IDC Robocon staffs. Rules and properties of the game field may be changed based on the discussions.

e. The questions and answers will be also archived and distributed to the contestants through the team contactor.