

RoboCupRescue Robot League 2022

Summary of Competition Organization and Logistics

Version 20220208

Subject to change, please visit our website for the most up-to-date version.

<https://rrl.robocup.org>

League Organization

Trustees:

Raymond Sheh, USA/Australia (1st Term) (2022-2024)

Jackrit Suthakorn (*Emeritus* 2016-2021)

Adam Jacoff (*Emeritus* 2009-2015) (*Co-Founder*)

Satoshi Tadokoro (*Emeritus* (2002-2008) (*Co-Founder*)

Executive Committee:

Jafar Chegini, Iran/Germany (2nd Term) (Exec 2019-2022)

Sören Schwertfeger, Germany/China (2nd Term) (Exec 2020-2023)

Tetsuya Kimura, Japan (2nd Term) (Exec 2020-2023)

Ann Marie Virts, USA (1st Term) (Exec 2022 - 2024)

Raymond Sheh, USA/Australia (*Emeritus*)

Johannes Pellenz, Germany (*Emeritus*)

Gerald Steinbauer, Austria (*Emeritus*)

Ehsan Mihankhah Iran/Thailand (*Emeritus*)

Andreas Birk, Germany (*Emeritus*)

Claude Sammut, Australia (*Emeritus*)

Adam Jacoff, USA (*Emeritus*)

Satoshi Tadokoro, Japan (*Emeritus*)



League Organization

Technical Committee:

Masayuki Okugawa, Japan (1st Term) (TC 2019-2022)

Martin Oehler, Germany (1st Term) (TC 2020-2023)

Xieyuanli Chen, China (1st Term) (TC 2020-2023)

Archer Losely, USA (1st Term) (TC 2022-2024)

Local Chairs:

Peerapat Owatchaiyapong (Thailand)

Branesh M. Pillai (Thailand)

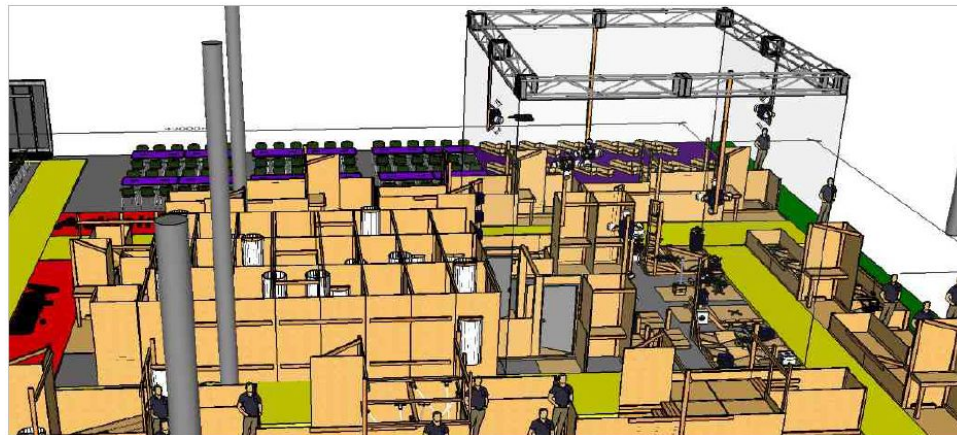
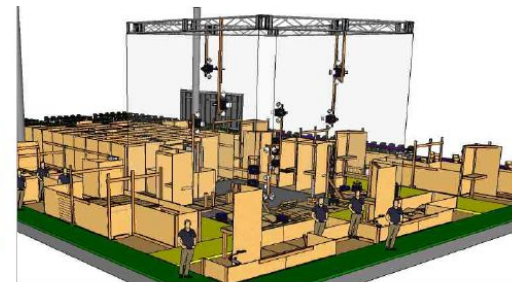
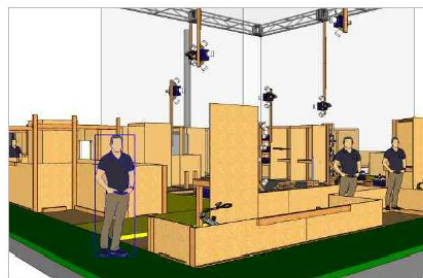
International Chair:

Adam Jacoff (USA)

Organizing Committee:

Johannes Pellenz (Germany)

Kamel Saidi (USA)



Contents:

- League Organization
- Other Documents
- Introduction of the League
- Important Dates
- Qualification Process Summary
- Competition Logistics, In Person and Remote Online
- Test Suites Summary
- Awards

Other Documents:

This presentation is one of four documents that describe the 2022 competition. The others are:

- Qualification Process (available now!)
- Rules Document (available soon!)
- Construction Guide (available soon!)

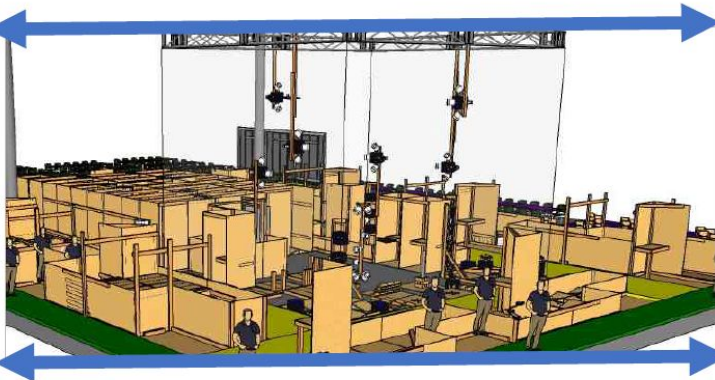
These are/will be made available at <https://rrl.robocup.org>. Join our mailing list and the forum (<https://rrl.forum.robocup.org>) to make sure you are kept up to date with any changes and additional information!

There are also documents for the RoboCupRescue Rapidly Manufactured Robot Challenge (RMRC) for Junior students. Please visit <http://rrl-rmrc.org> and join the mailing list at <http://group.rrl-rmrc.org> for further details.

Introduction of the League



Emergency responders need robots with assistive/autonomous capabilities to perform extremely hazardous tasks in complex environments from safe standoff distances.



Our arenas provide a tangible language between researchers, manufacturers, and emergency responders to refine, measure, and highlight breakthrough capabilities.



Introduction of the League

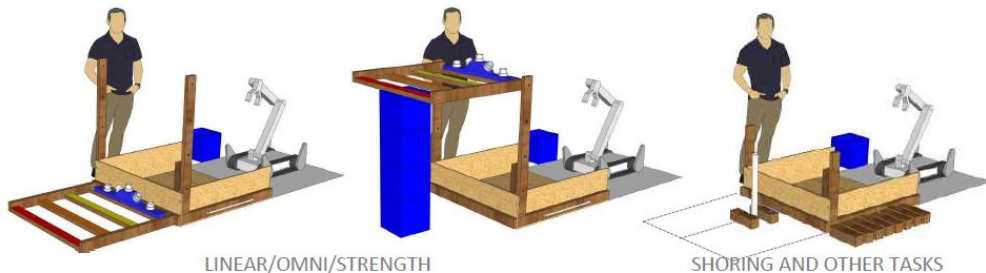
- Standard Test Methods facilitate communication between researchers, manufacturers, and responders.
- Responders and manufacturers learn about emerging technologies.
- Researchers learn about operational needs and gaps in capabilities.
- Local responders keep the tests after each competition to develop their own test facilities.



Introduction of the League

- Development and Validation of Standard Test Methods used worldwide by emergency responders.
- Evaluates robot capabilities of Mobility, Dexterity, Exploration, Mapping.
- Scales of 120 cm (48 in), 60 cm (24 in), 30 cm (12 in).
- Ground robots (including legged robots) and aerial drones.
- Individual and sequenced tests.

DEXTERITY TESTS



LEGGED AND AUTONOMOUS MOBILITY TESTS

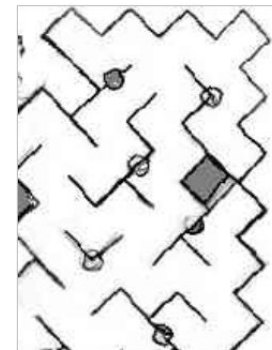


AERIAL DRONE PILOT PROFICIENCY TESTS



Introduction of the League

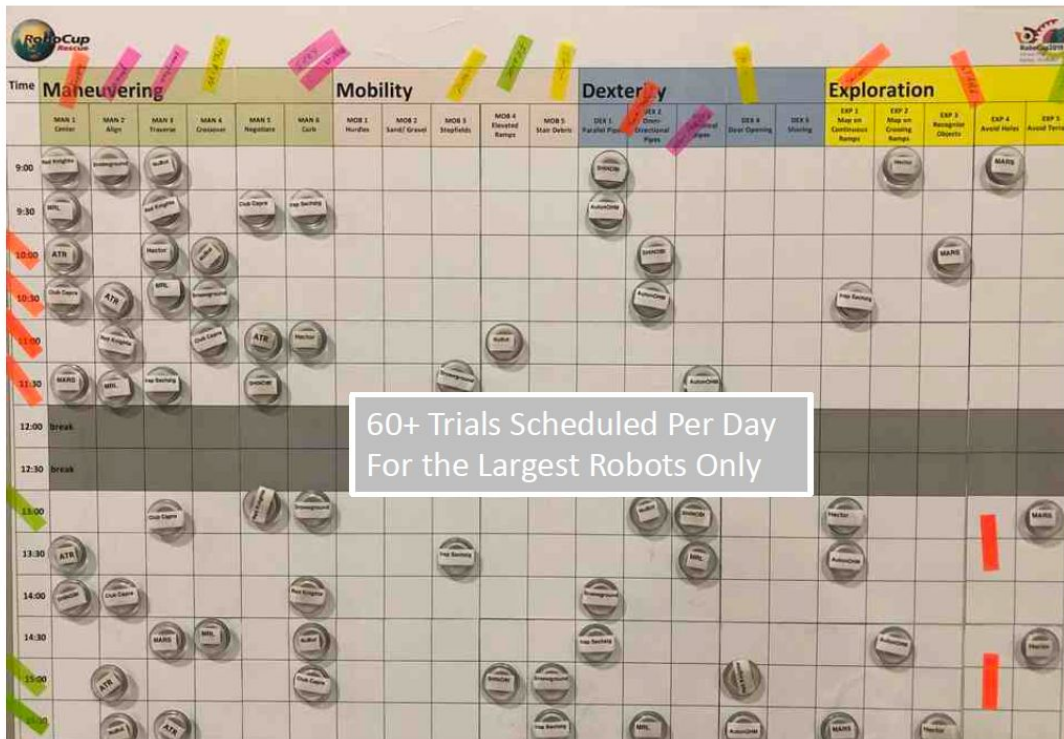
- Preliminary rounds consist of standard test methods, performed individually.
- Teams select which tests to run, with scores in each normalized to the best performer in that test.
- Best-performing teams qualify for the finals where tests are made harder and sequenced.
- Championship is awarded to best-performing team in the finals.
- Best-in-Class awards for best performance in specific suites during preliminary rounds.



More than 300 Test Trials Conducted in Every Competition

League Overview

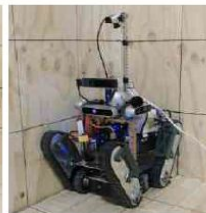
- RoboCupRescue has refined its massively concurrent scheduling of timed trials during three Preliminary days in individual tests.
- Teams proctor and score each other to practice conducting tests for their own team.
- Teams choose which tests they focus on to support their research goals.
- Teams participate evaluating their robots during all days but the Final day where the best teams conduct more difficult combined sequences of tests.
- This makes RoboCupRescue competitions astonishingly productive public evaluations with 300-400 test trials of data captured.



Robots Can Look Similar But Perform Very Differently

League Overview

Robots can have similar designs – success is often imitated. Or they can be very different. All need to be evaluated, compared, and differentiated based on statistically significant capabilities data.



Comparing Scores Across Various Suites of Tests

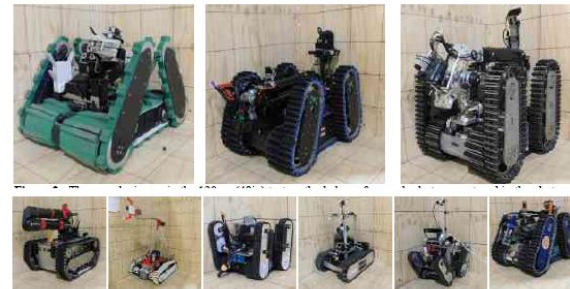
League Overview

Maneuvering (MAN 1-5) forward/reverse, control, awareness.

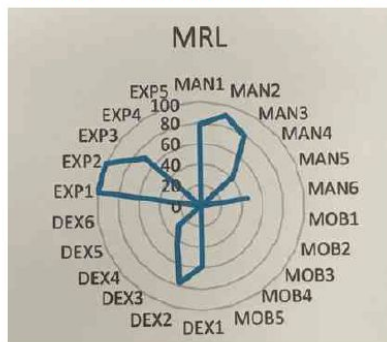
Mobility (MOB 1-5) advanced terrains and obstacles.

Dexterity (DEX 1-5) manipulator reach, strength, and tool use.

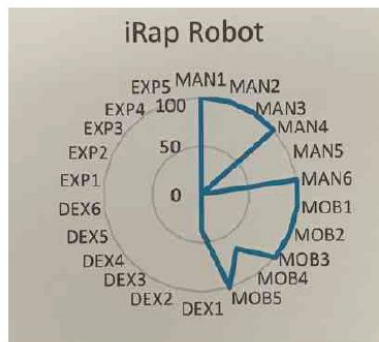
Exploration (EXP 1-5) 2D/3D mapping and autonomous behaviors.



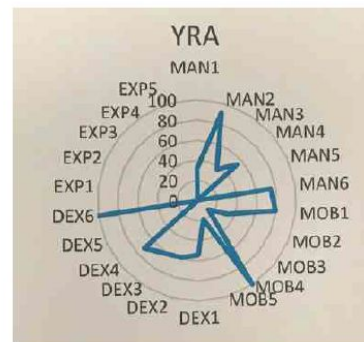
RADAR CHARTS FOR 20 TEST METHODS



Functional MAN, DEX, and EXP



Excellent MAN and MOB



Functional MAN, MOB, & DEX

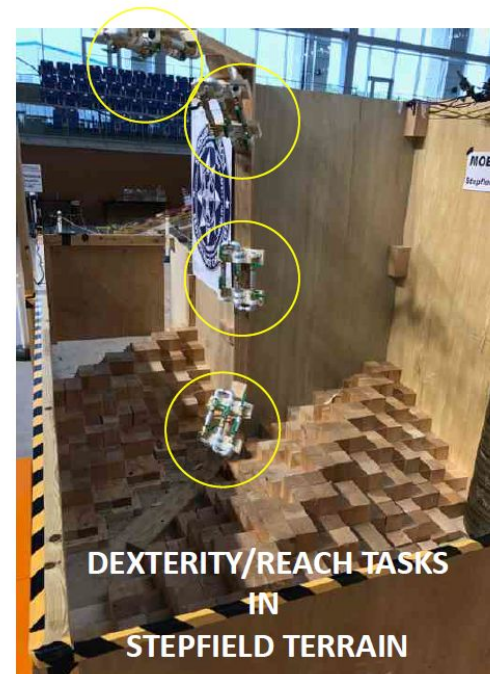
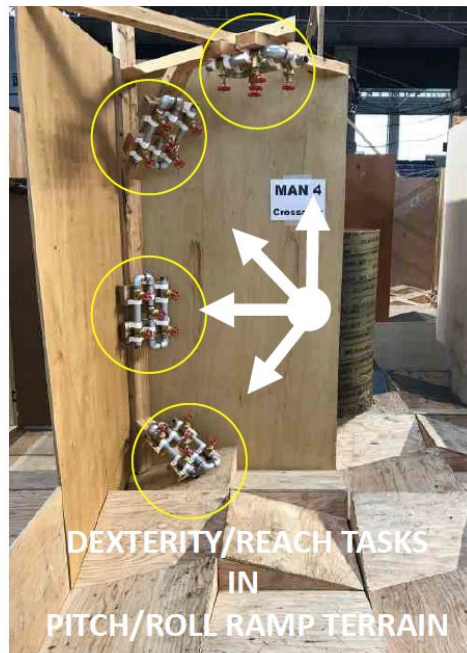
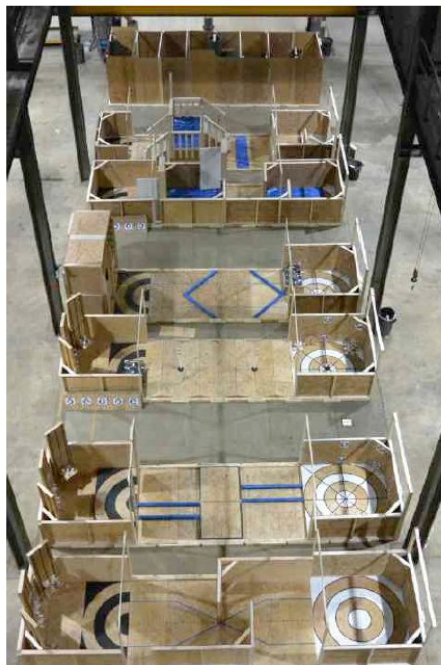


Excellent DEX, Functional MAN

Scales of Test Lanes: 120 cm (48 in) Wide

League Overview

- 120 cm (48 in) lateral clearance guaranteed.
- Lanes for maneuvering, terrains, and obstacles with dexterity tasks in the terrains to add complexity.



Scales of Test Lanes: 60 cm (24 in) Wide

League Overview

- 60 cm (24 in) lateral clearance guaranteed.
- Environments like dwellings, trains, busses, planes, or between parked cars, etc.



Scales of Test Lanes: 30 cm (12 in) Wide

League Overview

- 30 cm (12 in) lateral clearance guaranteed.
- Small throwable robots, potentially disposable, are deployed through access holes into large scale tests.
- Emphasis on 3D printed robots with effective designs that can be readily disseminated or improved.



Adding New Terrains for Legged Robots

Legged Mobility Tests



DIAGONAL HILL – SOLID STEPS



PYRAMID HILL – CHECKERED STEPS

Important Dates

This schedule is subject to change! Please join our mailing list (<https://rrl.robocup.org/contact/>) and forum (<https://rrl.forum.robocup.org>) to make sure you are kept up to date.

- For teams wishing to participate in-person (or in-person with remote fallback):
 - Friday March 4 - Team Description Papers (TDP) and Qualification Videos due. See Qualification presentation for further details.
 - Teams who submit late will be considered on a case-by-case basis.
 - Wednesday March 23 - Announcement of First Round Qualifying Teams (who don't have a regional open).
 - (To be announced) - Register for RoboCup.
 - (After final Regional Open) - Announcement of Second Round Qualifying Teams.
 - Monday July 11 - RoboCup starts.
- For teams wishing to participate remotely (or in-person with remote fallback):
 - (To be announced) - Register for RoboCup.
 - Sunday June 19 - Preliminary videos due.
 - Friday June 24 - Remote attestations due.
 - Monday June 27 - Remote Best-in-Class finals teams announced.
 - Monday July 4-8 - Remote Best-in-Class finals (live on telecon).

Qualification Process Summary

For in-person competition:

- Team Participation Form (TPF) to declare intent to participate (**NOW**).
 - See <https://rrl.robotcup.org/forms-guides-labels/> for TPF and TDP details.
- Team Description Paper (TDP) describing their entry (March 4).
 - Most teams will need to include videos of their robot doing tests from at least 2 suites.
 - There will be a **best** TDP award. You may update your TDP for the best TDP award any time up until June 27th.
- Regions with many teams should go to the local Regional Open, from which the best teams from the region will be selected.

For online competition:

- All teams welcome, TPF encouraged but not required.
- Teams must submit a TDP when they submit their preliminary video package.
 - There will be a **best** TDP award. You may update your TDP for the best TDP award any time up until June 27th.

Please see separate Qualifications presentation for further details!

Summary of competition logistics

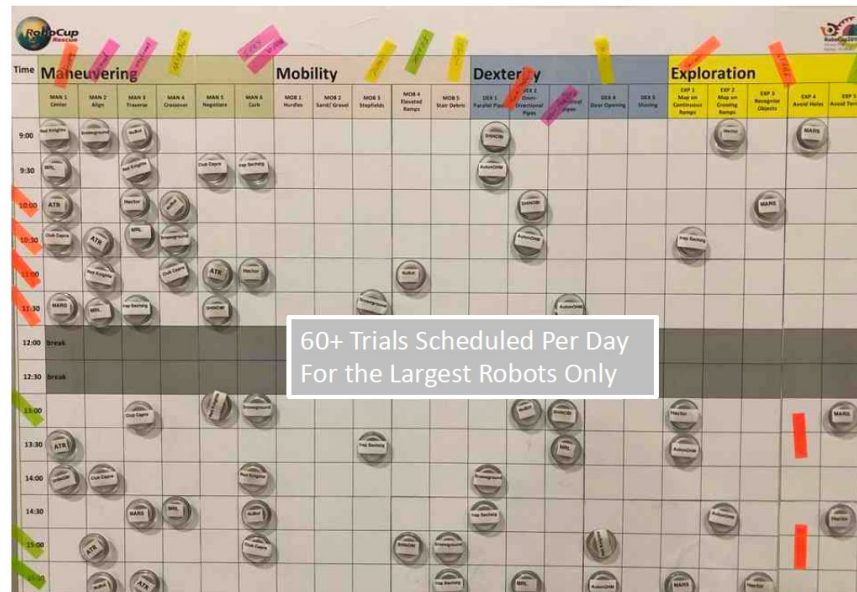
2022 presents unique challenges for the League. Leveraging the power of Standard Test Methods for reproducible testing, we plan to run a hybrid in-person and remote online competition. This will:

- Provide all teams, everywhere, with a way to compete remotely.
- Provide teams who participate in-person with the ability to have a viable competition, even if there are a limited number of in-person teams.
- Provide teams who plan to come to the in-person competition with a fall-back should they be prevented from participating at the last minute.
- Each robot configuration is treated separately.
 - A team can't do some tests with one robot configuration, and other tests with another robot configuration, and combine the scores.
 - A single robot that is modified between tests (e.g. adding or removing a sensor or arm, or any other modification that requires physically touching the robot) is considered a new configuration.

Competition Logistics - In Person

Preliminary Rounds - same as RoboCup 2019 Sydney

- Each day is divided into 30 minute synchronous time slots.
- Every day teams take turns selecting which time slot and test to run.
- Teams that have multiple robot configurations **do not** get extra time slots.
- At the end of preliminaries, for each test, scores are normalized to 100.
- Best total in each suite is awarded Best-in-Class.



Competition Logistics - In Person

Preliminary Rounds - same as
RoboCup 2019 Sydney

- At a prescribed point in the run, the 'Readiness Test' is performed, which tests the sensors and manipulator that the robot would need downrange.



Competition Logistics - In Person

Final Rounds - same as RoboCup 2019 Sydney

- Test methods are grouped into operationally relevant sequences that are performed one after the other.
- The readiness tests (representing “victims”) are performed at various locations during the sequence.
- Various manipulation tasks are also performed during the run (e.g. placing objects or turning valves).



Competition Logistics - Remote Online

A two-step process, like in 2021.

- Pre-Recorded Remote Best-in-Class Preliminaries: Teams submit pre-recorded videos of performance in their own facilities.
- Live Telecon Remote Best-in-Class Finals: The best teams participate in live trials via telecon from their own facilities.
- Groups may run multiple robots or multiple robot configurations but each configuration is considered a separate team **and registers separately** (even if all the people on the team are the same).

Competition Logistics - Remote Online

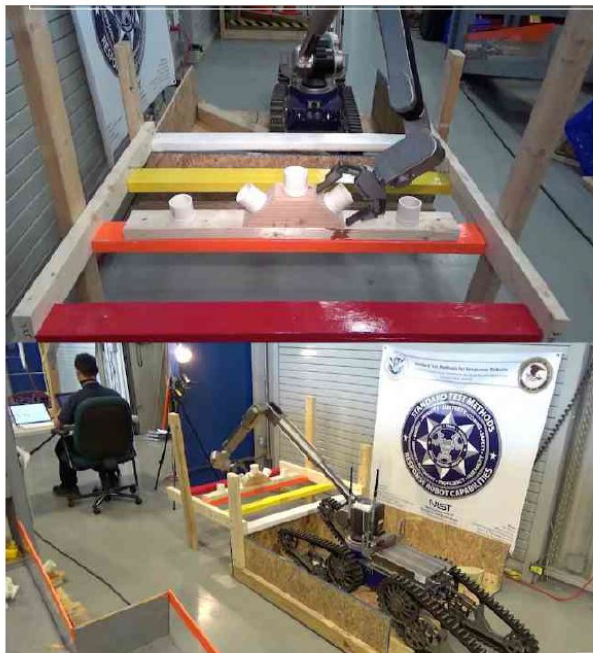
Pre-Recorded Remote Best-in-Class Preliminaries

- Teams build apparatuses for the tests that they wish to compete in.
- Teams upload uncut quadscreen video of their robots performing tests to a public, timestamped video sharing site, with their own scoring of the test.
- By the deadline, teams submit a list of their videos, scores, other details, ***and TDP if they haven't already (new requirement for 2022)***.
 - Teams only include their *best* run for each combination of test and setting.
 - Details of *how* to submit these videos via the forum will be made available shortly.
- Teams attest to each others' scores and submit proposals for correction.
- Scores are normalized as before.
- Top teams in each suite progress to the Best-in-Class Remote Finals.

Video Requirements

TASK DETAIL

SHOW AS MUCH
DETAIL OF THE
TASK AS
POSSIBLE



SHOW THE
OPERATOR IN THE
BACKGROUND
WITH BACK TOWARD
THE APPARATUS

ROBOT/INTERFACE VIEW



SAVE SCREEN TO
VIDEO OR ZOOM IN
WITH CAMERA AS
SHOWN HERE

SHOW EASILY
READABLE
TIMESTAMP, PRINTED
TRIAL INFO, AND ALL
OPERATOR ACTIONS

OVERVIEW OF ROBOT & OPERATOR

ALL OPERATOR ACTIONS

Video Requirements

- The entire test should be in one take, no cuts/edits.
- The robot should be clear enough to verify that it is of the same configuration (no components added/removed). The apparatus should be clear enough to verify that it is of the correct settings and dimensions.
 - The (uncut) video can start or end with a brief tour of the robot and apparatus if it is difficult to get an angle that shows this during the test.
- Videos from the four views should be merged into a time-synchronized quad-screen.
 - This can be done live via a video processing module (e.g. using a quad-box), live in software (e.g. using OBS Studio or a video conferencing program), or afterwards from several cameras.
 - See <https://rrl.forum.robocup.org/t/video-recording-processing-procedure-hints/54> for an example of a suitable process for merging videos from multiple cameras using the free FFmpeg program.

We strongly suggest creating and uploading an example of your test video, and posting it to the forum, early so everyone can check and make sure it's all OK!

Competition Logistics - Remote Online

Live Telecon Remote Best-in-Class Finals

- Teams perform runs live on video conference with judges and public before RoboCup week.
- Remote teams will get the same number of run slots as in-person teams.
 - We will try and accommodate teams who wish to have time between run slots to fix/recharge robots, perhaps by interleaving runs of teams in compatible timezones.
- Where relevant, the judges request last minute changes (e.g. asking for teams to move fiducials in mapping).
- Resulting performance in common tests are directly comparable to in-person Best-in-Class (preliminary) runs.

Step-by-Step for Remote Only

- Send us your TPF as soon as you know you may compete (no deadline).
- Register for RoboCup when registration opens. We will announce details when available.
- Submit a practice video early to make sure everything is OK. Check the forum for details!
- Submit your remote competition video package and TDP by Sunday June 19th.
 - Details on how will be announced on the forum (<https://rrl.forum.robocup.org>) and mailing list.
 - Remember there is a best TDP award! You may update your TDP at any time up until 2 weeks before the competition.
- Participate in the remote attestation process.
- Be prepared to compete in the remote Best-in-Class finals from July 4-8.

Step-by-Step for In-Person with Remote Fallback

- You should have sent us your TPF by now (we can be a little bit flexible, send it in ASAP).
- Qualify for the in-person competition:
 - Submit your TDP via EasyChair by March 4th.
 - Remember the qualification video requirement!
 - Remember there is a best TDP award! You may update your TDP at any time up until 2 weeks before the competition.
 - Attend a regional open if your region has more than 5 teams (you should already be in contact with your regional RoboCup organization).
- Submit a practice video early to make sure everything is OK. Check the forum for details!
- Register for RoboCup when registration opens. We will announce details when available.
- Submit your remote competition video package by Sunday June 19th.
 - Details on how will be announced on the forum (<https://rrl.forum.robocup.org>) and mailing list.
- Participate in the remote attestation process.
- If you find out before July 4 that you can't travel to RoboCup (or you don't qualify for the in-person competition), be prepared to compete in the remote Best-in-Class finals.
 - If you find out after July 4 that you can't come, we will try and accommodate you on a case-by-case basis.
- If you qualify for the in-person competition and can still travel, come to RoboCup!

Step-by-Step for In-Person Only

- You should have sent us your TPF by now (we can be a little bit flexible, send it in ASAP).
- Submit your TDP via EasyChair by March 4th.
 - Remember the qualification video requirement!
 - Remember there is a best TDP award! You may update your TDP at any time up until 2 weeks before the competition.
- Attend a regional open if your region has more than 5 teams (you should already be in contact with your regional RoboCup organization).
- Register for RoboCup when registration opens. We will announce details when available.
- If you qualify, come to RoboCup!

Note: If you follow this process (without submitting a video package by June 19th) and change your mind at the last minute and want to participate remotely, we will try to accommodate you on a case-by-case basis but cannot guarantee that we will be able to. If we are, you are likely to be at a significant disadvantage due to time constraints. If you think there is any chance you might want to compete remotely, please follow the process on the slide “Step-by-Step for In-Person with Remote Fallback”.

Test Suites

Many of these have been simplified for teams building and running remotely.

More details and construction guide coming shortly!

Maneuvering tests:

- MAN0: Sustained Speed on a Line (new)
- MAN1: Center Between Objects (updated)
- MAN2: Align Ground Contacts (updated)
- MAN3: Traverse Incline
- MAN4: Crossover Pinwheel Ramps
- MAN5: Negotiate Leaning Objects

Mobility tests:

- MOB1: Variable Height Rails (new)
- MOB2: Sand/Gravel
- MOB3: K-Rails on Crossover Slope (new)
- MOB4: Crossing Ramps on Crossover Slope (new)
- MOB5: Stair Debris

Dexterity tests:

- DEX1: Linear Tasks
- DEX2: Omni Tasks
- DEX3: Strength Tasks
- DEX4: Door Opening
- DEX5: Shoring

Legged and Autonomous Mobility:

- Pallet Terrains
- Crate Terrains

Search and Inspect Tasks

Mapping and Exploration Tasks

Aerial Tasks

Awards

Best TDP award

- In-person and remote teams are eligible.
- Judged based on how informative the TDP is to new teams.

Best-in-Class awards

- In-person and remote teams are eligible.
- Awarded per suite for tests that are common between in-person and remote competition.

World Championship (First/Second/Third)

- Only in-person teams are eligible.
- Awarded for performance in the in-person finals.

For More Info and Questions

- Please join our forum at <https://rrl.forum.robocup.org> to ask any general questions.
- For questions specific to your team, or to join our announcements mailing list, please email us at rescue.robot.league@nist.gov .
- Keep an eye on the website at <https://rrl.robocup.org> and <https://2022.robocup.org> for updates.
- Join our Facebook group <https://www.facebook.com/groups/robocuprescue>.
- To keep up to date with news across the RoboCup Federation, please email robocup-worldwide@lists.robocup.org.