

# RoboCupRescue

# Rapidly Manufactured

# Robot challenge 2022

Summary of Competition Organization and Logistics

Version 20220213

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

<https://rrl-rmrc.org>

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# Competition Committee

- Dr. Raymond Sheh (USA/Australia)
- Dr. Amy Eguchi (USA/Japan)
- Archer Losely (USA)
- Gerard Elias (Australia)
- Graham Stock (Australia)
- Adam Jacoff (USA)

## Local Chairs:

- Dr. Veerachai Malyavej
- Dr. Pannavy Pookaiyudom



## Other Documents:

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

- Rules Document (available soon!)
- Construction Guide (<http://arena.rrl-rmrc.org>)

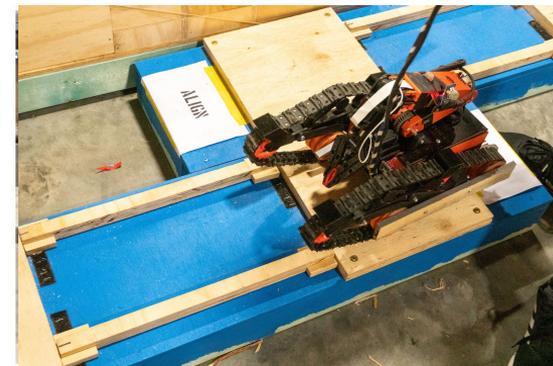
These are/will be made available at <http://rrl-rmrc.org> [1]. Join our mailing list at <http://group.rrl-rmrc.org> to make sure you are kept up to date with any changes and additional information!

*You might also want to check out the RoboCupRescue Robot League's documents for Major teams. Please visit <https://rrl.robocup.org> for further details.*

[1] RMRC is transitioning out of <http://comp.oarkit.org> to its own domain at <http://rrl-rmrc.org>! We will continue to link in both directions so folks with either URL should still be able to find what they're looking for.

# Introduction of the Rescue Robot League

- Standard Test Methods facilitate communication between the various stakeholders in Rescue and Response Robotics, including 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 Rescue Robot League

- The Rescue Robot League is part of the development and validation of Standard Test Methods used worldwide by emergency responders.
- Test methods are divided into several suites such as Mobility, Dexterity, Exploration & Mapping, Search & Inspection, and Sensing.
- Overall League has scales of 120 cm (48 in), 60 cm (24 in), 30 cm (12 in).
- Individual and sequenced tests.



# Introduction of the Challenge

- There are Preliminary and Final rounds.
- Preliminary rounds consist of standard test methods, performed individually.
- Teams select which tests to compete in.
- Scores for all teams in each test are 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 are given to teams with the best performance in each suite of tests 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.



RMRC robots with a NSW Police EOD robot

# Robots Can Look Similar But Perform Very Differently

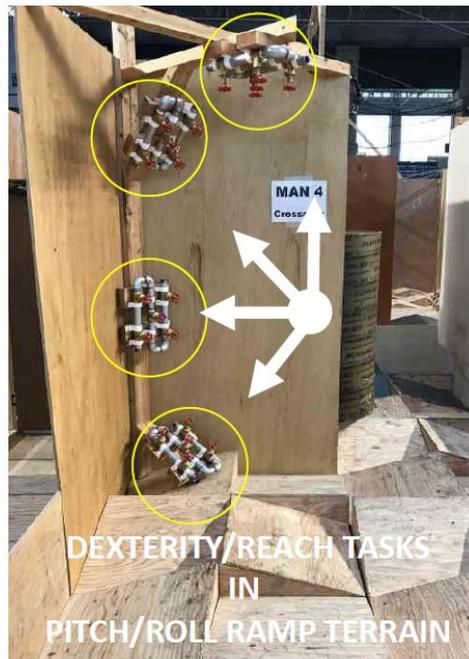
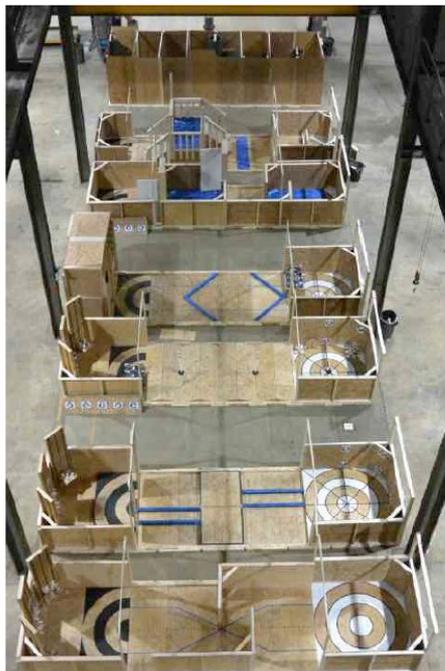
Robots can have similar designs – success is often imitated. Or they can be very different. All need to be evaluated, compared, and differentiated based on statistically significant capabilities data.



# 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.



## Scale of Test Lanes: 30 cm (12 in) Wide

**(Most tests in RMRC are carried out in this scale.)**

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



# Why Rapidly Manufactured Robot Challenge?

- Lower barriers for entry
  - Technical
  - Financial
  - Infrastructure/Space
- Promote the development of open source resources
  - 3D printing
  - Laser cutting
  - Desktop CNC milling
- Facilitate the use of robotics in STE(A)M education
- Develop a library of low cost designs that are tested to statistical significance
- Provide opportunities for outreach to, and collaboration with, local rescue/responders.



# Important Dates

*This schedule is subject to change! Please join our mailing list at <http://group.rrl-rmrc.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 4th - Qualification Team Description Materials (Qualification TDM) due for standard qualification (notification of qualification by the end of March).
    - We will accept late Qualification TDMs up until late May, although teams who submit late Qualification TDMs may experience delays in notification of qualification.
  - Register for RoboCup when registration opens. We will announce details when available.
  - Monday June 27 - Updated TDM due.
  - Monday July 11 - RoboCup starts.
- For teams wishing to participate remotely (or in-person with remote fallback):
  - Register for RoboCup when registration opens. We will announce details when available.
  - Sunday June 19 - Preliminary videos and Updated TDM 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

For in-person competition:

- Teams declare their intent to participate via the mailing list ([group.rrl-rmrc.org](mailto:group.rrl-rmrc.org)).
- Preliminary Team Description Materials (TDM) describing their entry (March 4th).
  - Most teams will need to include videos of their robot doing at least 2 tests.
- Updated TDM describing their entry is due 2 weeks prior to the competition.

For remote online competition:

- All teams welcome, please declare ASAP.
- Teams must submit their (Updated) TDM when they submit their preliminary video package.

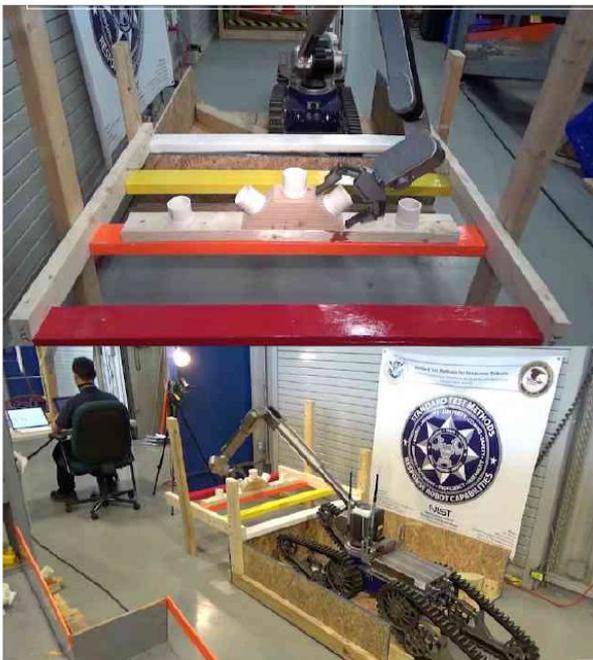
## Qualifying Videos

- By the TDM due date, all teams must submit videos, created during or after the last in-person competition (2019 is valid for this year), of a robot performing in at least two tests.
- Teams do NOT need to use the same robot that they will compete with - we know that teams will continue development on their robots right up until competition time. This is to demonstrate the team's ability, rather than the specific robot's.
- New teams who do not have a working robot may elect to skip this requirement and be judged only on their TDM. A team is considered new if the organizations and team members have not competed before.
  - One member (e.g. the mentor) changing organizations, or an organization with all-new team members, will be considered as a new team on a case-by-case basis. Please contact the RMRC Committee at [info@rrl-rmrc.org](mailto:info@rrl-rmrc.org) to describe your situation.

# Qualifying Videos (example from Major Rescue)

TASK DETAIL

SHOW AS MUCH  
DETAIL OF THE  
TASK AS  
POSSIBLE



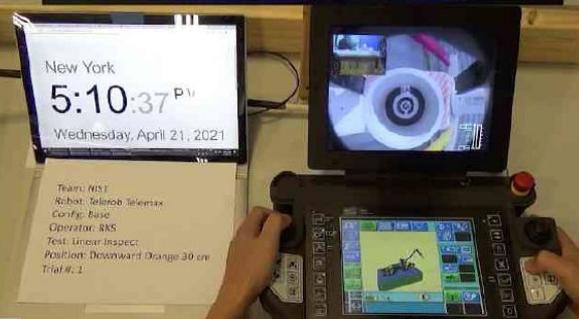
SHOW THE  
OPERATOR IN THE  
BACKGROUND  
WITH BACK TOWARD  
THE APPARATUS

OVERVIEW OF ROBOT & OPERATOR

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

ALL OPERATOR ACTIONS

# Video Requirements

- The entire test should be in one take, no cuts/edits.
- The robot should be sufficiently visible to verify that it is of the same configuration (no components added/removed). The apparatus should sufficiently visible 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.

# Qualification Team Description Materials

- Can be some combination of a traditional document, a series of blog posts, a video presentation, etc.
- Must cover the logistical information in the next slide. This must be under obvious headings. (Don't just point us to your website and make us dig for it - if you're doing the blog post route at least point us to a 'master' post that links to all the info under the relevant headings!)
- Aim to convince the RMRC Committee that your team knows what it's doing and is capable of putting together a good entry for RoboCup.

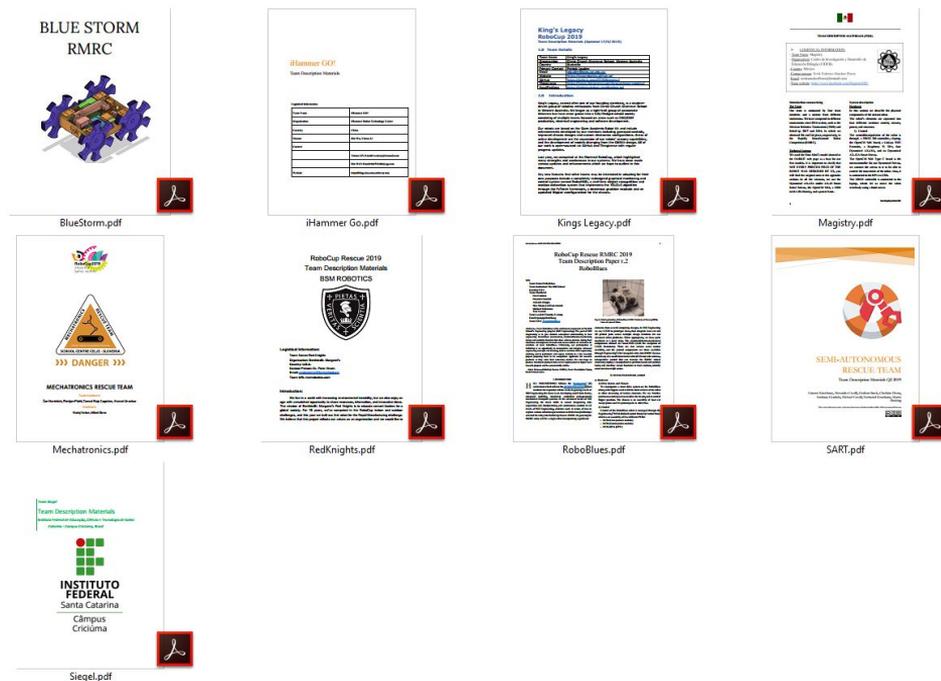
*We expect that you won't have your final robot built at this point. We want to see both what you have done and what you plan to do.*

# Team Description Materials

- Logistical info
  - Team Name
  - Organisation
  - Country
  - Contact person
  - Email
- Team website (if present)
- Introduction summarising:
  - The team.
  - The technical aspects that it focuses on.
- System description, describing:
  - Hardware.
  - Software.
  - Communications.
  - Human-robot interface.
- Application, describing:
  - Setup and packup of your robot and operator station.
  - Mission strategy.
  - Experiments and testing that you have done or will do.
  - How the particular strengths of your team are relevant to applications in the field.
- Conclusion, summarising:
  - What your team has learned so far.
  - What you plan on doing between now and the competition.
- Appendix containing:
  - One table per robot outlining the components and estimated cost of your robot.
  - At least one picture, 3D rendering or technical drawing of your robot.
    - Be sure to highlight particular features of your robot.
  - A list of software packages, hardware and electronic components that you have used, or plan to use, particularly those from the Open Source community, through the Open Academic Robot Kit or otherwise.
  - A list of software packages, hardware and electronic components and designs that you have, or plan to, contribute to the Open Source community, through the Open Academic Robot Kit or otherwise.
    - Note that you will still need to actually open source your components in the days prior to the competition as we assume you will continue development between the submission of the TDM and the competition!
- References (to other work that you have made use of).

# “Updated” Team Description Materials

- Due 2 weeks before the in-person RoboCup World Championship.
- Scored based on how well they help another team learn something useful for competing in RMRC.
- This becomes a multiplier for the preliminary scores.
- Encourage teams to share their knowledge and contribute to an open source body of work.
- Topics may include how to build the robot, software setup, tutorials on inverse kinematics, etc.
- Eventually - tie into other educational programs such as the Rescue Robotics Summer Schools.
- Visit <http://tdm.rrl-rrmc.org> for links to past Updated TDMs!



# 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 participate remotely or in-person.
- 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 cannot combine scores from tests performed with different robots (or robot configurations).
  - 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 10-15 minute synchronous time slots depending on number of teams.
- Every day teams take turns selecting which time slot and test to run.
- 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

- For RMRC, sensors is considered a separate test.

*Further details in the forthcoming rules document.*



# 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).

*Further details in the forthcoming rules document.*



# 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 (as described previously) of their robots performing tests to a public, timestamped video sharing site, with their own scoring of the test.
  - We highly recommend uploading one early and sending it to the list, to make sure everything is OK!
- By the deadlines, teams submit a list of their videos, scores, other details, and Updated TDM by emailing (links to them) to the mailing list.
  - Teams only include their \*best\* run for each combination of test and setting.
- 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.

# 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 QR codes).
- Resulting performance in common tests are directly comparable to in-person Best-in-Class (preliminary) runs.

## Step-by-Step for Remote Only

- Declare on the mailing list 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.
- Submit your remote competition video package by Sunday June 19th by emailing links to the mailing list.
- Submit your Updated TDM by Monday June 27th by emailing to the mailing list.
- 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 declared your participation by now (we can be a little bit flexible, send it in ASAP).
- Qualify for the in-person competition:
  - Submit your Qualification TDM by emailing it to the list by March 4th if you want to know you've qualified ASAP (or until sometime in May if you're OK with a wait).
    - Remember the qualification video requirement!
- Register for RoboCup when registration opens. We will announce details when available.
- Submit a practice video early to make sure everything is OK.
- Submit your remote competition video package by Sunday June 19th by emailing links to the mailing list.
- Submit your Updated TDM by Monday June 27th by emailing to the 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 declared your participation by now (we can be a little bit flexible, send it in ASAP).
- Submit your Qualification TDM to the mailing list by March 4th if you want to know you've qualified ASAP (or until sometime in May if you're OK with a wait).
  - Remember the qualification video requirement!
- Register for RoboCup when registration opens. We will announce details when available.
- Submit your Updated TDM by Monday June 27th by emailing to the mailing list.
- 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 Methods

*The following test methods have been used in previous years. Which ones do you already have? Which ones can you build? We will be discussing in the mailing list if this lineup makes sense for remote online, and if it makes sense to add some other scenarios such as “Search and Inspect”.*

## Terrain tests:

- Gravel
- Hurdles
- Stepfield
- Mulch
- Elevated Ramps
- Sand

## Manipulator Dexterity:

- Dexterity Field

## Maneuvering tests:

- Ramps
- Pinwheel Ramps
- Center
- Align

## Sensing:

- Sensors
- Mapping
- QR Pinwheel Ramps
- QR Stepfield
- QR Ramps

# Awards

## Open Source and Innovation award

- Best and most innovative open source contribution to the RMRC community.

## 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.

## Questions?

- Please join our forum at <https://rri.forum.robocup.org> and mailing list at <http://group.rri-rmrc.org> to ask any general questions.
- For questions specific to your team, please email us at [info@rri-rmrc.org](mailto:info@rri-rmrc.org) .
- Keep an eye on the website at <http://rri-rmrc.org> for updates.

*The details from this presentation are subject to change, particularly as the pandemic changes! Please keep an eye on the mailing list to make sure you're kept up to date.*