SPACE ROBOTICS CHALLENGE
PHASE 2
FREQUENTLY ASKED QUESTIONS

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1.0 REVISIONS SUMMARY:

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2.0 WHAT:

Q: What is the goal of the Space Robotics Challenge Phase 2 (SRC2)?

A: The goal of SRC2 is to advance the science of robotic autonomy. Self-driving vehicles on Earth can use complex positioning systems in concert with highly precise sensing technology, all supported by advanced computer algorithms. Off world, on the Moon or Mars, no global positioning technology exists, vision systems must contend with wholly different environments and computer processing power is severely constrained. Hence the need for innovative programing solutions that can allow for meaningful autonomy for robotics supporting or supplementing human operations.

Q: What are the important dates for SRC2?

A:

<table>
<thead>
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<th>Date/Deadline</th>
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<tr>
<td>August 12, 2019 9:00 AM Central Time</td>
<td>Challenge Opens for Registration</td>
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<td>December 20, 2019 5:00 PM Central Time</td>
<td>Challenge Registration Closes</td>
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<td>January 15, 2020 5:00 PM Central Time</td>
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March 16, 2020
9:00 AM Central Time
Qualification Round Opens

August 19, 2020
5:00 PM Central Time
Qualification Round Closes (simulation code due)

November 9, 2020
9:00 AM Central Time
Qualification Round Winners Announced

December 7, 2020
9:00 AM Central Time
Competition Round Opens

June 30, 2021
5:00 PM Central Time
Competition Round Closes (simulation code due) & Electronic Summary due

September 13, 2021
Winners Announced at live Space Center Houston Event

Q: What awards are available to competitors?

A: A prize purse of up to $1,000,000 USD will be awarded across two rounds of competition:

**Qualifying Round - Awards:**
The Top 25 scoring competitors in the Qualification Round that meet or exceed a given threshold score, will be awarded prizes from a purse of $375,000 USD. Only the Top 25 scoring competitors will be invited to compete in the Competition Round.

Competitors will be able to win a maximum of $15,000 USD. Should a competitor not complete all required tasks, but still be in the Top 25 scoring competitors that meet or exceed a given threshold score, a percentage of the $15,000 will be awarded based on the percentage of the trial that was completed.

**Competition Round - Awards:**
The Top 10 scoring competitors in the Competition Round that meet or exceed a given threshold score, will be awarded prizes from a purse of $625,000 USD.

- First Place: $185,000 USD
- Second Place: $125,000 USD
- Third Place: $75,000 USD
- Fourth Place: $50,000 USD
- Fifth Place: $40,000 USD
- Sixth through Tenth Place: $30,000 USD each

3.0 WHERE:

Q: Where can I find important documents related to SRC2?

A: Please visit [www.spaceroboticschallenge.com](http://www.spaceroboticschallenge.com) for all Challenge information, including Challenge Rules, Competitor Packets, and the Challenge Timeline.

Q: Where will the final event take place?
A: The Final Event will take place at Space Center Houston in Houston, Texas. At the final event, the winners of Competition Round will also be announced.

4.0 WHO:

Q: Who is conducting SRC2?

A: NASA Centennial Challenges program is providing the $1,000,000 USD prize purse, and has partnered with Space Center Houston / Manned Space Flight Education Foundation Inc. to develop and conduct this Challenge. The U.S. Army Engineer Research & Development Center is also supporting the Challenge through contributing Subject Matter Experts.

Additionally, Space Center Houston / Manned Space Flight Education Foundation Inc. has recruited the following support:
- Presenting Sponsor - BHP (an Australian mining company)
- Challenge Coordinator - NineSigma North America

Q: Who is BHP?

A: BHP is a resources company based in Melbourne, Australia, that extracts and processes minerals, oil and gas for distribution worldwide. They have joined with Space Center Houston to sponsor the second phase of the Space Robotics Challenge because they are interested in adapting technology developed for space-based applications to terrestrial work such as resource identification, location and collection to improve the speed, efficiency and safety of their operations.

Q: Who can I contact for more information about SRC2?

A: All questions related to participating and/or competing in the Challenge should be sent to info@spaceroboticschallenge.com.

Questions sent to any other email address or individual will not be addressed.

Media inquiries should be directed to:
Jenalane Rowe – jenalane.rowe@nasa.gov
NASA Centennial Challenge
+1 256-544-5022

Meridyth Moore - mmoore@spacecenter.org
Space Center Houston
+1 281-244-2139

5.0 WHY:

Q: Why do I need insurance for a virtual challenge?

A: The U.S. Government requires all individuals and entities involved in challenges of this type to have adequate insurance coverage. While it is unlikely that an incident resulting in injury will occur during this Challenge, competitors are obligated to abide by existing U.S. Government guidelines.

Q: Why is NASA sponsoring this Challenge?
A: NASA’s goals for this Challenge are twofold: 1) to advance the science of off-world autonomous robotics and 2) to engage with the global community of experts for the advancement of space exploration.

Q: Must the Insurance Coverage document be in English?

A: Competitors will need to provide the main information from the insurance in English so that NineSigma Challenge Administrators can check it against the requirements. Competitors should ask their insurance provider for English versions of their paperwork. If not, a machine translation is fine (e.g. Google Translate). We do not require a legal document-level official translation.

6.0 HOW:

Q: How do I enter as a competitor for SRC2?

A: First, visit www.spaceroboticschallenge.com and download the Competitor Packet. Then, use the Registration Form link on the Challenge page to upload your packet and appropriate documentation. When your registration has been reviewed and approved, you will receive an email notification from info@spaceroboticschallenge.com to confirm.

Q: How can I determine if I am eligible to participate in SRC2?

A: SRC2 is open to individuals and teams from around the globe, with some restrictions.

No individual competitor shall be a citizen of a country on the NASA Export Control Program list of Designated Countries List Category II: Countries determined by the Department of State to support terrorism. The current list of designated countries can be found at http://oiir.hq.nasa.gov/nasaecp. Please check the link for latest updates. This includes individuals with dual citizenship unless they are a U.S. citizen or a lawful permanent U.S. resident (green card holder).

While China is not a Category II designated country, pursuant to Public Law 116-6, Section 530, NASA is prohibited from participating, collaborating, or coordinating bilaterally in any way with China or any Chinese-owned entity. Team members who are citizens of China but not affiliated with a Chinese entity may be permitted to participate on a Team.

Subject to the conditions set forth herein, foreign nationals and foreign national teams can participate in the Challenge. However, they are not eligible for a cash prize, and must acknowledge acceptance of this by signing and submitting a Foreign Participant Acknowledgement Form.

Interested competitors should refer to the Official Challenge Rules for full details on the eligibility criteria (including requirements for foreign participation) for participating in the challenge and being eligible to receive a prize.

7.0 HELPDESK QUESTIONS:

Q: What is the intended meaning of "Chinese entity"?

A: Competitors cannot be affiliated with a Chinese entity. An entity includes a Chinese company, university, government entity, research institute, etc. So competitors cannot work for the Chinese government or a Chinese company or be students at a Chinese university or school.
Q: A US Passport Card is acceptable as a proof of citizenship equivalent to a Passport according to this government website: https://travel.state.gov/content/travel/en/passports/need-passport/card.html. It is not explicitly listed in your list, so I wanted to make sure. I will assume that it is acceptable and proceed unless you tell me otherwise.

A: A US Passport Card is acceptable.

Q: What is the difference between registering as an individual vs registering as an entity?

A: Whether a team registers as an Entity or Individuals is up to the Team Members to decide. Things like distribution of the potential winnings, access and/or use of resources, and insurance coverage are some of the things that should be discussed with the potential Entity when deciding how to register.

Q: I was wondering whether the lunar model and robots for the Space Robotics Challenge Phase 2 will be made available to non-competitors.

A: We will not make the competition lunar environment publically available in order to ensure the challenge’s integrity. It is unknown at this time if the simulation and/or the robot information will be released post-challenge. However, we will make an announcement if it is made available.

Q: It's hard to find insurance based on the requirements... but for example, one insurer told me we can't get an 18 months policy anywhere, it should be one 1 year policy, and then another 6 months policy. Is that OK?

A: This is acceptable. As long as proof of coverage can be shown in advance of the new policy starting and there is no gap in coverage, this satisfies the requirement.

Q: We have one faculty member that is from Iran, but is a green card holder. Is he able to participate?

A: The rules state: No individual competitor shall be a citizen of a country on the NASA Export Control Program list of Designated Countries List Category II: Countries determined by the Department of State to support terrorism. The current list of designated countries can be found at http://oiir.hq.nasa.gov/nasaecp. Please check the link for latest updates. This includes individuals with dual citizenship unless they are a U.S. citizen or a lawful permanent U.S. resident (green card holder). If he is a green card holder, then he is eligible to compete.

Q: Do all team members need to be on the same insurance plan, or can they be on multiple, provided they all meet the requirements and have proof?

A: All members should be covered, but that can be done through multiple policies if that is easier.

Q: Section 9.1 contains this statement: "...large virtual robotic teams will likely decrease the speed at which the simulation will run." It is my understanding that when using Gazebo, complex robots and environments will increase the amount of *real* time used per simulation time step, but should not affect *simulation* time. Is my understanding incorrect?

A: Yes. The more real time used per simulation step, the longer it takes to run. Please note, the time for runs given in each round are in "simulation" time, not "real" time.
Q: Section 8.1, task 1 contains this statement: "Competitors will develop software that allows a robotic system to search the lunar surface within a predefined area for resources." How is the area's boundary defined? Does a physical barrier surround the area? This question also applies to tasks 2 and 3.

A: The area's boundary will have a barrier.

Q: Section 8.1, task 3 contains this statement: "Additional points will be provided for aligning the robot with a specific target at home base. Fiducial markers will be provided to assist with alignment." Will the robot be on the home base when task 3 begins?

A: The robot will be spawned randomly.

Q: Section 8.1, task 2 contains this statement: "Resources will be considered “collected” if they are in the robotic haulers at the end of the task." Are the haulers stationary? If not, are they supposed to sense when they are full, and dump their contents somewhere?

A: Hauler will be a rover that will collect resources excavated by the excavator. There is no limit on how much resources it collects.

Q: Section 8.1, task 2 contains this statement: "Location of the resources to be collected will be provided within the simulation." What is the origin of the coordinate system? Will task 2's environment contain the home base with fiducial markers that is described in task 3, which could be used as the coordinate system's origin? If so, will the excavator begin task 2 on the base?

A: The origin is at the center of the terrain/map. Task 2 will not have home base model. The excavator and hauler will be spawned randomly.

Q: Section 8.1, task 1 contains this statement: "Resource locations shall be provided relative to the robot’s starting location within the environment." Will task 1's environment contain the home base with fiducial markers that is described in task 3? If so, will the prospecting robot begin task 1 on the base?

A: Task 1 will not have home base model. Position of resources relative to the robot's initial position will be provided.

Q: The documentation says details of the robots will be available after registration opens. When can we expect more information?

A: Per the Rules Document, a packet of robot information will be delivered to competitors in January/2020.

Q: The qualification specifications say there will be excavator and hauler robots. What others will there be?

A: Per the Rules Document, a packet of robot information will be delivered to competitors in January/2020.

Q: Even if exact robot details are not available can you provide the level of control provided by APIs vs raw ROS control. For example, will the robots be controlled at low level via 'twist' commands or some higher level?

A: A wiki site will contain such information before qualification round opens.

Q: What sensor capability for navigation - 'autonomous perception' - will be available, e.g vision, IMU, gyro, lidar, 3d vision?
A: Per the Rules Document, a packet of robot information will be delivered to competitors in January/2020.

Q: How large is search / working area?

A: A wiki site will contain such information before qualification round opens.

Q: What is the speed of the robots?

A: Per the Rules Document, a packet of robot information will be delivered to competitors in January/2020.

Q: Could a generic robot be provided early to allow basic testing?

A: Gazebosim.org and ROS.org provides tutorials that will assist in getting familiar with the capabilities that SRC simulation will provide.

Q: Will the terrain + robot height be such that the robot always has line-of-sight to the lander?

A: No

Q: 8.1 "Each task will come with its own simulation environment..." To "spice things up", it might be fun to have the topology and orientation of the lander in said topology be the same from task to task. If the mapping done in one task were transferable to the next task, it would add some additional strategizing to the competition: Which task to perform first to get the upper hand in mapping.

A: Qualification rounds can be performed in any order and the environment may differ from round to round.

Q: Will the robot have any idea of where the scenario is starting in relation to lunar and celestial landmarks.

A: No - the robot(s) will start from the lander, which will be the landmark. But the lander could be in a different location from run to run.

Q: Will the topology of the surface already have been mapped and available to the robot(s)?

A: No - competitors will need to use the sensors provided to map their own way and surroundings.

Q: Will the computer be available mid-competition to evaluate performance trade-offs which are not evident on contestant's available machines?

A: Dry-runs will be required during the development period. The dry-runs will allow the competitor teams to evaluate their performance and adjust if needed. The final virtual competition requires solutions to be fully autonomous, and competitor teams will not have access to the computer evaluating their runs.

Q: Do you know what graphics card will be used? I assume I can just throttle my CPU down to 2.4ghz... is this an "all core" rating, or something else. A specific processor, memory module(s), and graphics card model, would give all contestants the necessary information to either make their own computer or simulate it with alternative hardware. If this is still unknown at this time, you might say something like "we plan to use XXXX parts in the system or something very similar."

A: The recommended specification is a baseline performance needed to operate the simulation. Having a higher or lower performance machine will only speed up or slow down the simulation steps, but the end duration time will be equal for all competitors. (CP)
Q: The team leader need to be a US citizen/perm. res. at time of registration in order to win prize $? Proposed team leader is currently in process to obtain green card (expected Feb 2020) - would like to know if prize eligibility will change at that time.

A: The Team Leader must have his green card by the closing date of the qualification round (August 19, 2020) in order to be eligible to receive a prize. Once the Team Leader has received his/her green card, NS/SCH will confirm the new eligibility status.

Q: Due to the real-world communication limits between Earth and the moon, I assume that cloud computing in the simulation is prohibited. The legality of using cloud computing, and any limits placed on it, should be specified in the rules.

A: The cloud computing applies to how we run the simulations. While the usage of cloud computing by competitors is not prohibited, it will not be possible to simulate cloud computing within the simulation.

Q: Section 6.1 contains this statement: "2. Organizations must be an entity incorporated in AND maintaining a primary place of business in the United States." Should the word "incorporated" be taken literally, i.e. does this statement specify that the entity must be a corporation rather than, for example, a sole proprietorship, partnership, or limited liability company?

A: All forms of business incorporation are acceptable, as long as it can be demonstrated, upon request, that such legal status has been enacted in the United States.

Q: Regarding "Task 2: Resource collection": Will the robotic excavator be equipped with a resource sensor, as is the prospecting robot? To perform sensing in permanently shadowed regions, is the excavator equipped with a light or LIDAR?

A: Only prospecting robot will have resource sensor. All robot model will be equipped with a light source, LIDAR and depth camera.

Q: Regarding "Task 3: Self-localization": Will the model template for the *a priori* object be provided to the team at the beginning of the 45-minute task period (for the Qualification Round), or beforehand? Similarly, will the template be supplied at the beginning of the first scoring run of the Competition Round, or beforehand? A machine learning approach to object detection could consume a significant amount of processing time, so it would be very useful to know how much time will be available for training.

A: The template will be provided with the release of the qualifying software.

Q: Section 9.1 contains this statement: "...competitors should expect their virtual robotic team to operate in the dark." As asked above in question 4, are the robots equipped with lights or LIDAR?

A: Only prospecting robot will have resource sensor. All robot model will be equipped with a light source, lidar and depth camera.

Q: Will you use a specific version of Gazebo and other software not already specified as the Ubuntu Linux was?

A: Gazebo 9 will be used for the competitions per Section 10.0 of the Official Rules document. This section also includes all of the system requirements that will be needed.

Q: Re: pg 9: "Gazebo simulation time decreases with increased models in a world, and as such, large virtual robotic teams will likely decrease the speed at which the simulation will run." I have an i7-8086K
and P6000. Will this accurately reflect the official NASA computer to be used to run the simulation, or would something need to be done to "slow it down" to i5 and worse graphics card capabilities? More info on the simulation computer's performance may be desirable for teams depending on... lots of things.

A: Recommended System Requirements: * CPU with 2.4GHz or equivalent with 4 cores / 8 threads; 8 GB RAM, 50GB HDD; Ubuntu 18.04.2 LTS; ROS Melodic Morenia; Gazebo 9.

Q: Section 8.0 contains this statement: "The 25 competitors with the highest scores will be required to submit their software to be run on the Challenge's host computer for verification." What is the host computer's configuration? Section 10.0 specifies a *minimum* configuration, but what if a team's software requires, for example, a NVIDIA graphics card with 8 GB of memory, and the host computer's graphics card has only 4 GB? What if a team's software runs on a small group of connected computers? I think that a reference configuration of the host computer needs to be specified. Alternatively, the host computer could be upgraded until it meets the needs of the software of all the teams, which seems like an onerous burden on the organization running the competition.

A: Recommended System Requirements: * CPU with 2.4GHz or equivalent with 4 cores / 8 threads; 8 GB RAM, 50GB HDD; Ubuntu 18.04.2 LTS; ROS Melodic Morenia; Gazebo 9.

Q: Section 9.0 contains this statement: "Competition runs will be managed on a field computer by the SRC2 challenge administrators." The configuration of the field computer needs to be specified.

A: Recommended System Requirements: * CPU with 2.4GHz or equivalent with 4 cores / 8 threads; 8 GB RAM, 50GB HDD; Ubuntu 18.04.2 LTS; ROS Melodic Morenia; Gazebo 9.

Q: Will knowing science assist in determining where resources should be? For example, water and other volatiles might be found in larger concentrations in perpetually shaded areas...? Or will resources be distributed by some other means?

A: Resources will be randomly distributed.

Q: Will the environment change per the time elapsed as would be realistic? (sun/stars moving, etc)

A: The environment will not change per time elapsed.

Q: Will the robot have any idea of where and when the scenario is starting in relation to lunar and celestial landmarks, and will the topology of the surface already have been mapped and available to the robot(s)?

A: No - the robot(s) will start from the lander, which will be the landmark. But the lander could be in a different location from run to run.

Q: Will the topology be different from run to run, or will it be predetermined so that mission parameters may be optimized by the contestants beforehand?

A: Different run to run.

Q: Page 9 of the rules: ...allowed three runs for the final competition. Will this be with different simulation worlds? Is only the best used, or are they averaged or something else?
**A:** Per section 11.0 of the rules, once each competitors’ three scoring runs have been completed on the field computer, the average score of the three runs will be calculated, and all competitors’ scores will be ranked highest to lowest. Each run should be expected to be different.

**Q:** Will the computer be available mid-competition to evaluate performance trade-offs which are not evident on contestant's available machines?

**A:** Dry runs will be required during the development period.

**Q:** Are we allowed to detach "things" from the robots as they move, or shoot them? Of particular interest would be a sensor tower at the lander, and balls or emitters as the robot travels.

**A:** Only models provided by the simulation are authorized to be used. No new models can be created.

**Q:** Will the robot leave tracks? Similarly, will actions by the robot (such as digging up samples, etc) affect the appearance of the terrain?

**A:** There will be no tracks left for the robots. Also, the appearance of the terrain will not be altered due to digging up volatiles.

**Q:** Will there be any moving objects not controlled by the team's programming within sensor range?

**A:** No.

**Q:** In the qualifiers, is the sensor suite specified by each team, or is it generic and the same for all teams?

**A:** Same for all teams.

**Q:** We'd like to know if we'll have to handle a handful of robots (3-5), or we need to prepare for a fleet of 10-20 robots.

**A:** Handful of robots.

**Q:** What kind of capabilities need to be developed to identify the regolith? Do we need a computer vision expert, or will the robots have some sensor that gives analyzes the environment for us?

**A:** Did you meant "volatile"? The simulation will be provided with volatile sensor that detects different types of volatiles.

**Q:** Similar questions for mining, navigating and repairing of the robots, do we need a manipulation/control/navigation expert?

**A:** In order to be fair to all competitors, we cannot give guidance on the type of expertise a Team should have. Teams should review the Rules and choose the contributing members of their teams as they deem necessary.

### 8.0 COMPETITOR WEBINAR QUESTIONS

**Q:** Is there a policy for using open source / licensed code for including in our submission? The context is that we are looking at defining our technology stack for the challenge. Different packages have different licenses. We understand that the code submission will be to provide a docker image, so we could install any software inside that image. In this context, consider the situation where one team buys a
commercial localization and mapping solution from a commercial company. They use it as a black box within their docker image.

1. Would that be compatible with the competition rules? i.e. “do the rules allow using licensed software in the code that is submitted for the computation”?
2. Would it lead to a situation where teams putting down higher expenses create higher scoring submissions?
3. On the other hand, would there be a score bonus if we used only open source code + our own code in the submission for the competition?

A: The rules document does not state anything about using third-party software so competitors may use any software to assist with the tasks for the qualification round.

However, there will be an issue if the license of a software being used is non-transferrable, as the competition run will run on our end and it would be illegal to run a licensed software that was meant for someone else. If proprietary/licensed software is used, we cannot run that software on our boxes for competition. If teams buy licenses or subscriptions for something, that something will not be able to run during the competition.

However, if they use any software/packages that have a freeware license, then there’s no problem. Like Apache or similar.

For the scoring, there is a possibility that the team using a black box to help with a task can get higher score, but there won't be any bonus points for teams that strictly use open source software.

Q: Are we allowed to showcase our simulations and programs using the NASA simulation code outside of the competition? What is the license for the simulation code provided for the competition?

A: Per the Team Agreement, IP associated with any solution developed and submitted by teams for the competition stays with the competitors/team. Additionally, Teams are encouraged to use their experiences and outcomes from participating in the Space Robotics Challenge to submit papers, present at conferences, use as case studies, etc. There will be licensing on the simulation code developed by NASA for the purposes of this competition; the details of which are still being assessed.

Q: Is there a way for a foreign national to participate, in a team that has the team leader based in the US but is not an entity?

A: A foreign national may participate as part of a team with a team leader based in the US as long as the foreign national is not on the NASA Export Control Program list of Designated Countries List Category II.

Q: If we want to add or remove team members once we started is this possible? Are teams final at the time of registration, or could members be added or removed at a later time?

A: Team modifications will be allowed from January 15, 2020 to February 15, 2020 for the Qualification Round and October 15, 2020 to November 15, 2020 for the Competition Round.

Individuals who are additions to the team will need to provide the same paperwork as original registrants in order to be accepted into the competition. Please see the Registration Packet.

Q: How to join a team, if a researcher would like to apply the project, but no current collaboration with the US citizen?

A: The only portal that we provide to look for team members is our forum. There may be other portals created by individuals, but as we do not moderate them, we will not indorse them.
Q: We are a team from a university in Ontario, Canada. Most of us are Canadian PR and citizens, but none had U.S green card or citizenship. Is it a problem since you stated that foreign nations cannot weigh more than 50% of the team?

A: The Team Leader must be a U.S. citizen or permanent resident in order for the team to be eligible for a prize. Can compete but not eligible for prizes, Per Rules Document, section 6.

Q: Can an individual participate on multiple teams or lead multiple teams? If there were multiple solutions you wanted to compete with, is that allowed?

A: An individual will only be allowed to participate on one team.

Q: Can you give more information on the insurance for international teams?

A: Requirements are the same.

Q: When do you have to provide proof of insurance?

A: Proof of insurance must be provided by February 1, 2020.

Q: What type of Ubuntu version are we required to use?

A: Refer to Section 10 of the Rules document.

Q: What is the cutoff date for being 18 and being eligible for the competition?

A: When your registration is submitted. If someone is younger than 18 when the registration is submitted, the submission will not be approved.

Q: Can US Incorporated Business Entity Team with US Citizen Team Lead and Members from foreign nationals and still win full prize?


Q: If a team did not participate in SRC Phase I is in any disadvantage?

A: Totally different challenge, but experience of any kind may be helpful.

Q: Will the JSC event be multiple days as it was for the first SRC?

A: Yes, the SCH event will be multiple days.

Q: Could you provide information on the virtual lunar environment used for the competition? Any specifics on gazebo developments?

A: It is a simulated Lunar environment with craters and rocks.

Q: Would humanoid robot hands be useful for these tasks?

A: No.

Q: Which functioning capability of the robot would be most rewarding?
A: Autonomous navigation and multi robot communication.

Q: Will it be considered that all robots in the team will have communication with challenge solution or between robots of same team for collaboration? Or will communication downtime will be part of simulation?

A: Robots will be able to communicate with each other through ROS communication protocol.

Q: Is there a link between phase 1 and phase 2? (Expect teams to carry over. Or head start in simulation?) Is there a plan for a phase 3 challenge?

A: There is no link between Phase 1 and 2. Phase 3 is TBD.

Q: How accurate will the properties of the regolith be modeled, will there be mobility challenges resultant from environmental conditions.

A: Per the Rules Document, a packet of robot information along with simulation details will be delivered to competitors in January/2020.

Q: When will the ROS simulation environment be available for download?


Q: What version of Gazebo is being targeted?

A: Refer to Section 10 of the Rules document.

Q: Is there a version of ROS that is planned on being used or required?

A: Refer to Section 10 of the Rules document.

Q: Regarding the verification of the code in the qualification round, what will be the criteria to mark it as valid or not? There may be a randomness component that prevents you from getting exactly the same result as the log provided.

A: The solution will be correct if within certain threshold as stated in the Rule's Document.

Q: What kinds of external libraries (e.g. TensorFlow, Keras) may be used?

A: Competitors are free to choose any external libraries as they see fit.

Q: Are you able to configure different robots for the qualifier? Or will the qualifier be a set group?

A: Set group.

Q: Is there a maximum number of robots that can be made?

A: As long as it stays in the mass constraints specified in the Competitor's Packet.

Q: Will the specifications of the host and field computers be specified? For example, will the amount of video card memory be specified?
**A:** Recommended System Requirements: * CPU with 2.4GHz or equivalent with 4 cores / 8 threads; 8 GB RAM, 50GB HDD; Ubuntu 18.04 LTS; ROS Melodic Morenia; Gazebo 9.

**Q:** What kind of hardware specs will the competition round servers be running: CPU, threads, memory, graphics?

**A:** Recommended System Requirements: * CPU with 2.4GHz or equivalent with 4 cores / 8 threads; 8 GB RAM, 50GB HDD; Ubuntu 18.04 LTS; ROS Melodic Morenia; Gazebo 9.

**Q:** The official rules mention that teams will be given sensor/actuator models for a simulated robot. What will the interfaces be like for the sensors/actuators? I.e., what inputs/outputs do we need to handle?

**A:** Per the Rules Document, a packet of robot information along with simulation details will be delivered to competitors in January/2020.

**Q:** Regarding the rovers in the simulation: can the rovers be chosen and customized in the qualification phase?

**A:** No.

**Q:** What form or forms of locomotion will be used? Wheel, legged-ed, treds or other?

**A:** Per the Rules Document, a packet of robot information along with simulation details will be delivered to competitors in January/2020.

**Q:** Will we be using ROS Melodic or Kinetic?

**A:** Refer to Section 10 of the Rules document.

**Q:** In Phase 1, the software was provided via a docker image, where any software could be installed, can we assume a similar way of submitting the software?

**A:** Yes.

**Q:** What significance does the minimum hardware requirements have? Are we allowed to use better hardware for simulation?

**A:** The recommended specification is a baseline performance needed to operate the simulation. Having a higher or lower performance machine will only speed up or slow down the simulation steps, but the end duration time will be equal for all competitors. (CP).

**Q:** Will cloud computing be allowed?

**A:** The cloud computing apply to how we run the simulations. While the usage of cloud computing by competitors is not prohibited, it will not be possible to simulate cloud computing within the simulation.

**Q:** May we submit academic papers from our work?

**A:** Yes. That is why the template we provide them for "how did you do this" will be formatted a specific way - to get folks to publish their work.