DARPA Subterranean Challenge
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Link: https://www.fbo.gov/spg/ODA/DARPA/CMO/HR001118S0016/listing.html

Question & Answer #1

IN THE EVENT OF ANY INCONSISTENCY BETWEEN THE ANSWERS PROVIDED HEREIN AND THE BAA, THE BAA SHALL TAKE PRECEDENCE

Note: Questions below are separated into Programmatic and Technical sections for ease of reference; however, it is recommended that all questions and answers be reviewed.

Programmatic:

Question P1: Can teams submit proposals to both Track A and Track C?

Answer P1: Yes. If submitting a proposal for both Track A and Track C, proposers must submit separate proposals. Note that although proposals may be submitted for consideration for Track A and Track C, it is anticipated that a team may only be awarded a contract for either Track A or Track C but not both. Please refer to Section I.C.1.

Question P2: Can a DARPA-funded Track A team also participate in Track D?

Answer P2: It is anticipated that will be permitted.

Question P3: Are Track A and Track C teams required to participate in all three Circuit Events?

Answer P3: Track A and Track C Teams are required to participate in all Circuit Events for which they are funded. It is envisioned that potential awards will be structured as a base (culminating in the first circuit) and priced options, for the remaining circuits and Final Event. Teams should submit proposals that address all three Circuit Events and the Final Event.

Question P4: Is the challenge available to entries from outside the U.S.?

Answer P4: Yes. Please refer to Section III.A of the BAA.

Question P5: Will posters from Proposers Day be available online?

Answer P5: No, but the Lightning Talk slides are posted on the DARPA Opportunities web page.

Question P6: Can teams compete in the challenge even if their proposal is not selected/funded?

Answer P6: Yes, teams could participate under the Self-Funded tracks (Track B, Track D).

Question P7: When will phase 1 actually start?

Answer P7: The actual Phase 1 start date will be determined by the contract negotiation process. The Program Initiation Meeting is anticipated to be in Fall 2018.

Question P8: Can a non-profit-organization participate in the challenge?

Answer P8: Please refer to Section III.A of the BAA.

Question P9: How will the Virtual Track be populated with new technologies? Will the Systems Track teams be allowed to decide if they want to share their technology?

Answer P9: Please refer to Section I.B.1. of the BAA. Systems Track teams will be required, as part of their proposal deliverables, to provide DARPA with virtual models of their systems (see also Section I.C.2.a).

Question P10: Is there a way online viewers could get in touch with onsite participants and each other to exchange needs and capabilities? (Like a forum/marketplace site)

Answer P10: Yes, contact information for attendees who opted-in is made available as an attendee list, available on the DARPA Opportunities page.

Question P11: How will Track B and D entries be evaluated for qualification?

Answer P11: It is anticipated that qualification criteria will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question P12: Can you tell us more about the Track D challenge format and how we should anticipate to prepare for it?

Answer P12: Details for Track D will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question P13: For simulation teams on Track D, can they compete remotely (from another country) for all (or some) challenges?

Answer P13: See Section IV.B.2.b. of the BAA. Track C teams are only expected to travel for the Final Event. It is anticipated that Track D teams may be able to participate remotely. Periodic site visits by DARPA may be required for qualification purposes. Additional information about Track B and Track D will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question P14: Can platform providers or technology providers be on multiple teams for one track? Is this “proper?”

Answer P14: Yes, providers may consider any teaming strategies that work for them.

Question P15: Do all four tech focus areas need to be proposed for a virtual track submission?

Answer P15: Please refer to Section IV.B.2.a. of the BAA.

Technical:

Question T1: What level of fidelity will be provided in the simulator? (e.g., sensor models, photorealism, mobility models, radio frequency (RF) propagation)?

Answer T1: The SubT Virtual Testbed will be developed to emulate the subterranean environments, mobility challenges, and operational contexts as realistically as possible. Additional details will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T2: With regard to the question of how far a capture platform is expected to penetrate a cave system, please define the total horizontal extent and vertical relief, and if the vertical is sheer or free drop, or highly exposed but against rock.

Answer T2: Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T3: Can you provide (notional) minimum expected dimensions for the entrance to the crawl spaces and constrained passages that are described in the BAA?

Answer T3: It is anticipated that human-crawlable spaces will be the minimum expected dimensions. Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T4: Can you provide guidelines for the desired cost, weight, and volume of the composite robot team?

Answer T4: DARPA does not anticipate providing specific guidelines. It will be up to the performers to determine the ideal composition for their proposed approach. However, the illustrative scenario described in BAA Section I.A.3 includes, e.g., the need for rapid coverage of large-scale environments, ability to navigate constrained passages, and likelihood of attrition.

Question T5: Can a vehicle leave the subterranean space to communicate with the control center, or does the system require a communication system that can transmit that data to the command center while in the underground environment?

Answer T5: It is anticipated that it will be permissible for a system component to exit and re-enter the subterranean space. Additional rules will be released at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T6: Please define cave conditions, e.g., water (how much? drippy? flowing streams? waterfalls? ice?), dust, mud (how wet, how deep), temperature gradient?

Answer T6: Any realistic conditions found in subterranean environments may be considered in-scope for inclusion in the course. Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T7: What types of maps are desired? Can you describe what an expected semantic map would look like? Are high resolution 3D maps of the interior of interest, or should the system "reduce" the maps before transmitting to the outside world?

Answer T7: The maps of interest are those that would be relevant to the illustrative scenario described in Section I.A.3. These may include a variety of map formats including full detail, reduced detail, semantic labeling, heat maps, topological representations, and other approaches. A semantic map could include categorization and labeling of features of interest such as hazards, materials, terrain features, traversability, objects of interest, and other information that may be useful in the illustrative scenario.

Question T8: What examples of known caves might be offered as a measure of how occluded an environment a capture platform will be challenged to navigate, and to what level the system will be expected to return a model with minimal data shadows?

Answer T8: Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T9: Can you list most cases of degraded conditions such as smoke and dust that are to be expected?

Answer T9: Any realistic conditions found in subterranean environments may be considered in-scope for inclusion in the course. Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T10: Are measurements of the structural integrity of the subterranean environment of interest?

Answer T10: While structural integrity characterization is of interest, it is not anticipated to be the focus of the challenge. Please refer to Section I.B. of the BAA. Additional challenge details and objectives will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T11: Are you interested in monitoring/measuring environmental conditions such as CBRN or explosive gasses for human habitability?

Answer T11: While environmental monitoring is of interest, it is not anticipated to be the focus of the challenge. Please refer to Section I.B. of the BAA. Additional challenge details and objectives will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T12: Is discovering the tunnel/cave/structure part of the problem? Or is the location of the entrance(s) a given?

Answer T12: It is anticipated that the location of at least one entrance is known. The challenge is interested in navigating, mapping, and searching subterranean environments rather than initial detection.

Question T13: Will the three challenge domains differ in visual clarity?

Answer T13: Yes, each subdomain course will respectively incorporate their relevant (and potentially differentiating) challenge elements that are characteristic of the real-world environments.

Question T14: Are manned systems and/or human operators allowed in the challenge environment?

Answer T14: It is expected that competitor personnel will not be allowed in the challenge environment. It is expected that high levels of autonomy will be needed to successfully meet the challenge requirements.

Question T15: Will the subterranean environments include water elements that would require submerged or partially submerged operation?

Answer T15: Any realistic conditions found in subterranean environments may be considered in-scope for inclusion in the course. Full submersion may not be required, but it is expected that mud, mist, and water elements could be included. Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T16: Do proposals need to address all technology breakthroughs and areas?

Answer T16: Proposals need to address the full set of capabilities for the track to which they are proposing.

Question T17: Are robots expected to defeat any obstacles (instead of navigating around them)? For example, are they expected to open a door or move an obstacle?

Answer T17: Navigating around, over, and through obstacles is expected. However, finger-like manipulation, grasping, or opening of doors is not currently anticipated.

Question T18: Are there any limitations on use of animals in this program? What kinds of approvals will be required?

Answer T18: Proposers that anticipate involving Human Research Subjects or Animal Use must comply with the approval procedures detailed at http://www.darpa.mil/work-with-us/additional-baa. For projects anticipating animal use, proposals should briefly describe plans for Institutional Animal Care and Use Committee (IACUC) review and approval. Animal studies in the program will be expected to comply with the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals, available at http://grants.nih.gov/grants/olaw/olaw.htm.

Question T19: Is breaching part of the challenge?

Answer T19: Please refer to Section I.B.3 of the BAA for additional details.

Question T20: What is the remaining foot print? Can it leave tracks, wires, small devices, etc., or must it all be self-contained?

Answer T20: It is anticipated that leave-behind components will be permitted. Proposals that intend to include such approaches should address the impact on long-term utility of the system and relevance to the illustrative scenario.

Question T21: What ground truth do you provide for the map?

Answer T21: It is anticipated that only the geo-position of the entrance or entrances of the courses will be made available at the start of the competition run.

Question T22: Does air movement from high pressure zones to low pressure zones need to be a consideration? If so, will you simulate gusts or steady state?

Answer T22: Any realistic conditions found in subterranean environments may be considered in-scope for inclusion in the course. Both steady state and gusts of airflow are possible challenge elements. Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T23: Will the approximate length, slopes, and obstacles of the tunnels/caves be provided ahead of the competition? If yes, when?

Answer T23: Additional details of the expected course elements will be provided at Challenge Kickoff in Fall of 2018 and in advance of each event.

Question T24: Is it permissible to use non-human assets such as K9 (enhanced with technology) as part of the system?

Answer T24: All innovative approaches are welcome to propose to the SubT Challenge BAA. Proposers that anticipate involving Human Research Subjects or Animal Use must comply with the approval procedures detailed at http://www.darpa.mil/work-with-us/additional-baa. For projects anticipating animal use, proposals should briefly describe plans for Institutional Animal Care and Use Committee (IACUC) review and approval. Animal studies in the program will be expected to comply with the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals, available at http://grants.nih.gov/grants/olaw/olaw.htm.

Question T25: Do robots bigger than a “crawling human” have a chance at competing by going around some obstacles or could they get blocked totally?

Answer T25: Some portions of the course may be traversable by larger systems; however, it is anticipated that teams will need to traverse extended human-crawlable portions to be successful.

Question T26: What is the range of depths for the subterranean structures in this challenge?

Answer T26: Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T27: What kind of entrances are expected for the human-made tunnels, For instance, vertical drilled holes? If so, of what diameter?

Answer T27: Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T28: Could a solution require more entrances to be made based on locations identified by the competitor?

Answer T28: Please refer to Section I.B.3 of the BAA.

Question T29: Would it be acceptable for a Track A team to deliver only hardware (and hooks for software control), such that a B or D track team could make use of the hardware?

Answer T29: No, Track A proposals should describe an integrated solution capable of meeting the challenge objectives.

Question T30: Would research aimed at improving tunnel boring (e.g., speed) be excluded from scope of the Challenge/research areas?

Answer T30: Please refer to Section I.B.3 of the BAA.

Question T31: In human-made tunnels, will there be any infrastructure left behind by the builders that can be used?

Answer T31: Additional details of the expected course elements will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T32: Since this could be a search and rescue event, could there be a need to ferry supplies to trapped personnel?

Answer T32: Possibly; additional details of the competition rules will be provided at the Challenge Kickoff anticipated to be held in Fall 2018.

Question T33: Is the operator allowed to remotely assist the robots during navigation, or should navigation be fully autonomous?

Answer T33: Please refer to Section I.B.3 of the BAA.

Question T34: Any limitations on whether the system can be tethered or connected physically to the operator?

Answer T34: No, other than the limitations imposed by the large-scale, potentially dynamic, complex environments.

Question T35: Can the robots be assisted via remote control during navigation?

Answer T35: See Question 46. It is not anticipated that manual teleoperation of individual systems will be viable.

Question T36: Can the system be waived from inspection by Transportation Security Administration (TSA) during transportation to prevent any potential damage?

Answer T36: It is the responsibility of each team to transport or arrange for the transport of their systems to/from events.