The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States ...

- A NASA Primary Objective --- National Aeronautics and Space Act of 1958
The Combating Terrorism Technical Support Office (CTTSO) and the NASA Software, Robotics, and Simulation Division have partnered to assist with CTTSO’s mission of expanding bomb squad focus and capabilities development to meet special threat areas. More specifically, the partnership addresses the CTTSO Improvised Device Defeat/Explosives Countermeasures (IDD/EC) subgroup’s focus area of robotics and remote means, which seeks to develop or enhance platforms, systems, and technologies to remotely conduct activities related to the neutralization or rendering safe of IEDs, unexploded ordnance (UXO), homemade/improvised explosives and their precursors, and enhanced hazard devices containing chemical, biological, or radiological materials.

NASA is proud to partner with CTTSO to effectively use the scientific and engineering resources of the United States. Partnering with CTTSO also allows NASA to explore robotic means of inspection and manipulation in unknown and harsh environments.
The NASA Software, Robotics, and Simulation Division at The NASA Johnson Space Center in Houston, Texas is conducting a one-week, hands-on robotics workshop for bomb technicians selected by the United States Department of Defense Combating Terrorism Technical Support Office (CTTSO). The workshop includes a challenge of specific interest to CTTSO for which participants will attempt to conquer with rapid and inexpensive robotic solutions.

Four teams, of about ten members each, comprised of bomb technicians, NASA engineers, and seasoned robotics students will have five days to analyze the given challenge, prototype solutions, design a robot, manufacture parts, create software, integrate their robot, test their robot, upgrade their robot, and execute the mission to conquer the challenge. The challenge will be difficult, the hours will be long, the failures will be many, the results will be satisfying ... bomb technicians learning how to build & use robots for their real-world challenges, bomb technicians learning what is possible using inexpensive robots, NASA learning the challenges of bomb technicians who are combating terrorism, agencies helping agencies ... AND, hopefully, great solutions that will help bomb technicians all over The World do their most difficult jobs more safely and effectively!
AGENDA

Sunday, July 14th
• Workshop participants arrive in Houston (see "Travel" – page 3)

Monday, July 15th
• 0800 – NASA JSC Badging (Building 110 at NASA JSC front gate)
• 0900 – Workshop Overview, Challenge Review, & Introductions
• 1030 – Safety Briefing
• 1200 – Lunch
• 1300 – Chassis Buildup
• 1800 – Demonstrate & Practice Driving Chassis

Tuesday, July 16th
• 0900 – Group Analysis of Challenge & Divide into Teams
• 1100 – Prototype…Build…Test…Prototype…Build…Test

Wednesday, July 17th
• Prototype…Build…Test…Prototype…Build…Test

Thursday, July 18th
• Prototype…Build…Test…Prototype…Build…Test

Friday, July 19th
• 1000 – Challenge is Available for Teams to Conquer
• 1500 – Group Review of Robotics Workshop
• 1700 – Conclusion (participants are welcome to stay later)
TRAVEL

Location
• NASA Johnson Space Center:
  • https://goo.gl/maps/4mVEVujXVtk

Airports
• Houston Hobby Airport (HOU)
  • 20 miles from NASA JSC
  • Primary Carrier is Southwest Airlines
  • https://goo.gl/maps/6SVZ9xUkmAr
• George Bush Intercontinental Airport (IAH)
  • 50 miles from NASA JSC
  • All carriers except Southwest & is a United Airlines hub
  • https://goo.gl/maps/op7nd7boxH2

Hotels
• Courtyard by Marriot Houston NASA/Clear Lake
  • https://goo.gl/maps/pb2zexyQfo82
• Hilton Houston NASA Clear Lake
  • https://goo.gl/maps/ksBr19PQzUJ2
• Microtel Inn & Suites by Wyndham Houston
  • https://goo.gl/maps/hm39pie2CLq
• Hampton Inn & Suites Houston Clear Lake NASA
  • https://goo.gl/maps/QoraAHDHzFN2
• Comfort Suites NASA - Clear Lake
  • https://goo.gl/maps/6KQtyQxJ5eo
• SpringHill Suites by Marriot - NASA/Webster
  • https://goo.gl/maps/AsHQJdMrphz
NASA Johnson Space Center has served as the home of America’s human spaceflight activities for more than half a century. JSC is home to the nation’s astronaut corps, the International Space Station mission operations, the Orion Program, and a host of future space developments. The center plays a pivotal role in enhancing scientific and technological knowledge to benefit all of humankind.
SAFETY

The Robotics Workshop environment must be safe and the participants must work safely. It is of the utmost importance and concern that each participant remain whole ... NASA demands it and our families deserve it. In this spirit of safety, Robotics Workshop participants will be directed and guided by NASA JSC Safety & Health Handbook, or “1700”, that can be found at https://jschandbook.jsc.nasa.gov/. For the workshop, the most relevant part of 1700 is Part 8 - Safety and Health Practices for Manufacturing, Installation, Repair and Maintenance. We will review 1700, concentrating on Part 8, upon the participants arrival on Monday and participants are also encouraged, but not required, to review Part 8.3, Shop Safety, before their arrival.

In preparation for the Robotics Workshop, participants should be prepared by bringing closed-toe shoes and long pants. NASA will provide Personal Protective Equipment (PPE) such as a safety glasses and hearing protection.

Concerning firearms, there are strict regulations for carrying firearms at NASA but we understand that law enforcement participants may have a need-to-carry. In general, there are no restrictions to carry firearms by Sworn Law Enforcement Officers with Credentials. If you are a Sworn Law Enforcement Officer with Credentials and will be carrying your firearm at NASA, please contact Ronald Lee (Ronald.B.Lee@NASA.gov); Ronald will notify Protective Services that you will carry your firearm at NASA.
We need your team to create a "walking" robot to traverse a series of elevation changes involving stairs and ladders to carry a "heavy" payload down range. Along with competing against other robots built by fellow robotics workshop teams, your robot will also go against some of the best tracked robots on the market such as the MTGR (http://www.robo-team.com/products/mtgr/) and the VANTAGE (https://transcendtactical.com/).

We know you will have ideas before you arrive and to help your ideas come to life, we would like to offer to buy items that will be at NASA awaiting your arrival for your team’s prototyping efforts. For example, maybe you know the perfect actuator for “walking”. To “order your parts”, simply send Candace (Candace.R.Campanelli@NASA.gov) and Lucien (Lucien.Q.Junkin@NASA.gov) an email to let us know what you’d like us to buy and from where to buy it. Since our budget is limited and we are building inexpensive robots, please keep your purchases to a reasonable amount... a few hundred dollars seems reasonable. We will get into the details of the challenge as a group on Monday morning of the workshop. There will be lots of “Can we do ...” & “What will ...” questions answered.
PARTICIPATION

Bomb Technicians
• Law Enforcement and United States Military Service personnel
• Selection of participants is made by the Combating Terrorism Technical Support Office (www.CTTSO.gov)

NASA Engineers & Technicians
• Mostly from NASA's Software, Automation, & Robotics Division at the NASA Johnson Space Center (https://er.jsc.nasa.gov/)
• All participants have mentored K-12 robotics teams
• Some robots that these engineers & technicians have helped create
  • Space Exploration Vehicle (SEV): https://www.nasa.gov/exploration/technology/space_exploration_vehicle/index.html
  • Modular Robotics Vehicle (MRV): https://technology.nasa.gov/patent/MSC-TOPS-74
  • Robonaut: https://robonaut.jsc.nasa.gov/
  • Valkyrie: https://www.nasa.gov/feature/valkyrie

Robotics Students
• Clear Creek ISD Students from the Robonauts robotics team
  • The four robots that these students created are
    • 2016: https://youtu.be/sWHwDfpeYjo
    • 2017: https://youtu.be/x6CtdZ91qzl
    • 2018: https://youtu.be/0fRt6sdKN7Y
    • 2019: https://youtu.be/kyfb8lGAveY
• Katy ISD Students from the CRyptonite robotics team
• Pasadena ISD Students from the High Voltage robotics team
• Woodlands ISD Students from the Texas Torque robotics team
To get “warmed up” on Monday, we will build mobility bases such as this AndyMark Rhino Track Drive (www.andymark.com/Outdoor-Rhino-p/am-3446.htm). This warm-up will help everyone get familiar with the facility, the tools, and the equipment, along with providing a hands-on appreciation of what is available from industry.

In addition, we will also be integrating an FRC-style control system (https://wpilib.screenstepslive.com/s/4485) to make our robots.
ROBOT RESOURCES

Robots
• Robot Shop
  • [http://www.robotshop.com](http://www.robotshop.com)
  • Although not an exhaustive resource, The Robot Shop is a good place to get an overview of current robots and components on the market including education, hobby, and professional robots.

Robot Components
• AndyMark
  • [www.AndyMark.com](http://www.AndyMark.com)
  • Chassis for Monday build will be from AndyMark
• VEX Robotics
  • [www.VEXrobotics.com/VEXpro](http://www.VEXrobotics.com/VEXpro)
  • VEX has a very wide range of robotic components and systems – the VEXpro line is the most applicable

General Components
• McMaster
  • [www.McMaster.com](http://www.McMaster.com)
• DigiKey
  • [www.DigiKey.com](http://www.DigiKey.com)

Control System (National Instruments RoboRIO)
• Worcester Polytechnic Institute (WPI)
  • [https://wpilib.screenstepslive.com/s/4485/m/13503](https://wpilib.screenstepslive.com/s/4485/m/13503)

Software
• C++
  • [http://wpilib.screenstepslive.com/s/4485/m/13810](http://wpilib.screenstepslive.com/s/4485/m/13810)
THANK YOU

Thank you for participating in the July 2019 Robotics Workshop. We look forward to working with you and building robots to help bomb technicians around the world.