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Two Virginia Tech College of Engineering teams, spin-off company TORC, advance in DARPA Robotics Challenge

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BLACKSBURG, Va., July 11, 2013 – Two Virginia Tech College of Engineering teams have advanced to the second phase of the futuristic Robotics Challenge[2] sponsored by the Defense Advanced Research Projects Agency, or DARPA, a subsidiary of the U.S. Department of Defense dedicated to high-tech research. The goal: Create rescue robots that can easily maneuver disaster scenes and save lives.

Each team within the competition -- one based in the Department of Computer Science[3], the other in the Department of Mechanical Engineering[4] -- combines both a strong partnership with additional university research groups and private companies, and includes alumni of the College of Engineering.

Team ViGIR -- short for Virginia-Germany Interdisciplinary Robotics, a collaboration between College of Engineering spin-off company TORC Robotics[5] - based at Virginia Tech's Corporate Research Center; computer science's Center for Human-Computer Interaction[6], and German-based Technische Universitat Darmstadt, a longtime student-exchange partner with the College of Engineering. ViGIR built software and control tools for use in the simulation-based Virtual Robotics Challenge. From 26 total competitors in this track, ViGIR was one of seven teams to advance and receive a robot that will be supplied by DARPA.

The team is headed by TORC's David Conner, a two-time Hokie graduate of mechanical engineering with bachelor's and master's degrees, and an adjunct assistant professor in the Bradley Department of Electrical and Computer Engineering[7]. Co-leading the team is Doug Bowman[8], professor of computer science and director of the Human-Computer Interaction center; and Oskar Von Stryk, professor of computer science and director of a robotics lab at Darmstadt. TORC engineer and two-time graduate of the College of Engineering Jesse Hurdus serves as project manager for the team.

The second Virginia Tech-based team to advance in the two-year DARPA Robotics Challenge is Team THOR[9], an international team of academic and private roboticists headed by Dennis Hong[10] of the Robotics and Mechanisms Laboratory, or RoMeLa[11] for short. The team's advancement to the second round of the robotics competition's physical portion was announced today in Boston at a DARPA-sponsored event, with five other teams moving onward from a total seven.

Team THOR must design and build a new, semi-autonomous robot[12] that will be tasked with driving a jeep-like vehicle, and then exiting the vehicle, walking over rubble, clearing objects blocking a door, and entering a building. The robot then must locate and shut off a leaking valve, install a hose, and climb an industrial ladder. Finally, it must use a power tool and break through a concrete wall.

Teaming with Hong's lab is The University of Pennsylvania's robotics lab, named GRASP, which previously worked with Hong for three continuous championship wins at the international autonomous

robot soccer competition RoboCup; ROBOTIS[13], a Seoul, Korea-based robotics company that partnered to develop an open-platform version of Hong's 18-inch soccer-playing humanoid robot, DARwIn-OP; and Harris Corp. headquartered in Melbourne, Fla.

According to DARPA, recent disasters such as the March 2011 earthquake in Japan that led to the meltdown of a nuclear engineering plant highlighted the limited responses humans could perform in highly dangerous environments. The agency, citing the Defense Department's Humanitarian Assistance and Disaster Relief mission, believes robotic response units can allow humans to quickly respond to such disasters, but from a remote, safe location.

Team ViGIR

For the Virtual Robotics Challenge, Conner and Bowman's team led the design of software to monitor and control a virtual robot in a simulated world, attempting to complete tasks exactly mirroring those of THOR's physical goals - driving, traversing difficult terrain, and manipulating a hose and valve. The goal: the software platforms should allow human operators to remotely control a robot without interruption. Having passed the first phase of the multi-year competition, ViGIR soon will receive a government-furnished robot - nicknamed ATLAS -- built by Boston Dynamics, with which they will compete in the upcoming phases of the competition.

"One of the biggest challenges was that both the robot and simulator were being designed concurrently with our efforts to develop the control software," said Conner of the team's efforts since the challenge began in fall 2012. "Our team maintained its focus on developing the fundamental controls for the robot, and designing an interface that allowed the human operator to focus on things humans do best, such as perception, in order to allow the humans to work with the robot as a team."

Added Bowman, "The goal is to design tools, algorithms, and processes that could be used to allow a humanoid robot and human operators to work together to respond to a real-world disaster ... quickly and effectively, without requiring the robot to be fully autonomous. A carefully designed user interface for the human operator is critical to achieving that goal."

Team ViGIR placed sixth among the top nine groups from an original pool of 26. One of the lead software developers and designers on the team was Felipe Bacim of Porto Alegre, Brazil; a doctoral student in computer science, assisted by several undergraduate students including Benjamin Waxler of Palos Verdes Estates, a recent bachelor's graduate of mechanical engineering; Jacob Sheppard of Winchester Va., and a recent bachelor's graduate in computer science ; and Lindsay Blassic of Oak Hill, Va., and a senior in computer science.

Team THOR

Watch video of the robots: https://vimeo.com/70126134

Hong's team advanced to the second stage of the robotics challenge after a June 13 test visit by members of the DARPA judging panel. During the visit, RoMeLa demonstrated functional subsystems of THOR - a state-of-the-art leg, robust arms, and dexterous hands - that will be part of the completed robot.

THOR - short for Tactical Hazardous Operations Robot - will operate under supervised autonomy, and

be "light, agile, and resilient with perception, planning, and human interface technology that infers a human operator's intent," said Hong, director of RoMeLa, and an associate professor of mechanical engineering.

"Something always goes wrong when you are doing a live demo with robots," said Hong after the DARPA visit. "But every single thing went well and worked exactly as planned. All of the team was exhausted with sleepless nights working in the lab, but at the same time we were all pumped and excited to show off all the incredible technology we have developed. How can one not be excited when showing off robots that will save people's lives?"

In one test, the RoMeLa team demonstrated SAFFiR, the Shipboard Autonomous Fire Fighting Robot funded by the U.S. Office of Naval Research, walking on gravel, plywood debris, and Astroturf. It is planned for SAFFiR to be used to extinguish onboard Navy ship fires in tandem with human firefighters. Similarly, THOR will be capable of traversing the difficult terrain encountered in disaster relief scenarios.

Team THOR is preparing for a more stringent competition this December, as is Team ViGIR. "Time is the biggest challenge," Hong said. "We are developing new robotic platforms based on new technology, and the tasks it needs to do are things that no one could ever do. We need to do all this in just a few months' time." The final competition date is set for December 2014.

Team THOR consists of many of the graduate- and undergraduate-level students that have worked on previous robot platforms. One former student, J.K. Han, now an engineer with ROBOTIS, also will work on the team. Han received his doctoral degree in mechanical engineering from Virginia Tech in spring 2012, and was the chief architect of CHARLI[14],which debuted in spring 2010. He is developing a second, more publicly accessible robot named THOR-OP with commercial open-platform possibilities.

"We truly believe that this is why we do robotics -- developing technology that will save the world," he added. "Though it is a competition with big cash prizes at stake, winning is not the most important thing. Whether we win or lose, if the technology we develop through this project can save even just one person's life, then everything is worth it."

The College of Engineering[15] at Virginia Tech is internationally recognized for its excellence in 14 engineering disciplines and computer science. The college's 6,000 undergraduates benefit from an innovative curriculum that provides a "hands-on, minds-on" approach to engineering education, complementing classroom instruction with two unique design-and-build facilities and a strong Cooperative Education Program. With more than 50 research centers and numerous laboratories, the college offers its 2,000 graduate students opportunities in advanced fields of study such as biomedical engineering, state-of-the-art microelectronics, and nanotechnology. Virginia Tech, the most comprehensive university in Virginia, is dedicated to quality, innovation, and results to the commonwealth, the nation, and the world.

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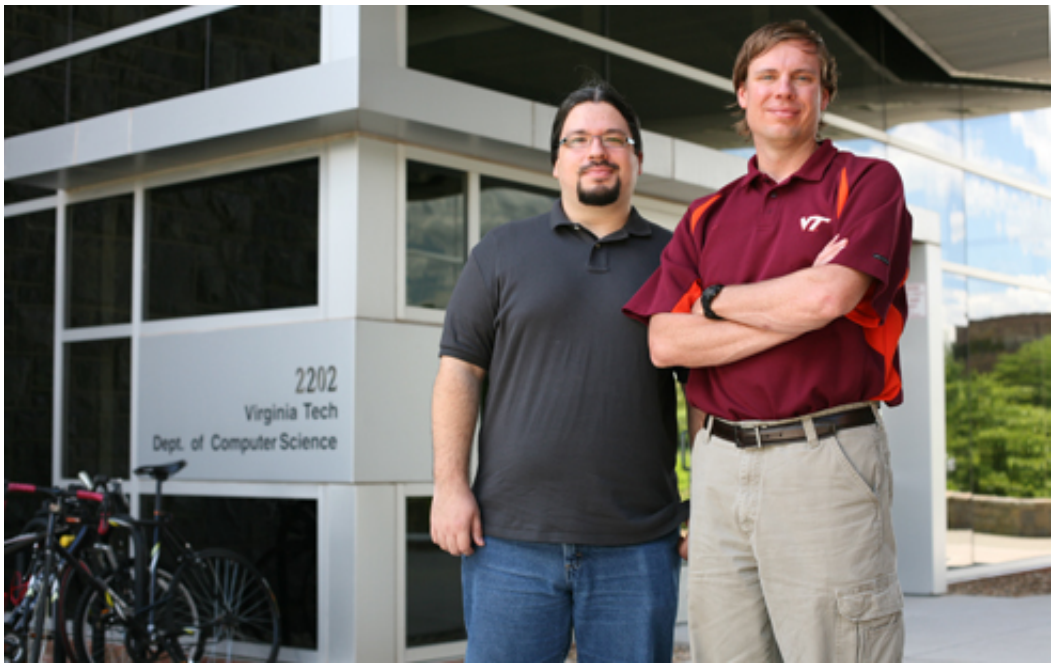

Felipe Bacim and Doug Bowman are part of a Virginia Tech College of Engineering team participating in the Defense Department-sponsored robotics challenge.

Related Links

- Virginia Tech takes on Department of Defense challenge to build disaster-response robots[16]
- Virginia Tech repeats RoboCup soccer win in Adult- and Kid-sized divisions[17]
- RoboCup win could put RoMeLa in forefront of humanoid robot field[18]
- Virginia Tech engineering students build CHARLI, a full-sized humanoid robot[19]

Links

[1]. http://www.vtnews.vt.edu/articles/media-contact/mackay-steven-res.html
[2]. http://www.theroboticschallenge.org
[3]. http://www.cs.vt.edu/
[4]. http://www.me.vt.edu/
[5]. http://www.torcrobotics.com
[6]. http://www.hci.vt.edu/
[7]. http://www.ece.vt.edu
[8]. https://research.cs.vt.edu/3di/user/123
[9]. http://www.thordrc.com/
[10]. http://www.me.vt.edu/_bios/hong_bio.html
[11]. http://www.romela.org
[12]. http://www.vtnews.vt.edu/articles/2012/10/102412-engineering-thorrobotannouncement.html
[13]. http://www.robotis.com/xe/
[14]. http://www.vt.edu/spotlight/innovation/2010-04-26-charli/charli-robot.html
[15]. http://www.eng.vt.edu/
[16]. http://www.vtnews.vt.edu/articles/2012/10/102412-engineering-thorrobotannouncement.html
[17]. http://www.vtnews.vt.edu/articles/2012/06/062812-engineering-robocup.html
[18]. http://www.vt.edu/spotlight/achievement/2011-08-29-robocup/romela.html
[19]. http://www.vt.edu/spotlight/innovation/2010-04-26-charli/charli-robot.html