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The Team Scorpion members with the Scorpion vehicle.

UA Engineers Building Smart Vehicle with Urban Challenge Team

By Ed Stiles
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University of Arizona engineers are part of a team selected by a Department of Defense agency to build a smart vehicle that can drive itself through 60 miles of city traffic.

The team, named Team Scorpion, is led by Raytheon Co. and includes Preferred Chassis Fabrication, of Tucson; Tucson Embedded

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Systems; and iRobot, of Burlington, Mass. The UA engineers are being led by Professor Larry Head, of Systems and Industrial Engineering (SIE), and Professor Jerzy Rozenblit, of Electrical and Computer Engineering (ECE).

Team Scorpion is one of ten teams to have received \$1 million research grants from DARPA (Defense Advanced Research Projects Agency) to build a vehicle for the Urban Challenge. More than 60 teams competed for the grants.

The Urban Challenge race will take place at an undisclosed location in the western United States on Nov. 3, 2007. The vehicles will be tested on simulated military supply missions of 60 miles through a mock urban area.

Raytheon will provide sensor technology and Preferred Chassis will contribute its rock-crawling Scorpion vehicle, which includes a suite of

electronic and digital controls. Tucson Embedded Systems will build the computing platform, and iRobot will provide the perceptual environment to sense where the vehicle is, where obstacles are located and where the other vehicles are.

"Our piece of the project is smaller, but very important," said Head, department head in SIE. "Researchers in our department will do the traffic behaviors, and ECE will

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provide the intelligent systems capability that will integrate our traffic analysis and all the sensor information to make the decisions on how the vehicle will negotiate the environment."

When the vehicle drives through a city, it will have to follow traffic laws and know how the other vehicles will behave, Head said. "So we're going to provide some mission control logic that provides the driving knowledge for controlling the vehicle as it goes through the city.

"We'll be able to say, 'OK, drive around that other vehicle or make a lane change or just follow a vehicle.' If we're coming up to a stop sign and want to make a turn, we'll provide the information on how that's done."

"We'll also solve the routing problem," he said. "How are we going to drive to the waypoints? We'll show the fastest way to do it.

"Those are all SIE-type problems and then the reasoning needed to execute the mission will be handled by Jerzy Rozenblit's team in ECE."

Head noted that SIE has microscopic traffic simulation software that it uses to analyze many traffic networks, including Tucson's. He plans to use that software to test the vehicle.

"We will feed information about the roadway and where other objects are positioned to simulate sensor signals," Head said. "We'll be able to test all the different components using the microscopic traffic simulation system."

The challenge is to build an unmanned, robotic vehicle that can drive itself safely in an urban environment. Researchers are not allowed to send signals to the vehicle or

to in any way influence its progress once it's on the road. At that point, they're simply observers.

The driverless vehicle will have to merge into moving traffic, navigate traffic circles, negotiate busy intersections, and avoid a variety of obstacles, including other moving vehicles in a mock urban setting. The "city" will be designed to include the types of city streets on which military supply missions are conducted.

Just 24 hours before the Urban Challenge race, teams will receive a description of the city's street network. Then five minutes before the race, the teams will receive a file with a set of waypoints that the vehicle must visit. Teams will have six hours to drive 60 miles.

"They may block roads, and they're going to have all kinds of obstacles set up," Head noted.

The top three teams that complete the 60-mile course in less than six hours will receive trophies. Top prize will go to the team that drives the course in the fastest time.

Congress and the Department of Defense are sponsoring the competition to stimulate research on autonomous vehicles that can be sent into situations that present a high risk to soldiers or security personnel. These vehicles could be used in military and homeland security applications, as well as in a variety of industrial and commercial environments, such as high-risk construction and demolition.

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