

West Point cadets get adventures in autonomous manipulation, mobility

U.S. Army

ADELPHI, Md. (Aug. 27, 2012) -- The U.S. Army Research Laboratory's Autonomous Systems Division of the Vehicle Technology Directorate recently sponsored two U.S. Military Academy cadets for three weeks as part of their Academic Individual Advancement Development.

For more than 12 years, Raymond Von Wahlde, Vehicle Technology Directorate, or VTD, has mentored students from the academy on Academic Individual Advancement Development, or AIAD, topics by providing an optional educational experience that would otherwise be personal leave for the cadet. The program provides cadets with an opportunity to observe and implement concepts from their course work over several weeks during a summer internship.

Cadets Julianne Steurer and David Crossley were tasked with designing, building, programming and operating a robotic arm using Dynamixel motors. With consultation from the advanced mobility and manipulation team, the cadets focused the project on a rapid door opening via the "limp arm method."

"The 'limp arm method' allows the joints of the robot arm to become passive (limp), and therefore adapt to the door's motion while the mobile base drives the action of the door, as if pulling on it with a rope," explained Chad Kessens, VTD. "In this way, the robot does not need to possess or develop a highly accurate model for the door. Thus, the robot is able to open a wide range of doors both rapidly and robustly."

Pulling open a door using traditional techniques is very challenging because the motion of the door must be tracked precisely to avoid a buildup of internal forces within the system, said Kessens. He said that such forces can damage the robot, the door, or both.

As part of their project, the cadets did a lot of design work to build a virtual assembly of the robot. They printed its components on a 3D printer and assembled the robot. They also had to create a control for the robot and go through the sequence of events to put the robot into action.

"Being allowed the opportunity to work with such a knowledgeable team really opened my eyes to the possibilities and limitations of robotics," said Crossley. "Seeing robots in science fiction makes it very easy to forget exactly how much work goes into the simplest things, and the men and women who make it all possible. I learned more than I expected, and would like to thank Ray for all his patience and guidance."

Von Wahlde enjoyed working with and helping the cadets throughout the project.

"When they got the robot to open the door, you could hear them cheering," said Von Wahlde. "They were pleased, but there were also some frustrating times when things didn't go as well."

Prior to the door opening, the cadets operated the robot by moving a bolt across a table.

"The first time Julianne got the robot moving the bolt, the robot threw it across the room," said Von Wahlde. "We joked that she was trying to kill us and nicknamed her the terminator."

The project proved successful.

"Pretty impressive I think for less than 14 work days," said Von Wahlde. "They accomplished so much; I had to reorganize the project for a third cadet Stephen Peck who followed after them. And, Chad Kessens will be able to utilize the arm they constructed to conduct more door opening experiments resulting in technical papers and publications."

Von Wahlde said that the project could not have been accomplished without the teamwork of all involved.

"I appreciate Harris Edge, (Advanced Manipulation and Mobility, team lead) allowing the cadets to come. Thanks to Jason Collins (MRI contractor on the AMM team) for providing a starting arm off which to build and the initial instructions on how to operate it, Chad Kessens for use of his door opening technique and Jason Pusey for his door design and to the carpenter shop for making us the door," said Von Wahlde.

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