NovAtel and PSU Robotics

GPS Technology and Unmanned Vehicle Systems

Figure 1: PSU Robotics IGVC Entry

Photo Credit: Adam Dean

Introduction:

An Autonomous Unmanned Vehicle (AUV) is essentially a robot that has the ability to learn from, and navigate through, an environment for long periods of time without the help of a human operator. An autonomous vehicle is able to independently gain knowledge about it's environment, move itself through the environment that it is in, avoid situations that are harmful to either the robot or humans around the robot, and perform tasks without human intervention. Autonomous, intelligent unmanned vehicles are used by governments and educational institutes worldwide. These vehicles are used to enter areas that have been biologically or chemically contaminated, to survey or reconnoiter high risk and dangerous areas that would otherwise be unsurveyable, and hold the potential to become Intelligent Transport Systems (ITS).

AUVSI and IGVC

The Association for Unmanned Vehicle Systems International (AUVSI) is a non-profit organization dedicated to fostering the growth of unmanned autonomous vehicle technologies. With a membership base of over 1,400 members in 50 countries, AUVSI caters to every member of the unmanned vehicle community including government, educational facilities and industry. As an OEM of Global Navigation Satellite Systems (GNSS) components and subsystems, NovAtel® Inc. is a major contributor to the unmanned vehicles industry. GNSS is required for unmanned vehicles to navigate on a pre-planned path. NovAtel's inertial measuring systems are optimal choices for positioning accuracy, to keep the unmanned vehicles on track.

One of the ways that AUVSI stimulates interest and promotes the development of unmanned vehicle technology is to hold four different competitions, which challenge students to create autonomous vehicles for ground, air and underwater use. The Intelligent Ground Vehicle Competition (IGVC) is AUVSI's contest for ground systems.

Entries into IGVC cannot be remotely controlled. Instead, they must be programmed to sense and understand their surroundings and respond accordingly. The robots are required to have built-in obstacle detection and classification to avoid barriers without operator help. Courses are set up with natural and man-made obstacles, including fences, barrels and cones for the unmanned vehicles to navigate. The courses are outlined with white chalk, representing boundary lines. Vehicles must also have the ability to determine where the chalk lines are and must comprehend that the chalk lines represent boundaries. The Penn State Robotics Club (PSU Robotics) entered IGVC for the first time in May 2008, coming in 7th out of 19 overall in the navigation portion of the competition. See Figures 1 and 2. This remarkable accomplishment for the first time team was achieved with the help of NovAtel's positioning technology.

The Penn State Robotics Club (PSU Robotics)

Figure 2: Competing in the navigation challenge at IGVC

Photo Credit: Adam Dean

The Penn State Robotics club was founded in 2004 by a group of students interested in the field of robotics. They began competing in smaller competitions, including the "Sumo-bot" competition and an unmanned vehicle challenge modelled after DARPA's Grand Challenge, called the "Mini-Grand Challenge". With these competitions, interest grew in the club, and members moved onto larger and more complicated robotics competitions. Their entry into 2008's IGVC was a collaborative effort between the PSU Robotics club and the Mechanical and Nuclear Engineering Department at Penn State. A professor from the Mechanical and Nuclear Engineering department had developed a robotic tank platform for the competi-

tion but needed more manpower to develop the software necessary to participate in the competition.

The IGVC team, from the PSU robotics Club, was made up of 12 students, mostly undergraduates. As the team worked on preparing the robot for competition, they had to interface sensors, laser systems, robot behaviour control methods and navigation into their software. All of these components had to work seamlessly in order for the robot to function, which was a very difficult task. According to Rich Mattes, President of the Penn State Robotics Club and team lead for the IGVC, "Developing global planners, local planners, map builders, vision algorithms, and making them all work together was no easy feat".

The navigation system, a NovAtel DL-4*plus* and a Honeywell HG1700 IMU, were smoothly integrated into the software. "We found that the INS/GPS combined coordinates from the DL-4 were so accurate, we were able to use the data without any sort of WAAS or DGPS correction service" says Mattes.

The team used the coordinates and bearings from the DL-4*plus* and the IMU to directly create the robots internal occupancy grid, to navigate the waypoints provided on the obstacle course, and to determine whether or not the robot was moving properly through the course. The 100 Hz data rate ensured that the data was current and accurate when position information was processed.

The team managed to create the software in an astonishing 6 months, although they had little experience with a competition of this magnitude. The team first had to pass a qualifying round in order to compete in the remaining 4 challenges. Out of the 50 teams entered, 19 teams in total made it to the navigation challenge portion of the competition. The PSU Robotics Club came in 7th overall for the navigation challenge. The team is excited to participate in future iterations of the IGVC. "We've learned a lot in our first run, and feel confident that we will do better in our second year" says Mattes.

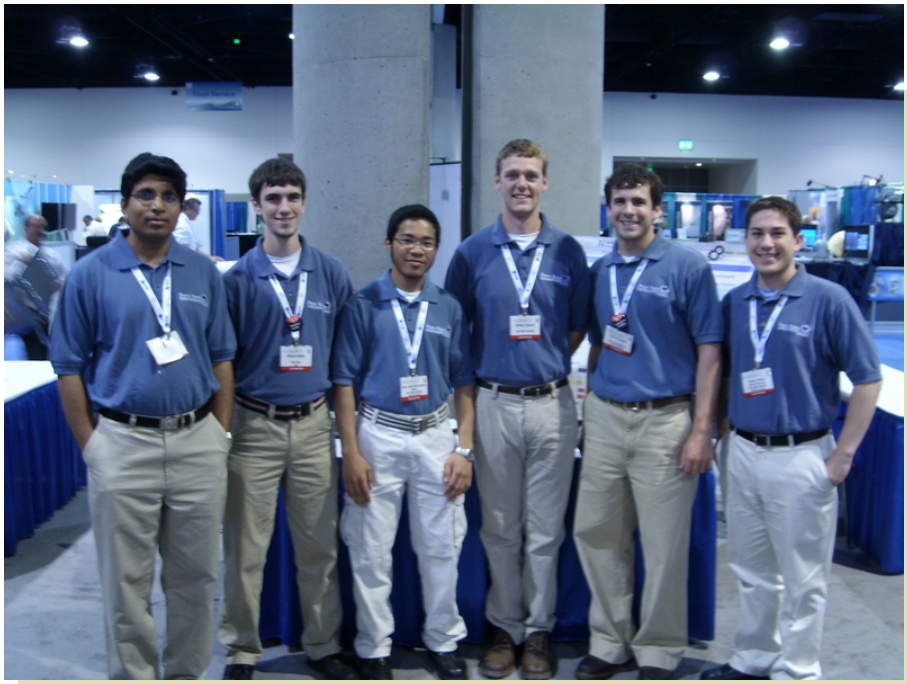

Figure 3: Members of the PSU Robotics Club at AUVSI 2008

Photo Credit: Wan Khalil

Figure 4: PSU Robotics Club UGV- The Nittalion Battalion

Photo Credit: Adam Dean

Summary:

Many industries use unmanned vehicles, from surveillance to automobiles. AUVSI's Intelligent Ground Vehicle Competition (IGVC) encourages students to build innovative technology, furthering the growth of the UGV industry.

The Penn State Robotics club, using NovAtel's Inertial Measurement technology, came in an impressive 7th place out of 19 competitors in the Navigation Challenge portion of the competition.