Colorado State University Student Takes Grand Prize at Colorado Undergraduate Space Research Symposium

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For the second year in a row, Colorado State University took the Grand Prize at the Colorado Undergraduate Space Research Symposium. At this year's Symposium, a cash prize of $1000 was awarded to electrical engineering student Jonathan Cox for his Dynamically Adaptive Inverted Pendulum Platform project. The 2008 Grand Prize winner from Colorado State was the Unmanned Aerial Vehicle, an airplane equipped with sensors and computer chips to fly autonomously.

Robots that are designed to maneuver in rigorous terrain, such as on the surface of the Earth's moon or on Mars, must be programmed to adapt quickly to sudden changes in terrain in order to maintain balance and minimize unwanted travel. Mobile robots used for space or industrial applications, such as for mail distribution or product stocking, often utilize an inverted pendulum, which has its mass above its pivot point, as the control system. While the number of wheels may vary, mobile platforms that rely on two wheels are superior in agility and their ability to maneuver in tight spaces due to the smaller base size.

Conventional inverted pendulum platforms are unstable because they don't adjust for changes in the device's center of mass. An example of this type of platform is the Segway human transporter, which relies on the rider's positioning and acceleration of the drive wheels to maintain balance. But for more advanced robotic applications, such as robots that are fitted with an articulated arm to pick up or move rocks on the surfaces of the moon or nearby planets, conventional platforms are too inflexible and unstable.

Jonathan's solution to these challenges included using Microelectromechanical Sensors (MEMS) on the platform to maintain balance, a gyroscope to sense the rate of rotation, an accelerometer to sense the actual tilt angle, and quadrature encoders on the motors to track position and speed. His custom-etched printed circuit boards were specially designed, and he used foam-filled tires for greater traction.

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Jonathan developed his demo platform in under three months, including the mechanical, electrical and software systems. His inverted pendulum platform is less expensive due to the reduced size and weight, making it practical to use these robots for mobile surveillance during large events, or as tour guides in museums and art galleries.

Robotic systems that require a very small footprint and high mobility are also very beneficial to people with special needs. Designing these platforms to provide a stable standing position for paraplegics or quadraplegics means greater freedom of motion and peace of mind for so many. To view videos and learn more, go to http://www.tuxrobotics.com/.

The Colorado NASA Space Grant Consortium, which sponsors the annual Undergraduate Space Research Symposium, provides Colorado students access to space-related experiences through innovative courses and real-world experiences. Dr. Azer Yalin, associate professor of mechanical engineering, directs CSU faculty and student participation in the Colorado NASA Space Grant Consortium.

"The Space Grant program provides opportunities for our CSU undergraduate students to conduct very exciting and worthwhile research," says Dr. Yalin. "For example, Jon Cox's inverted pendulum could have significant use in both terrestrial and space applications."

The Colorado State University 2009 DemoSat team also took honors at the 2009 Symposium. CSU's team was named a Session Winner for their project entitled HabiSAT: Geographical and Environmental Mapping BalloonSat. The 2009 DemoSat team consisted of team members Chris Reed, Zach Wiggins, Christina Watanuki and John Lucas.