AUTONOMOUS VEHICLE DRIFTING

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Abstract **–** A low-cost unmanned ground vehicle (UGV) designed to benchmark high-speed performance is presented. The E-Maxx four-wheel-drive radio-controlled vehicle equipped with a microcontroller is proposed as a low-cost, high-speed robotic platform useful for military applications. Keeping cost low is a major consideration in the design with the aim of providing a disposable military robot. The vehicle weighs less than ten kilograms making it easily portable by one person. The standard motors are replaced with a brushless DC motor. Lithium-Polymer batteries are used for primary power. The E-Maxx has A-arm suspension similar to full size automobiles; it is hoped that results will be relevant to the performance of full-scale vehicles. A prototype UGV incorporated a Robostix microcontroller with an Atmel Atmega128 processor running at 16MHz.

The project objective is to document vehicle performance under human control as a benchmark for performance of future autonomous operations. The result is a procedure for logging driver inputs and vehicle accelerations, and recording bird's-eye-view video to document vehicle dynamics. The overhead video is an excellent means of communicating the vehicle drifting performance; it complements the logged data. Logged quantities are steering and throttle PWM inputs, and lateral and longitudinal accelerations. Driver/vehicle performance is quantified by entry velocity, exit velocity and total time through a 90° turn on a packed dirt surface. The turn is laid out on the ground directly below the video camera. Entry and exit velocities are measured by ground-fixed optical sensors.

Expert drivers use controlled skidding to minimize time through turns and the long term goal of the project is to automate this drifting technique. A major challenge of working with small high-speed vehicles is to get accurate and fast-update performance data on-board the UGV while the wheels are slipping and the vehicle is yawing at a high rate. Future work includes analysis of the video footage to determine vehicle velocity, slide-slip, yaw angular velocity. A revision is underway to replace the Atmel microcontroller with a Microchip dsPIC33 device. A Simulink blockset is available for the dsPIC processor. This revision promises to make the development of algorithms for autonomy possible for engineers who do not have a strong programming background.

Keywords: unmanned ground vehicles, autonomy, low-cost, high-speed, drifting