CitadeL Engineered Traversing Intelligent System

Matthew Player, Kendall Nowocin, Luther McBee, and Nathan Lett

The Citadel Department of Electrical and Computer Engineering

Extended Abstract

The Intelligent Ground Vehicle Competition provides a design experience that is at the forefront of engineering education. The end goal is product realization through theory-based simulation, prototype validation, and team implementation. The robot's objective in the competition is to autonomously navigate a football field sized obstacle course within five minutes. Some real world applications include lane detection and following, obstacle detection, collision avoidance, driver aides, kinematic controls, and optimized path planning.

The project team members were selected based on prior collaborative experiences in The Citadel's engineering education program. The team had multiple meetings to discuss background experiences, interest areas, and vote team leaders for each semester. Kendall Nowocin, first semester team leader, was responsible for mechanics and non-tactile sensing due to past robotic system integration. Nathan Lett's Air Force experience in Combat Camera was essential for image processing and data communication. Luther McBee was in charge of navigation and component integration because of extensive marine electronics implementation. Matthew Player, second semester team leader, was developer of power distribution, control circuitry, and validation testing because of in-depth knowledge of electronics and environment testing.

The procedure for developing CLETIS was a multistep process involving design methodology and a variety of engineering tools. The design methodology was to: 1) Identify environmental variables to measure, 2) Identify sensor parameters, 3) Design the system in a virtual environment, 4) Develop and prototype subsystems, 5) Validate subsystems, and 6) Integrate subsystems and field test. Steps one through three were done in sequential order for the overall system while steps four and five were done in parallel for multiple subsystems to maximize development efficiency; total completion of steps one through five were a prerequisite for step six, which involves total system integration, implementation, and testing. In step one, flowcharts were created to determine the required sensor data that would be used to make intelligent navigation decisions. Step two analyzed engineering tradeoffs in speed regulation, image processing, pulse width modulation circuits, and etc. using Excel spreadsheets. In step three, computer aided design (Autodesk Inventor 2010) and modeling software (Matlab and Simulink) were used to develop the structural frame and simulate theory based design, respectively. Steps four and five used LabVIEW and a commercial off the shelf robotics controller to develop, prototype, and validate subsystems. A Gantt chart was created using Microsoft Project to give transparency and streamline the development process to the time constraints.

The development of the autonomous vehicle using the previously described design methodology has resulted in on-time delivery of specified components, optimized efficiency, and provided progression transparency for multiple parties. The design is currently on step six, fully validated two of the seven subsystems, and approximately a week ahead of schedule.