SoSE 2016 Paper – ACCEPTED

Proposed Testbed for the Modeling and Control of a System of Autonomous Vehicles

Authors Joaquin Labrado, Berat Erol, Jacqueline Ortiz, Benjamin Champion, Patrick Benavidez, Mo Jamshidi

Abstract

Large scale multi-agent systems are very important in today's world because of their varying uses. The Center for Testing, Evaluation and Control of Heterogeneous Large scale Autonomous Vehicles (TECHLAV) has been tasked to conduct research on Large Scale Autonomous Systems of Vehicles (LSASV). This paper focuses on the proposed testbed system that will help model the large scale system out in the field for Modeling, Analysis and Control tasks for LSASV (MACLAV). The system will use a team of UGVs, UAVs and AUVs to navigate, interact and complete missions through an unknown area as a cohesive unit. A small private cloud provides a computational backbone to the system.

Keywords

Testbed; Modeling; Cooperative SLAM; vSLAM; Robotics; RGB-D; Cloud Computing

WAC 2016 Papers – IN REVIEW

Formation Control Implementation Using Kobuki TurtleBots and Parrot Bebop Drone

Authors Nicolas Gallardo, Karthik Haradi, Berat Erol, Benjamin Champion, Nicolas Gamez, Patrick Benavidez, Mo Jamshidi

Abstract

Formation control of a collection of vehicles is a topic that has generated a lot of interest in the research community. This interest primarily stems from the increased performance and robustness that is provided by a swarm of agents as compared to an individual member. Formation control can be achieved through many approaches. The approach used by this paper is based on a leader-follower premise. A network of agents can be controlled by assigning a leader for each agent in the formation. The group as a whole will be capable of following either a Virtual Leader (VL) or an agent within the group. The algorithm applied to a test-bed consisting of three Kobuki TurtleBot2 robots. Each Turtlebot2 is programmed to follow a pre-defined virtual point in the formation. The test space is monitored by a Parrot Bebop drone hovering overhead that identifies agents uniquely through image processing techniques. The agents can then move in the test space, based on the leader's position, while maintaining a formation.

Keywords

formation control;virtual leader;robot; drone;UGV;UAV;turtlebot;parrot bebop

Cloud-based Control and vSLAM through Cooperative Mapping and Localization

Authors Berat Erol, Satish Vaishnav, Joaquin Labrado, Patrick Benavidez, Mo Jamshidi

Abstract

Simultaneous Localization and Mapping (SLAM) is one of the most widely popular and applied methods designed for more accurate localization and navigation operations. Our experiments showed that vision based mapping helps agents navigate in unknown environments using feature based mapping and localization. Instead of using a classical monocular camera as a vision source, we have decided to use RGB-D (Red, Green, Blue, Depth) cameras for better feature detection, 3D mapping, and localization. This is due to the fact that the RGB-D camera returns depth data as well as the normal RGB data. Moreover, we have applied this method on multiple robots using the concept of cooperative SLAM. This paper illustrates our current research findings and proposes a new architecture based on gathered data from RGB-D cameras, which are the Microsoft Kinect and the ASUS Xtion Pro for 3D mapping and localization.

Keywords

Cooperative SLAM; vSLAM; RGB-D; Cloud Computing; Robotics

Design and Control Architecture of a 3D Printed Modular Snake Robot

Authors Ikram Mohammed, Benjamin Champion, Patrick Benavidez, Nicolas Gallardo, Mo Jamshidi

Abstract

In this paper the design and construction of a 3D printed snake robot is presented. This snake robot has been designed to be able to complete a wide variety of tasks and motions that other snake robots are currently able to preform, such as serpentine motion, rolling and the ability to climb some objects. An approach is also investigated which allows the snake robot to be attached to the end of a serial manipulator robot to increase its available degrees of freedom. A modular design has been focused on, allowing for the fast and low cost generation and implementation of the robotic snake.

Keywords Only the chairs can edit

snake robot; modular robotics; robot; Dynamixel servos; 3D printing

Autonomous Mobile Robot Platform with Multi-Variant Task-Specific End-Effector and Voice Activation

Authors: Jonathan Tapia, Eric Wineman, Patrick Benavidez, Aldo Jaimes, Benjamin Champion, Ethan Cobb, John Parsi, Daniel Clifton, Mo Jamshidi

Abstract

The purpose of the paper is to demonstrate how 3D printing can be used to aid in the construction, design and implementation of an autonomous robot to accomplish a variety of tasks. A robot is designed using Polylactic acid (PLA) that has 3 modes: remote control, autonomous, and voice activation. Using these modes the robot is able to accomplish two specific tasks based on the given end-effector. The two tasks are to open a valve and to pick up an object. In addition analysis on how 3D printing can aid educational use and high risk situations will be presented.

Keywords

Polylactic Acid (PLA); Acrylonitrie Butadiene Styrene (ABS); Mecanum wheel; Solid Works; Voice Recognition; Fused Filament Fabrication (FFF); 3D printing

Converter Design for Solar Powered Outdoor Mobile Robot

Authors: Josue Lambert, Patrick Benavidez, Jacqueline Ortiz, Jack Richey, Shane Morris, Nicolas Gallardo, Mo Jamshidi

Abstract

This project presents a hybrid system implementing the use of solar panels and batteries to power a robot. The main aim is to integrate a charging system which allows the batteries to be charged from solar panels, wall outlet, and a deployable solar charging station. The proposed system is divided in three sections: design of solar panels, design of a battery charger and design of a DC-DC converter with fuzzy MPPT tracking system. This paper will cover only up to the design of the DC-DC converter, as further work is still pending design/results. For the design of the solar panels, different cell configurations were considered. Once the solar panels were designed and fitted to the robot, we determined the battery requirements to meet the robot power load and payload. Lithium Polymer batteries were chosen as the power source for the robot since they have a competitive power density to weight ratio. In order to extend the battery life, and simplify the load, we decided to take two battery banks. One battery is charging while the other battery is discharging. This allowed us to precisely control the battery charging profile without load variations interfering with our measurements. We used a fuzzy maximum power point tracking controller with an primary focus on regulating the power input for a LiPo. Different topologies of DC-DC converters were considered and based on our literature research, it was concluded that a Buck-Boost converter is the most appropriate option when working with solar cells. The following paper discusses all the design specifications, component decisions and construction of the solar powered robot. Various technologies, not used in the robot, are included here as a literature review of the current state of the art. The goal of this paper is summarize the tested methods and results to expedite future researchers in the correct direction.

Keywords

Solar, Renewable, LiPo, Lithium Polymer, Robotics, Fuzzy Controller, Energy