Simultaneous Localization And Mapping For Mobile Robots Introduction And Methods

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Simultaneous Localization And Mapping For Mobile Robots Introduction And Methods ***2022-11-07***

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Topological SLAM John Wiley & Sons
Provides a collection of works produced by COST Action IC1301 with the goal of achieving significant advances in the field of wireless power transmission This book constitutes together information from COST Action IC1301, a group of academic and industry experts seeking to align research efforts in the field of wireless power transmission (WPT). It begins with a discussion of backscatter as a solution for Internet of Things (IoT) devices and goes on to describe ambient backscattering sensors that use FM broadcasting for low cost and low power wireless applications. The book also explores localization of passive RFID tags and augmented tags using nonlinearities of RFID chips. It concludes with a review of methods of electromagnetic characterization of textile materials for the development of wearable antennas. Wireless Power Transmission for Sustainable Electronics: COST WiPE - IC1301 covers textile-supported wireless energy transfer, and reviews methods for the electromagnetic characterization of textile materials for the development of wearable antennas. It also looks at: backscatter RFID sensor systems for remote health monitoring; simultaneous localization (of robots and

objects) and mapping (SLAM); autonomous system of wireless power distribution for static and moving nodes of wireless sensor networks; and more. Presents techniques for smart beam-forming for "on demand" wireless power transmission (WPT) Discusses RF and microwave energy harvesting for space applications Describes miniaturized RFID transponders for object identification and sensing Wireless Power Transmission for Sustainable Electronics: COST WiPE - IC1301 is an excellent book for both graduate students and industry engineers involved in wireless communications and power transfer, and sustainable materials for those fields.

Wireless Power Transmission for Sustainable Electronics World Scientific

This important work is an attempt to synthesize two areas that need to be treated in tandem. The book brings together the fields of robot spatial mapping and cognitive spatial mapping, which share some common core problems. One would expect some cross-fertilization of research between the two areas to have occurred, yet this has begun only recently. There are now signs that some synthesis is happening, so this work is a timely one for students and engineers in robotics.

2019 IEEE 4th Advanced Information Technology, Electronic and Automation Control Conference (IAEAC) Springer Nature

Simultaneous localization and mapping (SLAM) is a process where an autonomous vehicle builds a map of an unknown environment while concurrently generating an estimate for its location. This book is concerned with computationally efficient solutions to the large scale SLAM problems using exactly sparse Extended Information Filters (EIF). The invaluable book also provides a comprehensive theoretical analysis of the properties of the information matrix in EIF-based algorithms for SLAM. Three exactly sparse information filters for SLAM are described in detail, together with two efficient and exact methods for recovering the state vector and the covariance matrix. Proposed algorithms are extensively evaluated both in simulation and through experiments. Contents:IntroductionSparse Information Filters in SLAMDecoupling Localization and MappingD-SLAM Local Map Joining FilterSparse Local Submap Joining Filter Readership: Researchers, academics, and graduate students in robotics and automated systems. Keywords:Simultaneous Localization and Mapping (SLAM);Extended Information Filter (EIF);Sparseness *Simultaneous Localization and Mapping for Mobile Robots: Introduction and Methods* Springer Science & Business Media Simultaneous localization and mapping (SLAM) is a process where an autonomous vehicle

builds a map of an unknown environment while concurrently generating an estimate for its location. This book is concerned with computationally efficient solutions to the large scale SLAM problems using exactly sparse Extended Information Filters (EIF). The invaluable book also provides a comprehensive theoretical analysis of the properties of the information matrix in EIF-based algorithms for SLAM. Three exactly sparse information filters for SLAM are described in detail, together with two efficient and exact methods for recovering the state vector and the covariance matrix. Proposed algorithms are extensively evaluated both in simulation and through experiments.

MRSLAM - Multi-Robot Simultaneous Localization and Mapping Springer Nature Focusing on autonomous robotic applications, this cutting-edge resource offer you a practical treatment of short-range radar processing for reliable object detection at the ground level. This unique book demonstrates probabilistic radar models and detection algorithms specifically for robotic land vehicles. It examines grid based robotic mapping with radar based on measurement likelihood estimation. You find detailed coverage of simultaneous localization and Map Building (SLAM) – an area referred to as the "Holy Grail" of autonomous robotic research. The book derives an extended

Kalman Filter SLAM algorithm which exploits the penetrating ability of radar. This algorithm allows for the observation of visually occluded objects, as well as the usual directly observed objects, which contributes to a robot's position and the map state update. Moreover, you discover how the Random Finite Set (RFS) provides a more appropriate approach for representing radar based maps than conventional frameworks.

Simultaneous Localization and Mapping Via Multi-vehicle Map Merging

Springer Science & Business Media

This monograph is devoted to the theory and development of autonomous navigation of mobile robots using computer vision based sensing mechanism. The conventional robot navigation systems, utilizing traditional sensors like ultrasonic, IR, GPS, laser sensors etc., suffer several drawbacks related to either the physical limitations of the sensor or incur high cost. Vision sensing has emerged as a popular alternative where cameras can be used to reduce the overall cost, maintaining high degree of intelligence, flexibility and robustness. This book includes a detailed description of several new approaches for real life vision based autonomous navigation algorithms and SLAM. It presents the concept of how subgoal based goal-driven navigation can be carried out using vision sensing. The development concept of vision based robots for path/line tracking using

fuzzy logic is presented, as well as how a low-cost robot can be indigenously developed in the laboratory with microcontroller based sensor systems. The book describes successful implementation of integration of low-cost, external peripherals, with off-the-shelf procured robots. An important highlight of the book is that it presents a detailed, step-by-step sample demonstration of how vision-based navigation modules can be actually implemented in real life, under 32-bit Windows environment. The book also discusses the concept of implementing vision based SLAM employing a two camera based system.

Simultaneous Localization and Mapping for an Autonomous Ground Vehicle Springer

This monograph describes a new family of algorithms for the simultaneous localization and mapping (SLAM) problem in robotics, called FastSLAM. The FastSLAM-type algorithms have enabled robots to acquire maps of unprecedented size and accuracy, in a number of robot application domains and have been successfully applied in different dynamic environments, including a solution to the problem of people tracking.

Using Negative Information in Simultaneous Localization and Mapping Springer Science & Business Media

An introduction to the techniques and algorithms of the newest field in robotics. Probabilistic robotics is a

new and growing area in robotics, concerned with perception and control in the face of uncertainty. Building on the field of mathematical statistics, probabilistic robotics endows robots with a new level of robustness in real-world situations. This book introduces the reader to a wealth of techniques and algorithms in the field. All algorithms are based on a single overarching mathematical foundation. Each chapter provides example implementations in pseudo code, detailed mathematical derivations, discussions from a practitioner's perspective, and extensive lists of exercises and class projects. The book's Web site, www.probabilistic-robotics .org, has additional material. The book is relevant for anyone involved in robotic software development and scientific research. It will also be of interest to applied statisticians and engineers dealing with real-world sensor data.

Human Robot Interaction with Vision-based Simultaneous Localization and Mapping for Service Robotics Springer Science & Business Media This book offers a systematic and comprehensive introduction to the visual simultaneous localization and mapping (vSLAM) technology, which is a fundamental and essential component for many applications in robotics, wearable devices, and autonomous driving vehicles. The book starts from very basic mathematic background

knowledge such as 3D rigid body geometry, the pinhole camera projection model, and nonlinear optimization techniques, before introducing readers to traditional computer vision topics like feature matching, optical flow, and bundle adjustment. The book employs a light writing style, instead of the rigorous yet dry approach that is common in academic literature. In addition, it includes a wealth of executable source code with increasing difficulty to help readers understand and use the practical techniques. The book can be used as a textbook for senior undergraduate or graduate students, or as reference material for researchers and engineers in related areas.

A Large Scale Inertial Aided Visual Simultaneous Localization and Mapping (SLAM) System for Small Mobile Platforms

University of Coimbra

This monograph describes a new family of algorithms for the simultaneous localization and mapping (SLAM) problem in robotics, called FastSLAM. The FastSLAM-type algorithms have enabled robots to acquire maps of unprecedented size and accuracy, in a number of robot application domains and have been successfully applied in different dynamic environments, including a solution to the problem of people tracking.

Simultaneous Localization and Mapping Springer Science & Business Media

Autonomous robot

vehicles are vehicles capable of intelligent motion and action without requiring either a guide or teleoperator control. The recent surge of interest in this subject will grow even grow further as their potential applications increase. Autonomous vehicles are currently being studied for use as reconnaissance/exploratory vehicles for planetary exploration, undersea, land and air environments, remote repair and maintenance, material handling systems for offices and factories, and even intelligent wheelchairs for the disabled. This reference is the first to deal directly with the unique and fundamental problems and recent progress associated with autonomous vehicles. The editors have assembled and combined significant material from a multitude of sources, and, in effect, now conviniently provide a coherent organization to a previously scattered and ill-defined field. *Autonomous Robot Vehicles* Artech House

The problem of autonomous navigation is one of efficiently utilizing available information from sensors and intelligently processing that information to determine the state of the robot and its environment. This thesis explores a topic often ignored in the Simultaneous Localization And Mapping (SLAM) literature: the utility of including Negative Information as a means of aiding state-estimation decisions and successfully re-localizing the autonomous agent. The work is motivated by a

low-cost underwater mine neutralization project, which requires that an Autonomous Underwater Vehicle (AUV) successfully localizes itself in a difficult SLAM environment. This thesis presents a new Negative And Positive Scoring (NAPS) algorithm for comparing multiple localization hypotheses and then uses a large number of simulations to quantify the effect of including the often ignored Negative Information (NI). The ultimate conclusion of this thesis, that careful inclusion of Negative Information increases the chances of successful localization across a wide variety of difficult SLAM situations, extends beyond the intended target reacquisition application and is generally applicable to robotic navigation problems.

Robotic Navigation and Mapping with Radar

Springer

Robot self-localization and mapping, or as it is termed Simultaneous Localization and Mapping (SLAM), is a common use case in robot functions. As a complex system that integrates analog sensor based data acquisition and processing SLAM has some accuracy limitations based on the sensors accuracy and environmental conditions that may alter or disrupt sensing [1]. The objective of this project is to demonstrate the benefits of Kalman Filtering on processing of the disruptive or noisy data for the goal of robot localization and mapping. In short Kalman Filter takes the mathematical

model of the process and the measurements. It predicts the future state acquires and adjusts the measurements, updates prediction of next states based on the success or errors of the prior prediction. Kalman Filtering is used in broad spectrum of applications including robotics, financial, medical and any other field where there is a need for improved accuracy of measurements or noise reduction. In our application the accuracy of the mapping and localization is greatly dependent on the environmental conditions that may affect the accuracy of the sensors, mechanical and electrical parameters of the hardware and the complexity and dynamics of the mathematical model of the system. In the interest of the scope of this project, for efficiency and maximum rewards vs. efforts we will ignore the environmental variables and focus on the parameters of the process and noisy measurement system. The robot that is used for the project is equipped with laser range scanner, compass and motor encoders. The motion model of the robot is based on differential drive with dual motors one on each side. The laser range scanner and the other sensors are independent and, when fused with Kalman filtering algorithm, will dramatically reduce the inaccuracies of the measurements.

A Simultaneous Localization and Mapping Implementation Using

Inexpensive Hardware
Springer
This work describes the design, development and implementation of a SLAM (Simultaneous Localization And Mapping) consists of two subsystems: low-cost autonomous robot and a ground station where telemetry data and information of the robot are displayed. The goal of a SLAM algorithm is to leave the robot in an unknown environment identify the environment through sensors and extract a map. The self-location of the robot is important in order to locate properly in the space all the sensor data. So the main objective of this project is to develop a low cost SLAM. In this work it will be used hardware for fast prototyping for the proof of concept and so can use it in future teaching. It compares different SLAM algorithms and choosing the most suitable for this system. The chosen algorithm is studied in depth and implemented in the system. Also it is studied one of the common errors in all the terrestrial robots localization: the odometry errors. It is studied these errors and the needed corrections. Then it is studied the hardware components for the construction of an autonomous robot. All parts are analysed individually and it is explained what task realizes each element. Then also is explained the design of the software (both the robot and the ground station) as well as its implementation and functionalities. The

software is separated into small pieces to make it more modular and this document explains each of these parts and their functions. Finally, it is shown the results obtained after the development of the system. It has designed a series of tests and analysed the results of each one.

FastSLAM University of Coimbra

As mobile robots become more common in general knowledge and practices, as opposed to simply in research labs, there is an increased need for the introduction and methods to Simultaneous Localization and Mapping (SLAM) and its techniques and concepts related to robotics. Simultaneous Localization and Mapping for Mobile Robots: Introduction and Methods investigates the complexities of the theory of probabilistic localization and mapping of mobile robots as well as providing the most current and concrete developments. This reference source aims to be useful for practitioners, graduate and postgraduate students, and active researchers alike.

Robotics and Cognitive Approaches to Spatial Mapping MIT Press

"Robotic Mapping and Exploration" is an important contribution in the area of simultaneous localization and mapping (SLAM) for autonomous robots, which has been receiving a great deal of attention by the research community in the latest few years. The contents are focused on the autonomous mapping

learning problem. Solutions include uncertainty-driven exploration, active loop closing, coordination of multiple robots, learning and incorporating background knowledge, and dealing with dynamic environments. Results are accompanied by a rich set of experiments, revealing a promising outlook toward the application to a wide range of mobile robots and field settings, such as search and rescue, transportation tasks, or automated vacuum cleaning.

FastSLAM LAP Lambert Academic Publishing Simultaneous Localization and Mapping (SLAM) is one of the most widely researched topics in Robotics. It addresses building and maintaining maps within unknown environments, while the robot keeps the information about its location. It is a basic requirement for autonomous mobile robotic navigation in many scenarios, including military applications, search and rescue, environmental monitoring, etc. Although SLAM techniques have evolved considerably in the last years, there are many situations which are not easily handled, such as the case of smoky environments where commonly used range sensors for SLAM, like Laser Range Finders (LRF) and cameras, are highly disturbed by noise induced in the measurement process by particles of smoke. There is an evident lack of solutions to this issue in the literature. This work focuses on SLAM

techniques for reduced visibility scenarios. The main objective of this work is to develop and validate a SLAM technique for those scenarios, using dissimilar range sensors and by evaluating their behavior in such conditions. To that end, a study of several laser-based 2D SLAM techniques available in Robot Operating System (ROS) is firstly conducted. All the tested approaches are evaluated and compared in 2D simulations as well as real world experiments using a mobile robot. Such analysis is fundamental to decide which technique to adopt according to the final application of the work. The developed technique uses the complementary characteristics between a LRF and an array of sonars in order to successfully map the aforementioned environments. In order to validate the developed technique , several experimental tests were conducted using a real scenario. It was verified that this approach is adequate to decrease the impact of smoke particles in the mapping task. However, due to hardware limitations, the resulting map is comprehensibly not outstanding, but much better than using a single range sensor modality. This work is part of the Cooperation between Human and rObotic teams in catastroPhic INcidents (CHOPIN) R&D project, which intends to develop a support system for small scale SaR missions in urban catastrophic scenarios by exploiting the human-robot

symbiosis.
Probabilistic Robotics
World Scientific
Nowadays, a collection of two or more autonomous mobile agents working together are denoted as teams or simply societies of mobile robots. In Multi-Robot Systems (MRS) robots are allowed to coordinate with each other in order to achieve a speci□c goal. In these systems, robots are far less capable as an entity, but the real power lies in the cooperation of the team. The simplicity of MRS has produced a wide set of applications such as in military tasks , searching for survivors in disaster hit areas, parallel and simultaneous transportations of vehicles and delivery of payloads. The success of single-robot Simultaneous Localization and Mapping (SLAM) in the past two decades has led to research on Multi-Robot Simultaneous Localization and Mapping (MRSLAM). A team of robots is able to map an unknown environment faster and more and reliably. However, MRSLAM raises several challenging problems, including map fusion, unknown robot poses and scalability issues. Rao-Blackwellized Particle Filters (RBPFs) have been demonstrated as an e□ective solution to the problem of single robot Simultaneous Localization and Mapping (SLAM), and a few extensions to teams of robots exist. However, these approaches are usually characterized by strict assumptions on both communication bandwidth and prior knowledge on relative poses between

teammates. In this dissertation, we describe in detail a distributed MRSLAM approach using RBPF in the case of possibly constrained communication and unknown relative initial poses using Robot Operating System (ROS). We consider the environment as a two dimensional space with several obstacles, which are explored by a team of cooperative mobile robots, equipped with laser sensors. In order to e□ciently tackle the problem, the cooperation between agents and the memory space available for observations storage must be taken into account. Experimental results using a team of up to two robots in a large indoor area show the robustness and performance of the approach.

Simultaneous Localization and Mapping with Sparse and Uncertain Visual Measurements in an Indoor Environment IGI Global

In this chapter, we proposed a vision-based approach to bearing-only SLAM in a 2dimensional space. We assumed the environment contained several visually distinguishable landmarks. This approach is inspired from techniques used in stereo vision and Structure From Motion. Our landmark initialization method relies solely on the bearing measurements from a single camera. This method does not require information from an odometer or a range sensor. All the object positions can be estimated in a landmark-

based frame. The trade-off is that this method requires the robot to be able to move in a straight line for a short while to initialize the landmarks. The proposed method is particularly accurate and useful when the robot can guide itself in a straight line by visually locking on static objects. Since the method does not rely on odometry and range information, the induced map is up to a scale factor only. In our method, the distance L1 - L 2 of two landmarks is taken as the measurement unit of the map. The selection of L1 and L 2 is critical for the accuracy of.

Bearing-only Simultaneous Localization and Mapping for Vision-Based Mobile Robots

Simultaneous Localization and Mapping (SLAM) has seen tremendous interest amongst the research community in recent years due to its ability to make the robot truly independent in navigation. Visual Simultaneous Localization and Mapping (VSLAM) is when an autonomous mobile robot is embedded with a vision sensor such as monocular, stereo vision, omnidirectional or Red Green Blue Depth (RGBD) camera to localize and map an unknown environment. The purpose of this research is to address the problem of environmental noise, such as light intensity in a static environment, which has been an issue that makes a Visual Simultaneous Localization and Mapping (VSLAM) system to be ineffective. In this study, we have introduced a Light Filtering Algorithm into

the Visual Simultaneous Localization and Mapping (VSLAM) method to reduce the amount of noise in order to improve the robustness of the system in a static environment, together with the Extended Kalman Filter (EKF) algorithm for localization and mapping and A* algorithm for navigation. Simulation is utilized to execute experimental performance.