

A novel method of unmanned surface vehicle autonomous cruise

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Abstract

Purpose – This paper aims to propose a new method for combining global path planning with local path planning, to provide an efficient solution for unmanned surface vehicle (USV) path planning despite the changeable environment. Path planning is the key issue of USV navigation. A lot of research works were done on the global and local path planning. However, little attention was given to combining global path planning with local path planning.

Design/methodology/approach – A search of shortcut Dijkstra algorithm was used to control the USV in the global path planning. When the USV encounters unknown obstacles, it switches to our modified artificial potential field (APF) algorithm for local path planning. The combinatorial method improves the approach of USV path planning in complex environment.

Findings – The method in this paper offers a solution to the issue of path planning in changeable or unchangeable environment, and was confirmed by simulations and experiments. The USV follows the global path based on the search of shortcut Dijkstra algorithm. Both USV achieves obstacle avoidances in the local region based on the modified APF algorithm after obstacle detection. Both the simulation and experimental results demonstrate that the combinatorial path planning method is more efficient in the complex environment.

Originality/value – This paper proposes a new path planning method for USV in changeable environment. The proposed method is capable of efficient navigation in changeable and unchangeable environment.

Keywords Navigation, Path planning, Autonomous robots, USV, Dijkstra

Paper type Research paper

1. Introduction

Over the past several decades, unmanned surface vehicle technology has been greatly improved with the advance of computer capabilities (Ham *et al.*, 2015). It attracted much attention for their ability to perform dangerous and time-consuming missions for military and civilian purposes such as environmental monitoring, survey and inspection of marine structures after natural disasters or large-scale accidents (Murphy *et al.*, 2011).

To perform these missions using unmanned surface vehicle (USV), autonomous navigation is a central capability, as USV can move between a starting point and a target point without human intervention (Tann and Bucknall, 2013). Robot navigation involves solving the path planning or obstacle avoidance problem to generate a feasible path and to optimize this path with respect to certain criteria (Gu and Cao, 2011; Kim *et al.*, 2014). Obstacle avoidance is consisted of global

obstacle avoidance and local obstacle avoidance, and the problem of autonomous obstacle avoidance has been studied intensively in the past (Markus *et al.*, 2014; Chen *et al.*, 2013).

For local path planning, different algorithms bring different effect of obstacle avoidance in unknown environment. Artificial potential field (APF) is a typical path-planning algorithm for robots (Khatib, 1986). Although it is very suitable for low-level real-time control of robot due to its explicit physical implication and simple mathematical description (Zhang *et al.*, 2010; Shu *et al.*, 2014), there are still some problems in the original algorithm, and some substantial improvements were made. Bacterial potential field, which improves the APF with Bacterial evolutionary algorithm (Moensiel *et al.*, 2015; Byrne *et al.*, 2014; Pétrès *et al.*, 2012), ensures a feasible, optimal and safe path. For dynamic obstacles, Liu and Bucknall (2015) presented the novel

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Unmanned A Novel

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Unmanned Dan Fesperman, 2015-06-23 From the widely acclaimed author of *The Prisoner of Guantamo* and *The Double Game* an electrifying timely psychologically gripping descent into the hidden expanding world of drone warfare Timely and disturbing An exciting story expertly told *The Washington Post Book World* As an F 16 fighter pilot Darwin Cole was a family man on top of his world Now he is a washout drunk living alone in a trailer in the Nevada desert Haunted by what he saw on the display of the Predator drone he piloted an Afghan child running for her life he reluctantly joins three journalists seeking to discover the identity of the anonymous and possibly rogue intelligence operative who called the shots in his last ill fated mission On the trail of this operative Cole and his new allies will discover the dark heart of our surveillance culture with connections to intelligence to the military and to the unchecked private contractors who stand to profit richly from the advancing technology technology not just for use over there but for right here right now [Advanced UAV Aerodynamics, Flight Stability and Control](#) Pascual Marqués, Andrea Da Ronch, 2017-04-19 Comprehensively covers emerging aerospace technologies Advanced UAV aerodynamics flight stability and control Novel concepts theory and applications presents emerging aerospace technologies in the rapidly growing field of unmanned aircraft engineering Leading scientists researchers and inventors describe the findings and innovations accomplished in current research programs and industry applications throughout the world Topics included cover a wide range of new aerodynamics concepts and their applications for real world fixed wing airplanes rotary wing helicopter and quad rotor aircraft The book begins with two introductory chapters that address fundamental principles of aerodynamics and flight stability and form a knowledge base for the student of Aerospace Engineering The book then covers aerodynamics of fixed wing rotary wing and hybrid unmanned aircraft before introducing aspects of aircraft flight stability and control Key features Sound technical level and inclusion of high quality experimental and numerical data Direct application of the aerodynamic technologies and flight stability and control principles described in the book in the development of real world novel unmanned aircraft concepts Written by world class academics engineers researchers and inventors from prestigious institutions and industry The book provides up to date information in the field of Aerospace Engineering for university students and lecturers aerodynamics researchers aerospace engineers aircraft designers and manufacturers [The Cambridge History of the American Novel](#) Leonard Cassuto, Clare Virginia Eby, Benjamin Reiss, 2011-03-24 This ambitious literary history traces the American novel from its emergence in the late eighteenth century to its diverse incarnations in the multi ethnic multi media culture of the present day In a set of original essays by renowned scholars from all over the world the volume extends important critical debates and frames new ones Offering new views of American classics it also breaks new ground to show the role of popular genres such as science fiction and mystery novels in the creation of the literary tradition One of the original features of this book is the dialogue between the essays highlighting cross currents between authors and their works as well as across historical periods While

offering a narrative of the development of the genre the History reflects the multiple methodologies that have informed readings of the American novel and will change the way scholars and readers think about American literary history **Wave and Tidal Energy** Carlos Guedes Soares,Matthew Lewis,2020-06-25 Concerns relating to energy supply and climate change have driven renewable energy targets around the world Marine renewable energy could make a significant contribution to reducing greenhouse gas emissions and mitigating the consequences of climate change while providing a high technology industry The conversion of wave and tidal energy into electricity has many advantages Individual tidal and wave energy devices have been installed and proven with commercial arrays planned throughout the world The wave and tidal energy industry has developed rapidly in the past few years therefore it seems timely to review current research and map future challenges Methods to improve understanding of the resource and interactions between energy extraction the resource and the environment are considered such as resource characterisation including electricity output design considerations e g extreme and fatigue loadings and environmental impacts at all timescales ranging from turbulence to decadal and all spatial scales from device and array scales to shelf sea scales **Hirell. A Novel** John Saunders (Novelist.),1872 **Proceedings of the International Conference on Artificial Intelligence and Computer Vision (AICV2021)** Aboul Ella Hassanien,Abdelkrim Haqiq,Peter J. Tonellato,Ladjel Bellatreche,Sam Goundar,Ahmad Taher Azar,Essaid Sabir,Driss Bouzidi,2021-05-28 This book presents the 2nd International Conference on Artificial Intelligence and Computer Visions AICV 2021 proceeding which took place in Settat Morocco from June 28 to 30 2021 AICV 2021 is organized by the Scientific Research Group in Egypt SRGE and the Computer Networks Mobility and Modeling Laboratory IR2M Hassan 1st University Faculty of Sciences Techniques Settat Morocco This international conference highlighted essential research and developments in the fields of artificial intelligence and computer visions The book is divided into sections covering the following topics Deep Learning and Applications Smart Grid Internet of Things and Mobil Applications Machine Learning and Metaheuristics Optimization Business Intelligence and Applications Machine Vision Robotics and Speech Recognition Advanced Machine Learning Technologies Big Data Digital Transformation AI and Network Analysis Cybersecurity Feature Selection Classification and Applications **Advances in Maritime Technology and Engineering** Carlos Guedes Soares,Tiago A. Santos,2024-05-08 Advances in Maritime Technology and Engineering comprises a collection of the papers presented at the 7th International Conference on Maritime Technology and Engineering MARTECH 2024 held in Lisbon Portugal on 14 16 May 2024 This Conference has evolved from the series of biannual national conferences in Portugal which have become an international event reflecting the internationalization of the maritime sector and its activities MARTECH 2024 is the seventh of this new series of biannual conferences This book comprises 142 contributions that were reviewed by an International Scientific Committee Advances in Maritime Technology and Engineering is dedicated to maritime transportation ports as well as maritime safety and reliability It further comprises sections dedicated to ship design cruise

ship design and to the structural aspects of ship design such as ultimate strength and composites subsea structures as pipelines and to ship building and ship repair The Proceedings in Marine Technology and Ocean Engineering series is dedicated to the publication of proceedings of peer reviewed international conferences dealing with various aspects of Marine Technology and Ocean Engineering The series includes the proceedings of the following conferences the International Maritime Association of the Mediterranean IMAM conferences the Marine Structures MARSTRUCT conferences the Renewable Energies Offshore RENEW conferences and the Maritime Technology MARTECH conferences The Marine Technology and Ocean Engineering series is also open to new conferences that cover topics on the sustainable exploration of marine resources in various fields such as maritime transport and ports usage of the ocean including coastal areas nautical activities the exploration and exploitation of mineral resources the protection of the marine environment and its resources and risk analysis safety and reliability The aim of the series is to stimulate advanced education and training through the wide dissemination of the results of scientific research

Interdisciplinary Evolution of the Machine Brain Wenfeng Wang, Hengjin Cai, Xiangyang Deng, Chenguang Lu, Limin Zhang, 2021-01-04 This book seeks to interpret connections between the machine brain mind and vision in an alternative way and promote future research into the Interdisciplinary Evolution of Machine Brain IEMB It gathers novel research on IEMB and offers readers a step by step introduction to the theory and algorithms involved including data driven approaches in machine learning monitoring and understanding visual environments using process based perception to expand insights mechanical manufacturing for remote sensing reconciled connections between the machine brain mind and vision and the interdisciplinary evolution of machine intelligence This book is intended for researchers graduate students and engineers in the fields of robotics Artificial Intelligence and brain science as well as anyone who wishes to learn the core theory principles methods algorithms and applications of IEMB

Autonomous Revolution: Strategies, Threats and Challenges Umair B. Chaudhry, Hamid Jahankhani, 2025-07-24 This book offers a comprehensive dive into the rapidly evolving world of autonomous vehicles and their pivotal role in modern data collection and mission critical operations From unmanned vehicles UVs navigating complex urban landscapes to traversing remote environments the integration of advanced algorithms and cloud based infrastructure enables real time data acquisition and processing Topics covered include resilient navigation systems bio inspired evolution for safer collaboration and the crucial governance and security challenges facing land air and sea based UVs Additionally the book explores emerging threats such as cyber physical vulnerabilities counter drone technologies and the need for secure Flying Ad Hoc Networks FANETs The future of UVs is further examined through the lens of quantum computing pushing the boundaries of autonomous navigation and decision making By compiling these scattered and essential topics into one resource this book serves as a vital reference for professionals researchers and policymakers seeking to understand and shape the future of autonomous systems

Advancements in Smart Computing and Information Security Sridaran Rajagopal, Parvez

Faruki,Kalpesh Popat,2023-01-10 This two volume constitutes the refereed proceedings of the First International Conference on Advancements in Smart Computing and Information Security ASCIS 2022 held in Rajkot India in November 2022 The 37 full papers and 19 short papers presented were thoroughly reviewed and selected from the 206 submissions The papers are organized in topical sections on artificial intelligence smart computing cyber security industry *AI and Robotics*

Applications in Disaster Response Menka Chopra,2025-01-24 AI and Robotics Applications in Disaster Response explores the innovative use of artificial intelligence and robotics in managing emergency situations We discuss how AI driven tools and robotic systems can aid search and rescue missions risk assessment and disaster recovery operations The book highlights real world case studies including the use of drones for disaster mapping and robots for hazardous material handling We also address the ethical implications and challenges of deploying AI in critical situations This book is an essential guide for emergency responders policymakers and technology enthusiasts aiming to leverage AI and robotics for disaster management

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Distributed Computer and Communication Networks: Control, Computation, Communications Vladimir M. Vishnevskiy,Konstantin E. Samouylov,Dmitry V. Kozyrev,2021-12-14 This book constitutes the refereed post conference proceedings of the 24th International Conference on Distributed and Computer and Communication Networks DCCN 2021 held in Moscow Russia in September 2021 The 26 revised full papers and 3 revised short papers were carefully reviewed and selected from 151 submissions The papers cover the following topics computer and communication networks analytical modeling of distributed systems and distributed systems applications **Cleveden. [A Novel.]** Stephen Yorke (pseud. [i.e. Mary Linskill.]),1876 **Advanced Autonomous Vehicle Design for Severe Environments** V.V.

Vantsevich,M.V. Blundell,2015-10-20 Classical vehicle dynamics which is the basis for manned ground vehicle design has

exhausted its potential for providing novel design concepts to a large degree At the same time unmanned ground vehicle UGV dynamics is still in its infancy and is currently being developed using general analytical dynamics principles with very little input from actual vehicle dynamics theory This technical book presents outcomes from the NATO Advanced Study Institute ASI Advanced Autonomous Vehicle Design for Severe Environments held in Coventry UK in July 2014 The ASI provided a platform for world class professionals to meet and discuss leading edge research engineering accomplishments and future trends in manned and unmanned ground vehicle dynamics terrain mobility and energy efficiency The outcomes of this collective effort serve as an analytical foundation for autonomous vehicle design Topics covered include historical aspects pivotal accomplishments and the analysis of future trends in on and off road manned and unmanned vehicle dynamics terramechanics soil dynamic characteristics uncertainties and stochastic characteristics of vehicle environment interaction for agile vehicle dynamics modeling new methods and techniques in on line control and learning for vehicle autonomy fundamentals of agility and severe environments mechatronics and cyber physics issues of agile vehicle dynamics to design for control energy harvesting and cyber security and case studies of agile and inverse vehicle dynamics and vehicle systems design including optimisation of suspension and driveline systems The book targets graduate students who desire to advance further in leading edge vehicle dynamics topics in manned and unmanned ground vehicles PhD students continuing their research work and building advanced curricula in academia and industry and researchers in government agencies and private companies

The Novels and Romances of Edward Bulwer Lytton Edward Bulwer Lytton Baron Lytton, 1898

Advances in Visual Computing George Bebis, Richard Boyle, Bahram Parvin, Darko Koracin, Fatih Porikli, Sandra Skaiff, Alireza Entezari, Jianyuan Min, Daisuke Iwai, Amela Sadagic, Carlos Scheidegger, Tobias Isenberg, 2016-12-09 The two volume set LNCS 10072 and LNCS 10073 constitutes the refereed proceedings of the 12th International Symposium on Visual Computing ISVC 2016 held in Las Vegas NV USA in December 2016 The 102 revised full papers and 34 poster papers presented in this book were carefully reviewed and selected from 220 submissions The papers are organized in topical sections Part I LNCS 10072 comprises computational bioimaging computer graphics motion and tracking segmentation pattern recognition visualization 3D mapping modeling and surface reconstruction advancing autonomy for aerial robotics medical imaging virtual reality computer vision as a service visual perception and robotic systems and biometrics Part II LNCS 9475 applications visual surveillance computer graphics and virtual reality

Risk Detection and Cyber Security for the Success of Contemporary Computing Kumar, Raghvendra, Pattnaik, Prasant Kumar, 2023-11-09 With the rapid evolution of technology identifying new risks is a constantly moving target The metaverse is a virtual space that is interconnected with cloud computing and with companies organizations and even countries investing in virtual real estate The questions of what new risks will become evident in these virtual worlds and in augmented reality and what real world impacts they will have in an ever expanding internet of things IoT need to be answered Within continually connected societies that require

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