

EXHIBIT 1033



All



ADVANCED SEARCH

Conferences > 2007 International Symposium ... ?

Smart Parking: An Application of Optical Wireless Sensor Network

Publisher: IEEE

[Cite This](#)

PDF

<< Results | < Previous | Next >

Jatuporn Chinrungrueng ; Udomporn Sunantachaikul ; Satien Triamlumlert **All Authors** ***89
Cites in
Papers2
Cites in
Patents2974
Full
Text Views

Alerts

[Manage Content Alerts](#)[Add to Citation Alerts](#)

Abstract

Document Sections

1. Introduction
2. A Review of Smart Parking Systems
3. Problem Settings for Application of WSNs to Monitoring Parking Garages
4. Conclusions

[Authors](#)[Figures](#)[References](#)[Citations](#)[Keywords](#)Downl
PDF

Abstract: Parking problems are commonplace in most major cities. The limited availability of parking results in traffic congestion, air pollution as well as driver frustration. The... [View more](#)

► Metadata

Abstract:

Parking problems are commonplace in most major cities. The limited availability of parking results in traffic congestion, air pollution as well as driver frustration. The price for parking expansion is usually prohibitive or extremely high. Recently researchers turned to applying technologies for efficient parking management. In our previous work, we have developed an optical wireless sensor network (WSN) for traffic monitoring. We have demonstrated our system to the public in several exhibitions. It is realized that this simple invention could be applied to monitor vehicles in a parking garage. The system can then inform drivers of the number of available parking spaces and in which area should they be directed to. This kind of system should avoid driver's frustration in trying endlessly to find a parking space in a crowded parking garage. This paper describes our work to modify our original WSN and applies it to parking garages. Problems associated to applying our original WSN to parking garage are explained, and solutions are proposed

Published in: 2007 International Symposium on Applications and the Internet Workshops

Date of Conference: 15-19 January 2007

DOI: 10.1109/SAINT-W.2007.98

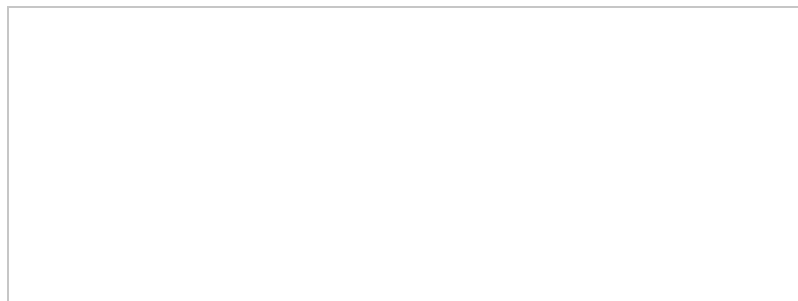
Contents

SECTION 1. Introduction



Parking problems are commonplace in most major cities. The limited availability of parking results in traffic congestion, air pollution, as well as driver frustration. The price for parking expansion is usually prohibitive or extremely high. Smart parking is a parking garage that utilizes various technologies to efficiently manage the garage. Since early 1970s, smart parking have been implemented throughout Europe, the United Kingdom and Japan. Early systems displayed to drivers parking information such as the availability status and/or the number of available spaces. This system is still widely used today and becomes a necessary part of new parking garages in major cities. More complex smart parking incorporates more advanced technologies to serve customers of different needs [3]. For example, parking garages in large shopping complexes can direct customers to available spaces close to where they want to shop. While at the same time some parking garages can employ security measures such as collecting vehicle's license plate and verifying it when checking out. Smart payment systems such as smart meters, smart cards, mobile communications and e-parking may also be incorporated. Park and ride facilities may also display real time information on the departure and arrival time of the next bus or train, in addition to parking availability. Such system will encourage high-way commuters exploiting public transportation. In a broadest and simplest sense, smart parking permits an optimization of existing parking spaces in order to best satisfy the customers' needs. To name a few, these include minimizing the time that customers spend on trying to find a parking space, provide real-time information on parking spaces, and provide smart payment options.

Obviously, an indispensable element of smart parking is vehicle detectors. Inductive loop is the most widely used detector today. New parking garages will at least install them at the entrances and exits. It yields an accurate vehicle count. The major drawbacks, however, include difficulties in installation and maintenance processes that involve road surface excavation [2]. This installation and maintenance can prevent normal operation within under-operation parking garages. Other detectors include video cameras, ultrasonic sensors, and doppler radars. To avoid installation and maintenance difficulties, we proposed an optical wireless sensor network (WSN) to monitor vehicular traffic [1]. It was a simple WSN that based on a star-topology as shown in Figure 1. The network consisted of a server node and a number of sensor nodes. The server node served as the central point for collecting traffic data from all sensor nodes installed at various monitored points. The sensor node was equipped with an optical sensor to detect passing vehicles. The use of optical sensor yielded very accurate count as well as position of vehicles. The design of our polling MAC protocol allowed an efficient-power mode of operation. Several tests and demonstrations at various exhibitions showed that our WSN was reliable and robust in counting vehicles and in relaying data to the central server.





IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.

A study on ship automatic berthing with
auxiliary devicesVan Luong Tran¹, Namkyun Im²  ¹ The Faculty of Navigation, Vietnam Maritime University² The Faculty of Marine Transportation System, Mokpo National Maritime University

Available online 16 March 2016, Version of Record 16 March 2016.

 What do these dates mean?Show less  Outline |  Share  Cite<https://doi.org/10.2478/IJNAOE-2013-0090> [Get rights and content](#) Under a Creative Commons [license](#) 

ABSTRACT

The recent researches on the automatic berthing control problems have used various methods such as expert system, fuzzy logic controllers and artificial neural network (ANN) as one of the most effective and attractive options. In a marine context, the berthing procedure in which both human experience and intensive control operations are taken into account. In this study, ANN is applied to design the controllers for auxiliary devices such as bow thruster and tug. Using back-propagation algorithm, we try to get a minimal error between output values and desired values of four control parameters: bow thruster, bow thruster and tug. Then, computer simulations of automatic berthing effectiveness of the system. The results of the simulations showed good performance of the control system.



Previous

KEY WORDS

What do these dates mean?



Publication milestones

The dates displayed for an article provide information on when various publication milestones were reached at the journal that has published the article. Where applicable, activities on preceding journals at which the article was previously under consideration are not shown (for instance submission, revisions, rejection).

The publication milestones include:

- **Received:** The date the article was originally submitted to the journal.
- **Revised:** The date the most recent revision of the article was submitted to the journal. Dates corresponding to intermediate revisions are not shown.
- **Accepted:** The date the article was accepted for publication in the journal.
- **Available online:** The date a version of the article was made available online in the journal.
- **Version of Record:** The date the finalized version of the article was made available in the journal.

More information on publishing policies can be found on the [Publishing Ethics Policies](#) page. View our [Publishing with Elsevier: step-by-step](#) page to learn more about the publishing process. For any questions on your own submission or other questions related to publishing an article, [contact our Researcher support team](#).



Open access information

International Journal of Naval Architecture and Ocean Engineering is a open access journal.

User rights

All articles published open access will be immediately and permanently free for everyone to read, download, copy and distribute. Permitted reuse is defined by your choice of one of the following user licenses:

Creative Commons Attribution (CC BY). Allows users to: distribute and copy the article; create extracts, abstracts, and other revised versions, adaptations or derivative works of or from an article (such as a translation); include in a collective work (such as an anthology); and text or data mine the article. These uses are permitted even for commercial purposes, provided the user: gives appropriate credit to the author(s) (with a link to the formal publication through the relevant DOI); includes a link to the license; indicates if changes were made; and does not represent the author(s) as endorsing the adaptation of the article or modify the article in such a way as to damage the authors' honor or reputation.

FEEDBACK

1 January 2015

[How to translate text using browser t](#)

Ship Identification Algorithm Based on 3D Point Cloud for Automated Ship Loaders

Chao Mi, Yang Shen, Weijian Mi, Youfang Huang

Author Affiliations +

Chao Mi,¹ Yang Shen,^{2,*} Weijian Mi,¹ Youfang Huang¹

¹†Container Supply Chain Tech. Engineering Research Center, Shanghai Maritime University, Shanghai 20

²‡Higher Technical College, Shanghai Maritime University, Shanghai 200000, China

*Corresponding author: kingdows@gmail.com

[J. of Coastal Research, 73\(sp1\):28-34 \(2015\). <https://doi.org/10.2112/SI73-006.1>](#)

Abstract

Mi, C.; Shen, Y.; Mi, W., and Huang, Y., 2015. Ship identification algorithm based on 3D point cloud for automated ship loader.

With the development of bulk port automation, the ship loader as the main quayside machine of bulk terminal is required for transformation from manual operation to automation. The ship identification method is a key inspection technique for automated ship loaders. In this paper, a fast ship identification algorithm was formulated based on the 3D point cloud of the ship, as generated by the Laser Measurement Systems (LMS) mounted on the ship loader. To meet the requirement of real-time computing for the automated ship loader, the 3D point cloud was first processed to reduce its dimensions from 3D point cloud into a 2D image. A projection method was then applied to locate and identify all bulk cargo holds in the ship. Finally, a group of experiments on ship identification was conducted using this algorithm in the Coal Terminal of Tianjin Port. The results showed that the computing time for a whole ship was lower than 200 ms and the error of the algorithm was lower than 10%, meeting the requirement of automated ship loaders.

© 2015 Coastal Education and Research Foundation

Citation [Download Citation](#) ▼

Chao Mi, Yang Shen, Weijian Mi, and Youfang Huang "Ship Identification Algorithm Based on 3D Point Cloud for Automated Ship Loaders," *Journal of Coastal Research* 73(sp1), 28-34, (1 January 2015). <https://doi.org/10.2112/SI73-006.1>

Received: 15 August 2014; Accepted: 16 November 2014; Published: 1 January 2015

ACCESS THE FULL ARTICLE

PERSONAL SIGN IN

Full access may be available with your subscription

Email

Password

[Forgot your password?](#)

☐ Show

☐ Remember Email on this computer

☐ Remember Password

SIGN IN

No BioOne Digital Library account? [Create an account](#)
or [Access Institutional Sign In via Shibboleth](#) or [OpenAthens](#)

PURCHASE THIS CONTENT

PURCHASE SINGLE ARTICLE

Price: \$25.00

[ADD TO CART](#)

Includes PDF & HTML, when available

The *Journal of Coastal Research (JCR)* is one of the leading international journals for coastal studies and is officially published bi-monthly by the **Coastal Education & Research Foundation (CERF)**. By covering the entire field of coastal research [e.g., geology, biology, ecology, geomorphology, physical geography, climate change, littoral oceanography, hydrography, sea-level change, coastal hydraulics, environmental (resource) management (law), coastal engineering, remote sensing, socio-economic topics, *etc.*], the JCR encompasses all subjects relevant to natural and engineered environments (freshwater, brackish, or marine) and the protection/management of their resources in the vicinity of coastlines of the world. Even though the journal broadly focuses on immediate shoreline zones, the JCR also embraces those coastal environments that either reach some indefinite distance inland or that extend seaward beyond the outer margins of the sublittoral (neritic) zone. The JCR disseminates accurate information to both the public and research specialists around the world on all aspects of coastal issues in an effort to maintain or improve the quality of our planet's shoreline resources. The JCR is currently surveyed in the BioOne Complete Collection; Google Scholar; SCOPUS (Elsevier); JSTOR; EBSCO; ProQuest; Charlesworth; BIOSIS Previews (Web of Science); Zoological Record (Web of Science); Biological Abstracts (Web of Science); Cabells Scholarly Analytics (Journalytics); Chemical Abstracts Service (CAS); Gale Group (Gale/Cengage Learning); Copyright Clearance Center, Inc. (CCC); Scimago; and the Scubavox Conservation Database.

The Coastal Education and Research Foundation (CERF) is a nonprofit research society dedicated to the advancement of the coastal sciences and serves as the official publisher of the international *Journal of Coastal Research (JCR)*. CERF-JCR is devoted to the multidisciplinary study of complex problems related to the coastal zone and is the founding organization of the International Coastal Symposium (ICS). Our purpose is to help in the translation and interpretation of coastal issues for the public and to assist professional and academic research programs by supporting and encouraging field and laboratory studies on a local, national, and global basis. Through printed scientific publications, current online content, and renowned international conferences, CERF-JCR brings accurate information to both the public and researchers alike on all aspects of coastal issues in an effort to maintain and improve the quality of

[Skip to Main Content](#)

shoreline resources.

The International Coastal Symposium (ICS) was originally created by Per Bruun (deceased) and Charles W. Finkl as the official meeting of the Coastal Education and Research Foundation (CERF) and the *Journal of Coastal Research* (JCR), with one of the first meetings being held in Hilton Head, South Carolina, in 1993. After the repeated success of these meetings, CERF-JCR moved the ICS to an international platform by holding these conferences in conjunction with local sponsors in the United States, Argentina, Australia, Brazil, Denmark, England, Iceland, New Zealand, Northern Ireland, Poland, Portugal, Spain, and South Korea. The ICS brings together delegates from all over the world to collaborate and discuss the most current coastal research studies and projects. During the ICS 2014, which was held in Durban, South Africa, a grand celebration took place to mark the 30th Anniversary of CERF and the JCR.

For more information, please visit: <https://www.cerf-jcr.org/>



[Skip to Main Content](#)

[CERF-JCR Home](#)

[JCR Special Issues](#)

Journal of Coastal Research (JCR)

**Official Publication of the
Coastal Education and Research Foundation, Inc. (CERF)**

<https://www.cerf-jcr.org/>

AUTHOR INSTRUCTIONS & SUBMISSION GUIDELINES





DOI: <https://doi.org/10.4271/2017-01-2109>

Citation: Thupakula, K., "Data Fusion Techniques for Object Identification in Airport Environment," SAE Technical Paper 2017-01-2109, 2017, <https://doi.org/10.4271/2017-01-2109>.

[Download Citation](#)

Author(s): Kiran Thupakula

Affiliated: UTC Aerospace Systems

Pages: 5

Event: AeroTech Congress & Exhibition

ISSN: 0148-7191

e-ISSN: 2688-3627

Related Topics:

AIRPORTS

SENSORS AND ACTUATORS

IDENTIFICATION

MATHEMATICAL MODELS

CARTOGRAPHY

AIRCRAFT

PERSONNEL

SAE MOBILUS

Subscribers can view, annotate, and download all of SAE's content. [Learn More »](#)

[Access SAE MOBILUS »](#)

☒ Digital \$37.00

☐ Print \$37.00

Members save up to 16% off list price.

[Login](#) to see discount.

Special Offer: Download multiple Technical Papers each year? TechSelect is a cost-effective subscription option to select and download 12-100 full-text Technical Papers per year. [Find more information here.](#)

SAE Technical Papers

Cutting-Edge & Historical Research Articles for Both Industry & Educational Use

Supporting the automotive, aerospace, and commercial vehicle sectors, SAE Technical Papers provide professionals and students with the latest advances in mobility research.

SAE Technical Papers help guide engineers through their project challenges and establish leadership in a competitive landscape. Reference current and historical research to define best practices and strategies. From combustions processes to simulation & modeling to test procedures, Technical Papers contain in-depth test results, comparative studies, and methodologies on a variety of topics. SAE's Technical Papers are all peer-reviewed by leading industry experts to ensure high quality and dependable information.

Powerful, industry-leading data made available with a range of custom pricing options.

Contact Sales

Research Breakdown



80,000+
Automotive

19,400+
Aerospace

7,900+
Commercial
Vehicle

Latest Technical Papers

2017-01-2109



▼Filter by [Industry](#) ▼ ▼Filter by [Topic](#) ▼

Title	Category	Date	
2017-01-2109 Data Fusion Techniques For Object Identification In Airport Environment	Aerospace	2017-09-19	View Details

Featured Papers

Title	Category	Date
-------	----------	------

2017-09-19

Data Fusion Techniques for Object Identification in Airport Environment 2017-01-2109

Airport environments consist of several moving objects both in the air and on the ground. In air moving objects include aircraft, UAVs and birds etc. On ground moving objects include aircraft, ground vehicles and ground personnel etc. Detecting, classifying, identifying and tracking these objects are necessary for avoiding collisions in all environmental situations. Multiple sensors need to be employed for capturing the object shape and position from multiple directions. Data from these sensors are combined and processed for object identification.

In current scenario, there is no comprehensive traffic monitoring system that uses multisensor data for monitoring in all the airport areas. In this paper, for explanation purposes, a hypothetical airport traffic monitoring system is presumed that uses multiple sensors for avoiding collisions. The referenced system employs multiple types of sensors for object data collection in different situations, wherein the collected multi object data is combined to classify and identify the objects, and identified objects are accurately tracked for collision prediction.

This paper discusses a data fusion model of multisensor data for object identification in an airport environment to allow the traffic monitoring system to determine the shape, type and position of an object. As a future scope of this paper, the object shape, type and position data from the object identification stage is provided as input to the next stage in the airport traffic monitoring system to track the object movements for collision prediction. Multiple type sensors are arranged in different configurations such as complementary, competitive and cooperative arrangements. Data from these sensors is combined for object detection and identification. Optimal fusion model and object model mapping algorithms are discussed for the object identification purpose. A case study of the competitive sensor data fusion is also discussed in this paper.

Team Cornell's Skynet: Robust perception and planning in an urban environment

Isaac Miller , Mark Campbell , Dan Huttenlocher , Frank-Robert Kline , Aaron Nathan , Sergei Lupashin , Jason Catlin , Brian Schimpf , Pete Moran , Noah Zych , Ephraim Garcia , Mike Kurdziel , Hikaru Fujishima  ... [See fewer authors](#) ^

First published: 23 July 2008

<https://doi.org/10.1002/rob.20253>

Citations: 93

Abstract

Team Cornell's Skynet is an autonomous Chevrolet Tahoe built to compete in the 2007 DARPA Urban Challenge. Skynet consists of many unique subsystems, including actuation and power distribution designed in-house, a tightly coupled attitude and position estimator, a novel obstacle detection and tracking system, a system for augmenting position estimates with vision-based detection algorithms, a path planner based on physical vehicle constraints and a nonlinear optimization routine, and a state-based reasoning agent for obeying traffic laws. This paper describes these subsystems in detail before discussing the system's overall performance in the National Qualifying Event and the Urban Challenge. Logged data recorded at the National Qualifying Event and the Urban Challenge are presented and used to analyze the system's performance. © 2008 Wiley Periodicals, Inc.

Supporting Information

Filename	Description
rob_20253_sm_TeamCornellNQEAraA.MPG 7.5 MB	www.interscience.wiley.com
rob_20253_sm_TeamCornellNQEAraB.MPG 7 MB	www.interscience.wiley.com
rob_20253_sm_TeamCornellNQEAraC.MPG 7.9 MB	www.interscience.wiley.com
rob_20253_sm_TeamCornellNQEThePass.MPG 8.5 MB	www.interscience.wiley.com
rob_20253_sm_TeamCornellWashingtonUtah.MPG 10.9 MB	www.interscience.wiley.com
rob_20253_sm_TeamCornellWrongWayVehicle.MPG 7.6 MB	www.interscience.wiley.com

Please note: The publisher is not responsible for the content or functionality of any supporting information supplied by the authors. Any queries (other than missing content) should be directed to the corresponding author for the article.



Advertisement

WILEY

Feature your work on the journal cover

Find out more

JOURNAL OF
FIELD ROBOTICS

Regular Article | Free Access

Team Cornell's Skynet: Robust perception and planning in an urban environment

Isaac Miller , Mark Campbell , Dan Huttenlocher , Frank-Robert Kline , Aaron Nathan , Sergei Lupashin , Jason Catlin , Brian Schimpf , Pete Moran , Noah Zych ... [See all authors](#) First published: 23 July 2008 | <https://doi.org/10.1002/rob.20253> | Citations: 93

PDF



TOOLS



SHARE

Abstract

Team Cornell's Skynet is an autonomous Chevrolet Tahoe built to compete in the 2007 DARPA Urban Challenge. Skynet consists of many unique subsystems, including actuation and power distribution designed in-house, a tightly coupled attitude and position estimator, a novel obstacle detection and tracking system, a system for augmenting position estimates with vision-based detection algorithms, a path planner based on physical vehicle constraints and a nonlinear optimization routine, and a state-based reasoning agent for obeying traffic laws. This paper describes these subsystems in detail before discussing the system's overall performance in the National Qualifying Event and the Urban Challenge. Logged data recorded at the National Qualifying Event and the Urban Challenge are presented and used to analyze the system's performance. © 2008 Wiley Periodicals, Inc.

Supporting Information

REFERENCES

Citing Literature



Volume 25, Issue 8

Special Issue on the 2007 DARPA Urban Challenge, Part I

August 2008

Pages 493-527

Advertisement



Ads by Google

Stop seeing this ad

Why this ad?



References



Related



Information

Metrics

Citations: 93

Details

Copyright © 2008 Wiley Periodicals, Inc.

Publication History

Issue Online:

23 July 2008

Version of Record online:

23 July 2008

Manuscript accepted:

16 June 2008

Manuscript received:

30 January 2008

JOURNAL OF FIELD ROBOTICS

Author Guidelines

TABLE OF CONTENTS

1. Submission
2. Aims and Scope
3. Preparing the Submission
4. Editorial Policies and Ethical Considerations
5. Author Licensing
6. Publication Process After Acceptance
7. Post-Publication
8. Editorial Office Contact Details

1. SUBMISSION

Authors should kindly note that submission implies that the content has not been published or submitted for publication elsewhere except as a brief abstract in the proceedings of a scientific meeting or symposium.

FROM MARCH 22ND 2021: New submissions should be made via the [Research Exchange submission portal](#). For technical help with the submission system, please review our [FAQs](#) or contact submissionhelp@wiley.com.

Data Protection

By submitting a manuscript to or reviewing for this publication, your name, email address, and affiliation, and other contact details the publication might require will be used for the regular operations of the publication, including, when necessary, sharing with the publisher (Wiley) and partners for production and publication. The publication and the publisher recognize the importance of protecting the personal information collected from users in the operation of these services and have practices in place to ensure that steps are taken to maintain the security, integrity, and privacy of the personal data collected and processed. You can learn more at <https://authorservices.wiley.com/statements/data-protection-policy.html>.

Preprint Policy

This journal will consider for review articles previously available as preprints on non-commercial servers such as ArXiv, bioRxiv, psyArXiv, SocArXiv, engrXiv, etc. Authors may also post the submitted version of a manuscript to non-commercial servers at any time. Authors are requested to **update** any pre-publication versions with a link to the final published article.

Free Format

Journal of Field Robotics now offers Free Format submission for a simplified and streamlined submission process. Before you submit, you will need:

tracked. After publication of the final version article (the article of record), the DOI remains valid and can still be used to cite and access the article.

Proofs

Once the paper is typeset, the author will receive an email notification with full instructions on how to provide proof corrections.

Please note that the author is responsible for all statements made in their work, including changes made during the editorial process – authors should check proofs carefully. Note that proofs should be returned within 48 hours from receipt of first proof.

Early View

The journal offers rapid publication via Wiley's Early View service. **Early View** (Online Version of Record) articles are published on Wiley Online Library before inclusion in an issue. Note there may be a delay after corrections are received before the article appears online, as Editors also need to review proofs. Once the article is published on Early View, no further changes to the article are possible. **The Early View article is fully citable and carries an online publication date and DOI for citations.**

Citing this Article: eLocators

This journal now uses eLocators. eLocators are unique identifiers for an article that service the same function page numbers have traditionally served in the print world. When citing this article, please insert the eLocator in place of the page number. For more information, please visit the Author Services eLocator page [here](#).

7. POST PUBLICATION

Access and sharing

When the article is published online:

- The author receives an email alert (if requested).
- The link to the published article can be shared through social media.
- The author will have free access to the paper (after accepting the Terms & Conditions of use, they can view the article).
- For non-open access articles, the corresponding author and co-authors can nominate up to ten colleagues to receive a publication alert and free online access to the article.

Article Promotion Support

Wiley Editing Services offers professional video, design, and writing services to create shareable video abstracts, infographics, conference posters, lay summaries, and research news stories for your research – so you can help your research get the attention it deserves.

Cover Image Submissions

This journal accepts artwork submissions for Cover Images. This is an optional service you can use to help increase article exposure and showcase your research. For more information, including artwork guidelines, pricing, and submission details, please visit the **Journal Cover Image page**.

Measuring the Impact of an Article

Wiley also helps authors measure the impact of their research through specialist partnerships with **Kudos** and **Altmetric**.

Author Name Change Policy

In cases where authors wish to change their name following publication, Wiley will **update** and republish the paper and redeliver the **updated** metadata to indexing services. Our editorial and production teams will use discretion in recognizing that name changes may be of a sensitive and private nature for various reasons including (but not limited to) alignment with gender identity, or as a result of marriage, divorce, or religious conversion. Accordingly, to protect the author's privacy, we will not publish a correction notice to the paper, and we will not notify co-authors of the change. Authors should contact the journal's Editorial Office with their name change request.



All



ADVANCED SEARCH

Conferences > 2018 21st International Confe... ?

Semantic Segmentation on Radar Point Clouds

Publisher: IEEE

[Cite This](#)

PDF

<< Results

Ole Schumann ; Markus Hahn ; Jürgen Dickmann ; Christian Wöhler **All Authors** ***120
Cites in
Papers5125
Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

Abstract

Document Sections

- I. Introduction
- II. Related Work
- III. Methods
- IV. Results
- V. Conclusion and Outlook

Authors

Figures

References

Citations

Keywords

Metrics

Downl
PDF

Abstract:Semantic segmentation on radar point clouds is a new challenging task in radar data processing. We demonstrate how this task can be performed and provide results on a lar... [View more](#)

► Metadata

Abstract:

Semantic segmentation on radar point clouds is a new challenging task in radar data processing. We demonstrate how this task can be performed and provide results on a large data set of manually labeled radar reflections. In contrast to previous approaches where generated feature vectors from clustered reflections were used as an input for a classifier, now the whole radar point cloud is used as an input and class probabilities are obtained for every single reflection. We thereby eliminate the need for clustering algorithms and manually selected features.

Published in: 2018 21st International Conference on Information Fusion (FUSION)

Date of Conference: 10-13 July 2018

DOI: 10.23919/ICIF.2018.8455344

Date Added to IEEE Xplore: 06 September 2018

Publisher: IEEE

► ISBN Information:

Conference Location: Cambridge, UK



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.



All



ADVANCED SEARCH

Journals & Magazines > IEEE Robotics & Automation Ma... > Volume: 19 Issue: 3 ?

Tutorial: Point Cloud Library: Three-Dimensional Object Recognition and 6 DOF Pose Estimation

Publisher: IEEE

[Cite This](#)

PDF

<< Results

Aitor Aldoma ; Zoltan-Csaba Marton ; Federico Tombari ; Walter Wohlking ; Christian Potthast ; Bernhard Zeisl ; Radu Bogdan Rusu ; Suat... **All Authors** *****251**
Cites in
Papers**7**
Cites in
Patents**11535**
Full
Text Views

Alerts

[Manage Content Alerts](#)
[Add to Citation Alerts](#)

Free

Abstract

Document Sections

- » Local Descriptors
- » Global Descriptors
- » Recognition Pipelines
- » Evaluation of CAD Recognition and 6-DoF Pose Estimation
- » Classification of Unknown Objects

[Show Full Outline ▾](#)[Authors](#)[Figures](#)[References](#) [Citations](#)Downl
PDF

Abstract:With the advent of new-generation depth sensors, the use of three-dimensional (3-D) data is becoming increasingly popular. As these sensors are commodity hardware and sol... **View more**

► Metadata

Abstract:

With the advent of new-generation depth sensors, the use of three-dimensional (3-D) data is becoming increasingly popular. As these sensors are commodity hardware and sold at low cost, a rapidly growing group of people can acquire 3- D data cheaply and in real time.

Published in: IEEE Robotics & Automation Magazine (Volume: 19 , Issue: 3, September 2012)

Page(s): 80 - 91**DOI:** 10.1109/MRA.2012.2206675**Date of Publication:** 11 September 2012 ?**Publisher:** IEEE

► ISSN Information:



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.



Downl

PDF

Browse ▾

My Settings ▾

Help ▾



Sign Out

Sign Out

All



ADVANCED SEARCH

Journals & Magazines > IEEE Transactions on Aerospac... > Volume: 48 Issue: 2 ?

Sensitivity Analysis of a Tightly-Coupled GPS/INS System for Autonomous Navigation

Publisher: IEEE

Cite This

PDF

<< Results | Next >

Isaac Miller ; Mark Campbell All Authors ***

24

Cites in
Papers

2

Cites in
Patents

1609

Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

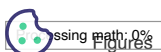
Abstract

Document Sections

- I. Introduction
- II. Cornell University'S "Skynet"
- III. Cornell'S Attitude and Position Estimation Algorithm
- IV. Ordered Sensitivity Analysis in the Design of Cornell'S Pose Estimator
- V. Sensitivity to Signal Blackouts

Show Full Outline ▾

Authors

Missing math: 0%
Figures

Abstract:The work presented here empirically analyzes the design of the tightly-coupled position, velocity, and attitude estimator used as a feedback signal for autonomous navigat... [View more](#)

► Metadata

Abstract:

The work presented here empirically analyzes the design of the tightly-coupled position, velocity, and attitude estimator used as a feedback signal for autonomous navigation in a large scale robot driving in urban settings. The estimator fuses GNSS/INS signals in an extended square root information filter (ESRIF), a numerically-robust implementation of an extended Kalman filter (EKF), and was used as the basis for Cornell University's 2007 DARPA Urban Challenge robot, "Skynet." A statistical sensitivity analysis is conducted on Skynet's estimator by examining the changes in its behavior as critical design elements are removed. The effects of five design elements are considered: map aiding via computer vision algorithms, inclusion of differential corrections, filter integrity monitoring, Wide Area Augmentation System (WAAS) augmentation, and inclusion of carrier phases; the effects of extensive signal blackouts are also considered. Metrics of comparison include the statistical differences between the full solution and variant; the Kullback-Leibler divergence; and the average and standard deviation of the position errors, attitude errors, and filter update discontinuities.

Published in: IEEE Transactions on Aerospace and Electronic Systems (Volume: 48 , Issue: 2, April 2012)

Page(s): 1115 - 1135

DOI: 10.1109/TAES.2012.6178052

Date of Publication: 05 April 2012 ?

Publisher: IEEE



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.

Introducing LiDAR Point Cloud-based Object Classification for Safer Apron Operations

Johannes Mund^{*1}, Frank Michel^{*1}, Franziska Dieke-Meier², Hartmut Fricke², Lothar Meyer²
and Carsten Rother¹

Technische Universität Dresden
Chair of Air Transport Technology and Logistics
Dresden, Germany

¹{johannes.mund, frank.michel, carsten.rother}@tu-dresden.de

²{dieke-meier, meyer, fricke}@ifl.tu-dresden.de

^{*}Joint First Authors

Abstract—Current procedures for conventional and remote airport ground control still rely on the direct (camera-) view. Despite further support by different Radar applications occasional shortcomings in the awareness of the responsible controllers may occur, particularly under adverse weather conditions, giving rise to capacity backlogs, incidents and accidents. As Laser scanners and computer vision algorithms have reached new performance levels in recent years, we proposed a novel concept for complete and independent airport apron surveillance based on LiDAR 3D point data. In this paper we extend our object detection/segmentation technique by addressing object classification in LiDAR 3D scans. We hereby enable LiDAR's unique capability to classify non-cooperative objects by means of a single sensor and learned model knowledge. Our technique was able to classify and to estimate the poses of an Airbus A319-100 and a Boeing B737-700 parked on the airport apron. In the future we will enhance our classification technique to a wider range of objects including moving ground vehicles and pedestrians.

Keywords- LiDAR, Laser scanning, 3D point cloud, airport ground surveillance, apron control, aircraft classification, pose estimation

1. INTRODUCTION

Airport ground operations are considered to be significant risk drivers in the aviation sector. Especially the actions that take place on the apron, which is in fact an unstructured working environment with a large variety of objects, substantially contribute to the operational risk. Additionally, various activities of moving aircraft, vehicles, equipment and personnel on a limited space turn the apron into a complex and dynamic system [1] [2] that lends itself to accidents and incidents [3] [4] creating a measurably high risk environment.

Current legacy procedures for apron control rely on the direct view. This principle, however, depends on weather/lighting conditions, resolution limits and the unobstructed line-of-sight. While typical support systems like non-cooperative ground Radar (X and Ku-band) and video cameras are subject to the same or similar conditions, cooperative sensors like Secondary Surveillance Radar (SSR) lack of the capability to detect passive objects like safety-critical foreign object debris (FOD).

Concluding, both the apron's unique characteristics and (temporary) limitations in the surveillance capabilities inevitably impact the situational awareness of all apron operators. The authors expect the resulting contribution to risk highest in the case of degraded situational awareness¹ at the apron control unit, since it is the overall authority to create and maintain operational safety on the apron.

Motivated by improving the safety level of apron operations beyond current targets (e.g. ICAO A-SMGCS target level of safety [5]), we aim at strengthening the situational awareness of tomorrow's apron control through the first-time provision of three dimensional (3D) data from an independent sensor source.

As laid down in our concept studies in [6] [7], our research approach foresees the development and implementation of a point cloud-based surveillance solution with the capability to recognize present or even emerging hazardous situations by using pattern recognition methods. Assuming that this post-processed 3D point cloud data is provided to the apron controller on an additional screen, he should

¹ Endsley [18] defines situational awareness as “perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future”.

We would like to thank the DFG (German Research Foundation) most sincerely for funding the research presented in this paper (FR 2440/4-1).



Try the new Google Books >



Books

Add to my library



GET PRINT BOOK

No eBook available

[AbeBooks](#)

[Amazon](#)

[Find in a library](#)

[All sellers »](#)



Get Textbooks on Google Play

Rent and save from the world's largest eBookstore. Read, highlight, and take notes, across web, tablet, and phone.

[Go to Google Play Now »](#)

► My library

ESAVS 2016 Proceedings: International Symposium on Enhanced Solutions for Aircraft and Vehicle Surveillance Applications, 07-08 April 2016, Berlin, Germany



Deutsche Gesellschaft für Ortung und Navigation, 2016

Bibliographic information

Title	ESAVS 2016 Proceedings: International Symposium on Enhanced Solutions for Aircraft and Vehicle Surveillance Applications, 07-08 April 2016, Berlin, Germany
Publisher	Deutsche Gesellschaft für Ortung und Navigation, 2016

Export
Citation

BiBTeX

EndNote

RefMan

[About Google Books](#) - [Privacy Policy](#) - [Terms of Service](#) -
[Information for Publishers](#) - [Report an issue](#) - [Help](#) - [Google Home](#)

DGON e.V.

GERMAN INSTITUTE OF NAVIGATION (DGON E.V.)

SOURCE: ESA / ATG MEDIALAB "GALILEO-FOC-SATELLITES-IN-ORBIT"



Organisation

The German Institute for Navigation was founded in 1951. From our Bonn office we manage an international network of members and organize conferences of national and international importance every year. You can find out more about our activities and staff at "About us" and "Conferences".

Commissions and technical committees

The DGON is organised into three commissions and five technical committees, each of which is up to date and regularly organises conferences and symposia for their specialist fields.

The commissions are divided into the Air Traffic and General Aviation Navigation Commission, the Maritime Traffic and Navigation Commission, and the Terrestrial Traffic and Vehicle Navigation Commission. On the scientific side, our five technical committees (Radar Technology Committee, Gyro Technology Committee, Satellite Navigation Committee, Traffic Telematics Committee and Underwater detection, navigation and communication) complete our organisation.



Announcements / Information

Currently no announcements / information



Deutsche Gesellschaft für Ortung und Navigation (DGON) e.V.

-German Institute of Navigation-

Kölustrasse 70

53111 Bonn

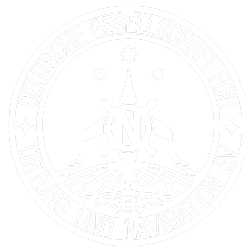
Germany

Phone: +49-228-20197.0

Fax: +49-228-20197.19

E-Mail: [✉ dgon.bonn\(at\)t-online.de](mailto:dgon.bonn(at)t-online.de)

Web: [🌐 www.dgon.de](http://www.dgon.de)



International Membership of the DGON



 [European Group of Institutes
of Navigation \(EUGIN\)](#)
based in Brussels, Belgium

 [International Association of
Institutes of Navigation \(IAIN\)](#)
based in London, UK



© 2024 DGON - German Institute of
Navigation e. V.

[Contact](#)

[Imprint](#)

Introducing lidar point cloud-based object classification for safer apron operations

☐ Search within citing articles

Object tracking with lidar: Monitoring taxiing and landing aircraft

Z Koppanyi, CK Toth - Applied Sciences, 2018 - mdpi.com

Featured Application Tracking aircraft during taxiing, landing and takeoffs at airports; acquiring statistical data for centerline deviation analysis and veer-off modeling as well as ...

☆ Save  Cite Cited by 9 Related articles All 7 versions 

Can LiDAR point clouds effectively contribute to safer apron operations?

J Mund, P Latzel, H Fricke - Proc. 6th SID, 2016 - sesarju.eu

The current system of conventional and remote airport ground control still largely relies on the direct visual contact between the ATCO and his area of responsibility. Despite ...

☆ Save  Cite Cited by 5 Related articles All 3 versions 

Validating LiDAR Sensor Surveillance Technology versus Conventional Out-the-window View for Safety-critical Airport Operations

H Brassel, A Zouhar, H Fricke - ... of the 9th SESAR Innovation Days, 2019 - academia.edu

This paper performs a quantitative comparison between established surveillance techniques based on Out-The-Window View and Light Detection And Ranging (LiDAR) under identical ...

☆ Save  Cite Cited by 3 Related articles All 3 versions 

The identification of aircraft without enough point cloud data

J Lijie, P Wei, W Peng, Z Kai... - 2021 IEEE 3rd International ..., 2021 - ieeexplore.ieee.org

With the flights of civil aviation increase recently, the need for precise and reliable surveillance sensor has become far stronger than ever before. Many Surveillance sensors ...

☆ Save  Cite Related articles

Hypothesis Generation for Object Pose Estimation From local sampling to global reasoning

F Michel - 2018 - core.ac.uk

Pose estimation has been studied since the early days of computer vision. The task of object pose estimation is to determine the transformation that maps an object from it's inherent ...

☆ Save  Cite Related articles All 4 versions 

Performance analysis of a lidar system for comprehensive airport ground surveillance under varying weather and lighting conditions

J Mund, A Zouhar, H Fricke - ICRAT, Castelldefels, 2018

☆ Save  Cite Cited by 5 Related articles



Browse ▾ My Settings ▾ Help ▾

Sign Out

Sign Out

All



ADVANCED SEARCH

Journals & Magazines > IEEE Transactions on Robotics > Volume: 27 Issue: 1 ?

Efficient Unbiased Tracking of Multiple Dynamic Obstacles Under Large Viewpoint Changes

Publisher: IEEE

Cite This

PDF

<< Results

Isaac Miller ; Mark Campbell ; Daniel Huttenlocher All Authors ***

33

Cites in
Papers

3

Cites in
Patents

1664

Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

Abstract

Document Sections

- I. Introduction
- II. Related Work
- III. Efficient, Unbiased-Tracking Algorithm
- IV. Experimental Performance
- V. Performance in the DARPA Urban Challenge

Show Full Outline ▾

Authors

Figures

References

Citations



Downl

PDF

Abstract:A novel-tracking algorithm is presented as a computationally feasible, real-time solution to the joint estimation problem of data assignment and dynamic obstacle tracking... **View more**

► Metadata

Abstract:

A novel-tracking algorithm is presented as a computationally feasible, real-time solution to the joint estimation problem of data assignment and dynamic obstacle tracking from a potentially moving robotic platform. The algorithm implements a Rao-Blackwellized particle filter (RBPF) to factorize the joint estimation problem into 1) a data assignment problem solved via particle filter and 2) a multiple dynamic obstacle-tracking problem solved with efficient parametric filters. The parametric filters make use of a new target representation and stable features developed specifically for tracking full-size vehicles in a dense traffic environment. The algorithm is validated in real time, both in controlled experiments with full-size robotic vehicles and on data collected at the 2007 Defense Advanced Research Projects Agency (DARPA) Urban Challenge.

Published in: IEEE Transactions on Robotics (Volume: 27 , Issue: 1, February 2011)

Page(s): 29 - 46

DOI: 10.1109/TRO.2010.2085490

SECTION I.

Introduction



Modern autonomous mobile robots operating at human scales of size face the significant challenge to perceive and understand the dynamic environment in which they (and we) interact. Fielded solutions to this perception problem must be both accurate and robust, as robotic failures in a human-populated operating environment can rapidly lead to disaster. The danger is particularly acute for full-size robotic vehicles, where tracking accidents and traffic accidents are separated only by a thin layer of actuators. Although better sensing hardware can improve perception of the current scene, autonomous systems benefit more from mitigating perception errors before they happen. The problem is, therefore, approached in the predictive language of data fusion, model-based estimation, and probabilistic analysis.

Historically, mobile robot dynamic obstacle-tracking techniques resemble the estimation techniques of classical target tracking. These approaches estimate the probability density function of a target's state, i.e., a vector of random variables that evolve according to a model of the target's dynamics. The target's probability density is then occasionally updated with measurements taken from one or more noisy sensors. The framework extends naturally to track multiple targets, where the goal is to estimate the joint probability density across all target states. If the pairings between measurements and targets are known, the tracking problem is commonly solved with a traditional Kalman filter (KF) or one of its variants [1].

With unknown measurement/target pairings, both the measurement correspondences and the target states must be estimated simultaneously. This is an instance of the well-known data assignment problem, which is also called the correspondence problem or the data association problem [2]. Since the problem's exact solution is intractable, a vast array of approximations have been investigated. These approximations include simple nearest neighbor matching schemes (the maximum likelihood approach) [2], global nearest neighbor matching schemes (the joint compatibility test) [3], one- and multistep approximations when marginalizing out data assignments (the joint probabilistic data association filter and multiple hypothesis tracking schemes) [2] [4], [5], and even Monte Carlo approximations to either the full-joint target state density or just to the data assignments (particle filters, Markov chain Monte Carlo (MCMC) techniques, Rao–Blackwellized particle filters (RBPFs), and the probabilistic hypothesis density filter) [6]–[10].

Although elegant in their Bayesian formulation, these classical-tracking approaches assume the tracked targets to be point objects. This approximation is reasonable for long-range-tracking scenarios, such as air, sea, or space traffic monitoring, where the targets are significantly smaller than sensor error at the ranges of interest. The approximation breaks down in many robotics applications, however, where the targets are nearby obstacles or landmarks. The approximation is particularly bad for human-scale robotics applications, where the robot may need to maneuver within a meter or two of large obstacles, such as cars and buildings. Furthermore, typical sensors, such as laser rangefinders, radars, and optical cameras, have errors that are only a small fraction of the width of these obstacles.

The breakdown of the point-obstacle assumption yields two significant challenges not addressed in target-tracking literature. First, the data assignment problem becomes more difficult, because the observed shapes of obstacles change rapidly at close range. Second, the obstacles cannot be estimated as point objects. One common ad hoc approach uses a feature extraction algorithm to



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.



Browse ▾ My Settings ▾ Help ▾

Sign Out

Sign Out

All



ADVANCED SEARCH

Journals & Magazines > IEEE Transactions on Robotics > Volume: 27 Issue: 1 ?

Efficient Unbiased Tracking of Multiple Dynamic Obstacles Under Large Viewpoint Changes

Publisher: IEEE

Cite This



PDF

<< Results

Isaac Miller ; Mark Campbell ; Daniel Huttenlocher All Authors ***

33

Cites in
Papers

3

Cites in
Patents

1664

Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

Abstract

Document Sections

- I. Introduction
- II. Related Work
- III. Efficient, Unbiased-Tracking Algorithm
- IV. Experimental Performance
- V. Performance in the DARPA Urban Challenge

Show Full Outline ▾

Authors

Figures

References

Citations



Downl

PDF

Abstract: A novel-tracking algorithm is presented as a computationally feasible, real-time solution to the joint estimation problem of data assignment and dynamic obstacle tracking... **View more**

► Metadata

Abstract:

A novel-tracking algorithm is presented as a computationally feasible, real-time solution to the joint estimation problem of data assignment and dynamic obstacle tracking from a potentially moving robotic platform. The algorithm implements a Rao-Blackwellized particle filter (RBPF) to factorize the joint estimation problem into 1) a data assignment problem solved via particle filter and 2) a multiple dynamic obstacle-tracking problem solved with efficient parametric filters. The parametric filters make use of a new target representation and stable features developed specifically for tracking full-size vehicles in a dense traffic environment. The algorithm is validated in real time, both in controlled experiments with full-size robotic vehicles and on data collected at the 2007 Defense Advanced Research Projects Agency (DARPA) Urban Challenge.

Published in: IEEE Transactions on Robotics (Volume: 27 , Issue: 1, February 2011)

Page(s): 29 - 46

DOI: 10.1109/TRO.2010.2085490

SECTION I.

Introduction



Modern autonomous mobile robots operating at human scales of size face the significant challenge to perceive and understand the dynamic environment in which they (and we) interact. Fielded solutions to this perception problem must be both accurate and robust, as robotic failures in a human-populated operating environment can rapidly lead to disaster. The danger is particularly acute for full-size robotic vehicles, where tracking accidents and traffic accidents are separated only by a thin layer of actuators. Although better sensing hardware can improve perception of the current scene, autonomous systems benefit more from mitigating perception errors before they happen. The problem is, therefore, approached in the predictive language of data fusion, model-based estimation, and probabilistic analysis.

Historically, mobile robot dynamic obstacle-tracking techniques resemble the estimation techniques of classical target tracking. These approaches estimate the probability density function of a target's state, i.e., a vector of random variables that evolve according to a model of the target's dynamics. The target's probability density is then occasionally updated with measurements taken from one or more noisy sensors. The framework extends naturally to track multiple targets, where the goal is to estimate the joint probability density across all target states. If the pairings between measurements and targets are known, the tracking problem is commonly solved with a traditional Kalman filter (KF) or one of its variants [1].

With unknown measurement/target pairings, both the measurement correspondences and the target states must be estimated simultaneously. This is an instance of the well-known data assignment problem, which is also called the correspondence problem or the data association problem [2]. Since the problem's exact solution is intractable, a vast array of approximations have been investigated. These approximations include simple nearest neighbor matching schemes (the maximum likelihood approach) [2], global nearest neighbor matching schemes (the joint compatibility test) [3], one- and multistep approximations when marginalizing out data assignments (the joint probabilistic data association filter and multiple hypothesis tracking schemes) [2] [4], [5], and even Monte Carlo approximations to either the full-joint target state density or just to the data assignments (particle filters, Markov chain Monte Carlo (MCMC) techniques, Rao–Blackwellized particle filters (RBPFs), and the probabilistic hypothesis density filter) [6]–[10].

Although elegant in their Bayesian formulation, these classical-tracking approaches assume the tracked targets to be point objects. This approximation is reasonable for long-range-tracking scenarios, such as air, sea, or space traffic monitoring, where the targets are significantly smaller than sensor error at the ranges of interest. The approximation breaks down in many robotics applications, however, where the targets are nearby obstacles or landmarks. The approximation is particularly bad for human-scale robotics applications, where the robot may need to maneuver within a meter or two of large obstacles, such as cars and buildings. Furthermore, typical sensors, such as laser rangefinders, radars, and optical cameras, have errors that are only a small fraction of the width of these obstacles.

The breakdown of the point-obstacle assumption yields two significant challenges not addressed in target-tracking literature. First, the data assignment problem becomes more difficult, because the observed shapes of obstacles change rapidly at close range. Second, the obstacles cannot be estimated as point objects. One common ad hoc approach uses a feature extraction algorithm to



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.

Map-aided localization in sparse global positioning system environments using vision and particle filtering

Isaac Miller , Mark Campbell  **IPR2019-00629**

First published: 09 August 2011

<https://doi.org/10.1002/rob.20395>

Citations: 32

Abstract

A map-aided localization approach using vision, inertial sensors when available, and a particle filter is proposed and empirically evaluated. The approach, termed PosteriorPose, uses a Bayesian particle filter to augment global positioning system (GPS) and inertial navigation solutions with vision-based measurements of nearby lanes and stop lines referenced against a known map of environmental features. These map-relative measurements are shown to improve the quality of the navigation solution when GPS is available, and they are shown to keep the navigation solution converged in extended GPS blackouts. Measurements are incorporated with careful hypothesis testing and error modeling to account for non-Gaussian and multimodal errors committed by GPS and vision-based detection algorithms. Using a set of data collected with Cornell's autonomous car, including a measure of truth via a high-precision differential corrections service, an experimental investigation of important design elements of the PosteriorPose estimator is conducted. The algorithm is shown to statistically outperform a tightly coupled GPS/inertial navigation solution both in full GPS coverage and in extended GPS blackouts. Statistical performance is also studied as a function of road type, filter likelihood models, bias models, and filter integrity tests. © 2011 Wiley Periodicals, Inc.

INTRODUCTION



Advertisement

Journal of
Electrical and Computer
Engineering

Call for papers

Special Issue: Leveraging the Advancements in
Chaotic Systems for Digital Distribution Network

Deadline: 3 May, 2024



JOURNAL OF FIELD ROBOTICS

Field Report | [Full Access](#)

Map-aided localization in sparse global positioning system environments using vision and particle filtering

Isaac Miller , Mark Campbell , Dan Huttenlocher

First published: 09 August 2011 | <https://doi.org/10.1002/rob.20395> | Citations: 32

SECTIONS



PDF



TOOLS



SHARE

Abstract

A map-aided localization approach using vision, inertial sensors when available, and a particle filter is proposed and empirically evaluated. The approach, termed PosteriorPose, uses a Bayesian particle filter to augment global positioning system (GPS) and inertial navigation solutions with vision-based measurements of nearby lanes and stop lines referenced against a known map of environmental features. These map-relative measurements are shown to improve the quality of the navigation solution when GPS is available, and they are shown to keep the navigation solution converged in extended GPS blackouts. Measurements are incorporated with careful hypothesis testing and error modeling to account for non-Gaussian and multimodal errors committed by GPS and vision-based detection algorithms. Using a set of data collected with Cornell's autonomous car, including a measure of truth via a high-precision differential corrections service, an experimental investigation of important design elements of the PosteriorPose estimator is conducted. The algorithm is shown to statistically outperform a tightly coupled GPS/inertial navigation solution both in full GPS coverage and in extended GPS blackouts. Statistical performance is also studied as a function of road type, filter likelihood models, bias models, and filter integrity tests. © 2011 Wiley Periodicals, Inc.

INTRODUCTION

As the military and civilian driving experience moves toward remote and even autonomous



Volume 28, Issue 5
September/October 2011
Pages 619-643



Figures



References



Related



Information

Metrics

Citations: 32

Details

Copyright © 2011 Wiley Periodicals, Inc.

Publication History

Issue Online:
09 August 2011

Version of Record online:
09 August 2011

Manuscript accepted:
06 April 2011

Manuscript received:
14 October 2010

JOURNAL OF FIELD ROBOTICS

Author Guidelines

TABLE OF CONTENTS

1. Submission
2. Aims and Scope
3. Preparing the Submission
4. Editorial Policies and Ethical Considerations
5. Author Licensing
6. Publication Process After Acceptance
7. Post-Publication
8. Editorial Office Contact Details

1. SUBMISSION

Authors should kindly note that submission implies that the content has not been published or submitted for publication elsewhere except as a brief abstract in the proceedings of a scientific meeting or symposium.

FROM MARCH 22ND 2021: New submissions should be made via the [Research Exchange submission portal](#). For technical help with the submission system, please review our [FAQs](#) or contact submissionhelp@wiley.com.

Data Protection

By submitting a manuscript to or reviewing for this publication, your name, email address, and affiliation, and other contact details the publication might require will be used for the regular operations of the publication, including, when necessary, sharing with the publisher (Wiley) and partners for production and publication. The publication and the publisher recognize the importance of protecting the personal information collected from users in the operation of these services and have practices in place to ensure that steps are taken to maintain the security, integrity, and privacy of the personal data collected and processed. You can learn more at <https://authorservices.wiley.com/statements/data-protection-policy.html>.

Preprint Policy

This journal will consider for review articles previously available as preprints on non-commercial servers such as ArXiv, bioRxiv, psyArXiv, SocArXiv, engrXiv, etc. Authors may also post the submitted version of a manuscript to non-commercial servers at any time. Authors are requested to **update** any pre-publication versions with a link to the final published article.

Free Format

Journal of Field Robotics now offers Free Format submission for a simplified and streamlined submission process. Before you submit, you will need:

tracked. After publication of the final version article (the article of record), the DOI remains valid and can still be used to cite and access the article.

Proofs

Once the paper is typeset, the author will receive an email notification with full instructions on how to provide proof corrections.

Please note that the author is responsible for all statements made in their work, including changes made during the editorial process – authors should check proofs carefully. Note that proofs should be returned within 48 hours from receipt of first proof.

Early View

The journal offers rapid publication via Wiley's Early View service. **Early View** (Online Version of Record) articles are published on Wiley Online Library before inclusion in an issue. Note there may be a delay after corrections are received before the article appears online, as Editors also need to review proofs. Once the article is published on Early View, no further changes to the article are possible. **The Early View article is fully citable and carries an online publication date and DOI for citations.**

Citing this Article: eLocators

This journal now uses eLocators. eLocators are unique identifiers for an article that service the same function page numbers have traditionally served in the print world. When citing this article, please insert the eLocator in place of the page number. For more information, please visit the Author Services eLocator page [here](#).

7. POST PUBLICATION

Access and sharing

When the article is published online:

- The author receives an email alert (if requested).
- The link to the published article can be shared through social media.
- The author will have free access to the paper (after accepting the Terms & Conditions of use, they can view the article).
- For non-open access articles, the corresponding author and co-authors can nominate up to ten colleagues to receive a publication alert and free online access to the article.

Article Promotion Support

Wiley Editing Services offers professional video, design, and writing services to create shareable video abstracts, infographics, conference posters, lay summaries, and research news stories for your research – so you can help your research get the attention it deserves.

Cover Image Submissions

This journal accepts artwork submissions for Cover Images. This is an optional service you can use to help increase article exposure and showcase your research. For more information, including artwork guidelines, pricing, and submission details, please visit the [Journal Cover Image page](#).

Measuring the Impact of an Article

Wiley also helps authors measure the impact of their research through specialist partnerships with [Kudos](#) and [Altmetric](#).

Author Name Change Policy

In cases where authors wish to change their name following publication, Wiley will **update** and republish the paper and redeliver the **updated** metadata to indexing services. Our editorial and production teams will use discretion in recognizing that name changes may be of a sensitive and private nature for various reasons including (but not limited to) alignment with gender identity, or as a result of marriage, divorce, or religious conversion. Accordingly, to protect the author's privacy, we will not publish a correction notice to the paper, and we will not notify co-authors of the change. Authors should contact the journal's Editorial Office with their name change request.



Browse ▾ My Settings ▾ Help ▾

Sign Out

Sign Out

All



ADVANCED SEARCH

Journals & Magazines > IEEE Control Systems Magazine > Volume: 36 Issue: 4 ?

Distributed Data Fusion: Neighbors, Rumors, and the Art of Collective Knowledge

Publisher: IEEE

[Cite This](#)

PDF

<< Results

Mark E. Campbell ; Nisar R. Ahmed **All Authors** ***43
Cites in
Papers1704
Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

Abstract

Document Sections

- » Linear Dynamic Gaussian Process
- » Static Process, Stationary Linear Sensors
- » Static Process, Stationary Nonlinear Sensors
- » Dynamical Systems
- » Linear Dynamic Processes

Show Full Outline ▾

Authors

Figures

References

Downl
PDF**Abstract:**Distributed data fusion (DDF) is the process whereby a group of agents sense their local environment, communicate with other agents, and collectively try to infer knowled... **View more**

► Metadata

Abstract:

Distributed data fusion (DDF) is the process whereby a group of agents sense their local environment, communicate with other agents, and collectively try to infer knowledge about a particular process. The applications are many and include cooperative robots mapping a room, cooperative unmanned aerial vehicles (UAVs) geolocating a moving object on the ground, a distributed formation of space telescopes, and a group of people discussing an interesting issue, either in person or online.

Published in: IEEE Control Systems Magazine (Volume: 36 , Issue: 4, August 2016)**Page(s):** 83 - 109**DOI:** 10.1109/MCS.2016.2558444**Date of Publication:** 18 July 2016 ?**Publisher:** IEEE

► ISSN Information:



Copyright (c) 2016 IEEE. All rights reserved. This article is intended only to provide the reader with a general idea of the content of the article. It is not to be used for reproduction or distribution without the prior written permission of IEEE.



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.



Downl

PDF

Browse My Settings Help

Sign Out

Sign Out

All



ADVANCED SEARCH

Conferences > 2009 IEEE Conference on Compu... ?

ImageNet: A large-scale hierarchical image database

Publisher: IEEE

Cite This

PDF

<< Results | < Previous | Next >

Jia Deng ; Wei Dong ; Richard Socher ; Li-Jia Li ; Kai Li ; Li Fei-Fei All Authors ***

30102
Cites in
Papers202
Cites in
Patents93348
Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

Abstract

Document Sections

1. Introduction
2. Properties of ImageNet
 - 2.1. ImageNet and Related Datasets
3. Constructing ImageNet
4. ImageNet Applications

Show Full Outline ▾

Authors

Figures

References

Citations

Keywords



Abstract:The explosion of image data on the Internet has the potential to foster more sophisticated and robust models and algorithms to index, retrieve, organize and interact with... **View more**

► Metadata

Abstract:

The explosion of image data on the Internet has the potential to foster more sophisticated and robust models and algorithms to index, retrieve, organize and interact with images and multimedia data. But exactly how such data can be harnessed and organized remains a critical problem. We introduce here a new database called "ImageNet", a large-scale ontology of images built upon the backbone of the WordNet structure. ImageNet aims to populate the majority of the 80,000 synsets of WordNet with an average of 500–1000 clean and full resolution images. This will result in tens of millions of annotated images organized by the semantic hierarchy of WordNet. This paper offers a detailed analysis of ImageNet in its current state: 12 subtrees with 5247 synsets and 3.2 million images in total. We show that ImageNet is much larger in scale and diversity and much more accurate than the current image datasets. Constructing such a large-scale database is a challenging task. We describe the data collection scheme with Amazon Mechanical Turk. Lastly, we illustrate the usefulness of ImageNet through three simple applications in object recognition, image classification and automatic object clustering. We hope that the scale, accuracy, diversity and hierarchical structure of ImageNet can offer unparalleled opportunities to researchers in the computer vision community and beyond.

Published in: 2009 IEEE Conference on Computer Vision and Pattern Recognition

Date of Conference: 20-25 June 2009

DOI: 10.1109/CVPR.2009.5206848

Date Added to IEEE Xplore: 18 August 2009

Publisher: IEEE



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.



Browse ▾ My Settings ▾ Help ▾

Sign Out

Sign Out

All



ADVANCED SEARCH

Conferences > 2011 IEEE International Confe... ?

3D is here: Point Cloud Library (PCL)

Publisher: IEEE

[Cite This](#)

PDF

<< Results | Next >

Radu Bogdan Rusu ; Steve Cousins All Authors ***

2867
Cites in
Papers26
Cites in
Patents24562
Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

Abstract

Document Sections

- I. Introduction
- II. Architecture and Implementation
- III. PCL and ROS
- IV. Visualization
- V. Usage Examples

[Show Full Outline ▾](#)

Authors

Figures

References

Citations

Keywords

Downl
PDF

Abstract:With the advent of new, low-cost 3D sensing hardware such as the Kinect, and continued efforts in advanced point cloud processing, 3D perception gains more and more impor... [View more](#)

► Metadata

Abstract:

With the advent of new, low-cost 3D sensing hardware such as the Kinect, and continued efforts in advanced point cloud processing, 3D perception gains more and more importance in robotics, as well as other fields. In this paper we present one of our most recent initiatives in the areas of point cloud perception: PCL (Point Cloud Library - <http://pointclouds.org>). PCL presents an advanced and extensive approach to the subject of 3D perception, and it's meant to provide support for all the common 3D building blocks that applications need. The library contains state-of-the-art algorithms for: filtering, feature estimation, surface reconstruction, registration, model fitting and segmentation. PCL is supported by an international community of robotics and perception researchers. We provide a brief walkthrough of PCL including its algorithmic capabilities and implementation strategies.

Published in: 2011 IEEE International Conference on Robotics and Automation

Date of Conference: 09-13 May 2011

DOI: 10.1109/ICRA.2011.5980567

Date Added to IEEE Xplore: 18 August 2011

Publisher: IEEE



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.

Computer-Aided Design and Applications >

Volume 4, 2007 - Issue 5

92 Views |
 24 CrossRef citations to date |
 9 Altmetric

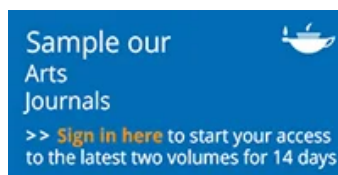
Original Articles

Retrieving Matching CAD Models by Using Partial 3D Point Clouds

Cheuk Yiu Ip & Satyandra K. Gupta

Pages 629-638 | Published online: 05 Aug 2013

 Cite this article
  <https://doi.org/10.1080/16864360.2007.10738497>



 References |
  Citations |
  Metrics |
  Reprints & Permissions |
 Read this article

Abstract

The ability to search for a CAD model that represents a specific physical part is a useful capability that can be used in many different applications. This paper presents an approach to use partial 3D point cloud of an artifact for retrieving the CAD model of the artifact. We assume that the information about the physical parts will be captured by a single 3D scan that produces dense point clouds. CAD models in our approach are represented as polygonal meshes. Our approach involves segmenting the point cloud and CAD mesh models into surface patches. The next step is to identify corresponding surface patches in point clouds and CAD models that could potentially match. Finally, we compute transformations to align the point cloud to the CAD model and compute



[Log in](#) | [Register](#)



[Cart](#)

[Home](#) ▶ [All Journals](#) ▶ [Computer-Aided Design and Applications](#) ▶ [Journal Information](#)

Computer-Aided Design and Applications

[About this journal](#)



[Browse all articles & issues](#)



[Alerts & RSS feed](#)



[Buy a
subscription](#)

About this journal

[▶ Journal metrics](#)

[▶ Aims & scope](#)

[▶ Journal information](#)

[▶ News & call for papers](#)

Journal information

Online ISSN: 1686-4360

6 issues per year

Computer-Aided Design and Applications is abstracted and indexed by:

British Library

CLOCKSS

CrossRef

Ei Compendex/ Engineering Village (Elsevier)

Excellence in Research for Australia (ERA)

Google Scholar

Microsoft Academic
Scopus (Elsevier)
Ulrich's Periodicals Directory
WorldCat Local (OCLC)
Zetoc

CAD Solutions, LLC make every effort to ensure the accuracy of all the information (the "Content") contained in our publications. However, CAD Solutions, LLC, our agents (including the editor, any member of the editorial team or editorial board, and any guest editors), and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by CAD Solutions, LLC. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. CAD Solutions, LLC shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to, or arising out of the use of the Content. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions> .



PUBLICATION DATES

The <pub-date> element should be used to capture control date and cover date. The <pub-date> element appears within the <article-meta> or <issue-meta> elements.

Control Date

The control date is a date representation of the journal volume year and cover month for each issue in the volume and is based on the journal's frequency of publication. For instance, if an issue's spine reads "January 2013", the corresponding control date for the issue will be

```
<day>1</day><month>1</month><year>2013</year>
```

The control date will normally be similar to, but does not have to match, the actual or estimated publication date of the issue. The control date controls the order in which issues appear on Taylor & Francis Online, and can affect what content a customer is able to access for date-based subscriptions.

The control date should be tagged in a <pub-date> element within an <article-meta> in article XML, or within <issue-meta> in Issue XML. The date should be formatted as

```
<day>D</day><month>M</month><year>YYYY</year>
```

For example:

```
<month>10</month><year>2018</year></pub-date>
```

Control date is required in all article and issue XML files. Control date will normally be provided in cats.xml.

For example:

```
<onlinecontroldate>15 Mar 2013</onlinecontroldate>
```

Cover Date

For journals that use cover dates, the cover date should be captured in a element with type “cover”. The complete cover date should be captured, which might be just a year.

For example:

```
<pub-date publication-format="print" date-type="cover"><string-date>November 2018</string-date></pub-date>
```

The control date and the cover date (if used) will normally be provided for each issue in cats.xml. If control date is not provided, the following rules may be used to populate control date from the issue’s cover date:

Rule	Example cover date	Corresponding control date
If cover date indicates a specific calendar day, that date should be used for control date.	March 15, 2013	<pre><day>15</day> <month>3</month> <year>2013</year></pre>

Control date		Control date
If cover date indicates a range of dates, the earliest date should be used for control date.	January 15– February 15, 2013	<code><day>15</day></code> <code><month>1</month></code> <code><year>2013</year></code>
If cover date contains only a month and a year, control date should be set as the first day of that month.	April 2013	<code><day>1</day></code> <code><month>4</month></code> <code><year>2013</year></code>
If cover date contains only a year, control date should be set as the last day of that year. (Note: This instruction was previously to use the first day of the year.)	2013	<code><day>31</day></code> <code><month>12</month></code> <code><year>2013</year></code>
If cover date contains a season, the season should be mapped to a month as follows, and set as the first day of that month:	• Spring = Mar • Summer = Jun • Autumn = Sep • Fall = Sep • Winter = Dec	<code><day>1</day></code> <code><month>3</month></code> <code><year>2013</year></code>

Articles not in an issue

For articles at the just-accepted/AMO/tagging stage, and for ahead-of-issue/Preview articles, the control date should be populated based on the current date. Typesetters should set control date to the next calendar day from the date the article files are supplied. For example, if just-accepted or ahead-of-issue files will be delivered to Taylor & Francis on 4 May 2013, control date should be set as `<day>4</day><month>5</month><year>2013</year>` Cover date should not be present in just-accepted or ahead-of-issue files.



Browse ▾ My Settings ▾ Help ▾

Sign Out

Sign Out

All



ADVANCED SEARCH

Conferences > 2012 IEEE International Confe... ?

3DNet: Large-scale object class recognition from CAD models

Publisher: IEEE

[Cite This](#)

PDF

<< Results

Walter Wohlkinger ; Aitor Aldoma ; Radu B. Rusu ; Markus Vincze **All Authors** *****92**
Cites in
Papers**1**
Cites in
Patent**1778**
Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

Abstract

Document Sections

I. INTRODUCTION

II. State Of the Art

III. DATABASE

IV. FRAMEWORK

V. BENCHMARK &
EVALUATION[Show Full Outline ▾](#)

Authors

Figures

References

Citations

Keywords

Downl
PDF

Abstract:3D object and object class recognition gained momentum with the arrival of low-cost RGB-D sensors and enables robotics tasks not feasible years ago. Scaling object class ... **View more**

► Metadata

Abstract:

3D object and object class recognition gained momentum with the arrival of low-cost RGB-D sensors and enables robotics tasks not feasible years ago. Scaling object class recognition to hundreds of classes still requires extensive time and many objects for learning. To overcome the training issue, we introduce a methodology for learning 3D descriptors from synthetic CAD-models and classification of never-before-seen objects at the first glance, where classification rates and speed are suited for robotics tasks. We provide this in 3DNet (3d-net.org), a free resource for object class recognition and 6DOF pose estimation from point cloud data. 3DNet provides a large-scale hierarchical CAD-model databases with increasing numbers of classes and difficulty with 10, 50, 100 and 200 object classes together with evaluation datasets that contain thousands of scenes captured with a RGB-D sensor. 3DNet further provides an open-source framework based on the Point Cloud Library (PCL) for testing new descriptors and benchmarking of state-of-the-art descriptors together with pose estimation procedures to enable robotics tasks such as search and grasping.

Published in: 2012 IEEE International Conference on Robotics and Automation

Contents

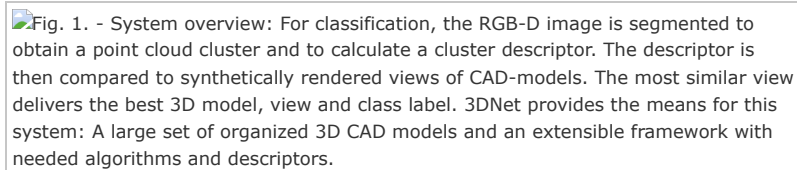
SECTION I. INTRODUCTION



Central tasks for robots are to find, grasp and manipulate objects. While an industrial robot helper needs to know about the specific objects in production, home robots should know about all the object classes typically found in human living space. And certainly, the user expects that the robot can learn novel objects and object classes.

Especially the domestic setting with its plethora of categories and their intraclass variety demands great generalization skills from a service robot. The categories are characterized mostly by their shape ranging from low intraclass diversification as in the case of fruits and simple objects like bottles up to high intraclass variety of classes such as liquid containers, furniture, and especially toys. With robots starting to tackle real-word scenarios, we require fast and reliable object and object class recognition. Especially in robotics manipulation, where object recognition and object classification have to work from all possible viewpoints of an object, data collection for training becomes a bottleneck. Especially for classes with high intraclass variability it is required to obtain a very large number of objects in the training phase.

With the arrival of an affordable RGB-D sensor, the Kinect, and the increasing number of mobile manipulators, e.g., WillowGarage's PR2, learning classes and objects for each one of the objects and robots seems like a waste of resources. The goal should be to have a common knowledge database shared between the robots. So when one robot in place A is trained on novel objects or classes, another robot at place B can update the reference database and detect the new object classes (maybe with the exception if objects differing too greatly from country to country). This also holds true for the introduction of new features and descriptors: once introduced and integrated, everyone should be able to use these algorithms. This is especially true for researchers not working in the field of object and object class recognition, as for them, classification is a necessary step to achieve their own research to provide the robot with new functionalities.

Fig. 1. - System overview: For classification, the RGB-D image is segmented to obtain a point cloud cluster and to calculate a cluster descriptor. The descriptor is then compared to synthetically rendered views of CAD-models. The most similar view delivers the best 3D model, view and class label. 3DNet provides the means for this system: A large set of organized 3D CAD models and an extensible framework with needed algorithms and descriptors.



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.



Technical Section

Fast template matching and pose estimation in 3D point clouds ☆

[Richard Vock](#)  , [Alexander Dieckmann](#), [Sebastian Ochmann](#), [Reinhard Klein](#)

University of Bonn, Germany

Received 20 June 2018, Revised 19 December 2018, Accepted 20 December 2018, [Available online 17 January 2019](#), Version of Record 20 February 2019.

 [What do these dates mean?](#)



[Show less](#) ^

 Outline |  Share  Cite

<https://doi.org/10.1016/j.cag.2018.12.007> ↗

[Get rights and content](#) ↗

Highlights

- Improved method for template search in point clouds.
- Based on point pair feature correspondences.
- Targeted, stochastic strategy for improved point pair sampling.
- Faster, approximate, voxel-based point-to-point correspondence estimation.
- Two orders of magnitude faster on large, cluttered real-world point cloud datasets.

Abstract

Template matching for 3D shapes in point cloud data is an essential prerequisite for a multitude of applications such as bin picking tasks for known objects, detection and completion of redundant object instances during scanning



ScienceDirect[®]

Computers & Graphics

Supports open access

4.9

CiteScore

2.5

Impact Factor

[Submit your article](#)

[Guide for authors](#)

[Menu](#)



[Search in this journal](#)

- [> Aims and scope](#)
- [> Editorial board](#)
- [> Call for papers](#)
- [> News](#)
- [> Announcements](#)
- [> Computers & Graphics team over 40 years](#)
- [> Editors' Choice](#)
- [> Awards](#)

Aims and scope

[FEEDBACK](#)

Computers & Graphics is dedicated to disseminate information on research and applications of **computer graphics** (CG) techniques. The journal encourages articles on:

1. Research and applications of **interactive computer graphics**. We are particularly interested in novel interaction techniques and applications of CG to problem domains.
2. State-of-the-art papers on late-breaking, cutting-edge research on CG.
3. Information on innovative uses of graphics principles and technologies.
4. Tutorial papers on both teaching CG principles and innovative uses of CG in education.

Computers & Graphics provides a medium to communicate information concerning interactive CG and CG applications. The journal focuses on interactive computer graphics, visualization and novel input modalities including virtual environments, and, within this scope, on graphical models, data structures, languages, picture manipulation algorithms and related software.

Replicability Badge and Software Publication

Computers and Graphics is collaborating with the GRSI (Graphics Replicability Stamp Initiative), an independent group of volunteers who help the community by enabling sharing of code and data as a community resource for non-commercial use. The volunteers review the submitted code (and data) and certify its replicability. Note that an accepted paper will be published independently of the GRSI application outcome. However, if the paper receives the Replicability Stamp, it will be given additional exposure by having an attached Replicability Badge, and by being listed on the Replicability Stamp website. See <http://www.replicabilitystamp.org> for further information.

We invite you to convert your open source software with GRSI Badge into an additional journal publication in [Software Impacts](#), a multi-disciplinary open access journal. Software Impacts provides a scholarly reference to software that has been used to address a research challenge. The journal disseminates impactful and re-usable scientific software through Original Software Publications which describe the application of the software to research and the published outputs.

For more information contact us at: software.impacts@elsevier.com

Benefits to authors

We also provide many author benefits, such as free PDFs, a liberal copyright policy, special discounts on Elsevier publications and much more. Please click here for more information on our [author services](#).



All



ADVANCED SEARCH

Conferences > 2017 IEEE Conference on Compu... ?

PointNet: Deep Learning on Point Sets for 3D Classification and Segmentation

Publisher: IEEE

[Cite This](#)

PDF

<< Results | < Previous | Next >

R. Qi Charles ; Hao Su ; Mo Kaichun ; Leonidas J. Guibas **All Authors** ***1869
Cites in
Papers19
Cites in
Patents19326
Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

Abstract

Document Sections

1. Introduction
2. Related Work
3. Problem Statement
4. Deep Learning on Point Sets
5. Experiment

Show Full Outline ▾

Authors

Figures

References

Citations

Keywords

Downl
PDF

Abstract:Point cloud is an important type of geometric data structure. Due to its irregular format, most researchers transform such data to regular 3D voxel grids or collections o... [View more](#)

► Metadata

Abstract:

Point cloud is an important type of geometric data structure. Due to its irregular format, most researchers transform such data to regular 3D voxel grids or collections of images. This, however, renders data unnecessarily voluminous and causes issues. In this paper, we design a novel type of neural network that directly consumes point clouds, which well respects the permutation invariance of points in the input. Our network, named PointNet, provides a unified architecture for applications ranging from object classification, part segmentation, to scene semantic parsing. Though simple, PointNet is highly efficient and effective. Empirically, it shows strong performance on par or even better than state of the art. Theoretically, we provide analysis towards understanding of what the network has learnt and why the network is robust with respect to input perturbation and corruption.

Published in: 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)

Date of Conference: 21-26 July 2017

DOI: 10.1109/CVPR.2017.16

Date Added to IEEE Xplore: 09 November 2017

Publisher: IEEE



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.



Browse ▾ My Settings ▾ Help ▾

Sign Out

Sign Out

All



ADVANCED SEARCH

Conferences > 2019 IEEE/CVF Conference on C... ?

Pseudo-LiDAR From Visual Depth Estimation: Bridging the Gap in 3D Object Detection for Autonomous Driving

Publisher: IEEE

[Cite This](#)

PDF

<< Results

Yan Wang ; Wei-Lun Chao ; Divyansh Garg ; Bharath Hariharan ; Mark Campbell ; Kilian Q. Weinberger **All Authors** ***546
Cites in
Papers1556
Full
Text Views

Alerts

Manage Content Alerts

Add to Citation Alerts

Abstract

Document Sections

1. Introduction
2. Related Work
3. Approach
4. Experiments
5. Discussion and Conclusion

Authors

Figures

References

Citations

Keywords



Downl

PDF

Abstract:3D object detection is an essential task in autonomous driving. Recent techniques excel with highly accurate detection rates, provided the 3D input data is obtained from ... **View more**

► Metadata

Abstract:

3D object detection is an essential task in autonomous driving. Recent techniques excel with highly accurate detection rates, provided the 3D input data is obtained from precise but expensive LiDAR technology. Approaches based on cheaper monocular or stereo imagery data have, until now, resulted in drastically lower accuracies --- a gap that is commonly attributed to poor image-based depth estimation. However, in this paper we argue that it is not the quality of the data but its representation that accounts for the majority of the difference. Taking the inner workings of convolutional neural networks into consideration, we propose to convert image-based depth maps to pseudo-LiDAR representations --- essentially mimicking the LiDAR signal. With this representation we can apply different existing LiDAR-based detection algorithms. On the popular KITTI benchmark, our approach achieves impressive improvements over the existing state-of-the-art in image-based performance --- raising the detection accuracy of objects within the 30m range from the previous state-of-the-art of 22% to an unprecedented 74%. At the time of submission our algorithm holds the highest entry on the KITTI 3D object detection leaderboard for stereo-image-based approaches.

 Contents

SECTION 1.
Introduction



Reliable and robust 3D object detection is one of the fundamental requirements for autonomous driving. After all, in order to avoid collisions with pedestrians, cyclist, and cars, a vehicle must be able to detect them in the first place.

Existing algorithms largely rely on LiDAR (Light Detection And Ranging), which provide accurate 3D point clouds of the surrounding environment. Although highly precise, alternatives to LiDAR are desirable for multiple reasons. First, LiDAR is expensive, which incurs a hefty premium for autonomous driving hardware. Second, over-reliance on a single sensor is an inherent safety risk and it would be advantageous to have a secondary sensor to fall-back onto in case of an outage. A natural candidate are images from stereo or monocular cameras. Optical cameras are highly affordable (several orders of magnitude cheaper than LiDAR), operate at a high frame rate, and provide a dense depth map rather than the 64 or 128 sparse rotating laser beams that LiDAR signal is inherently limited to.

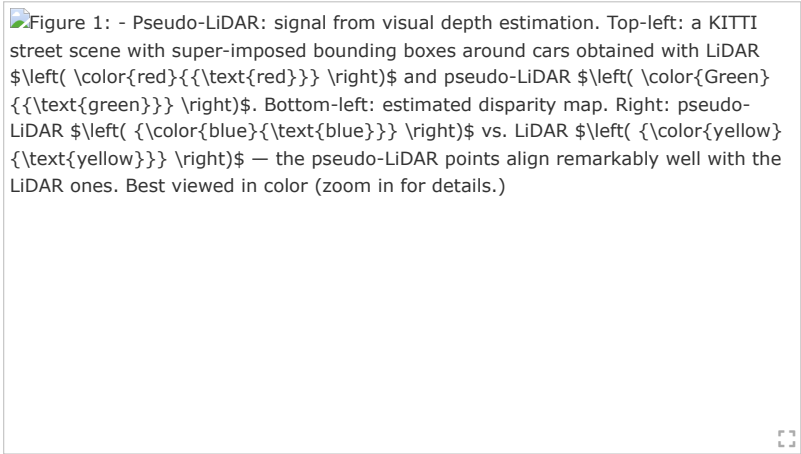


Figure 1: Pseudo-LiDAR: signal from visual depth estimation. Top-left: a KITTI street scene with super-imposed bounding boxes around cars obtained with LiDAR (red) and pseudo-LiDAR (green). Bottom-left: estimated disparity map. Right: pseudo-LiDAR (blue) vs. LiDAR (yellow) — the pseudo-LiDAR points align remarkably well with the LiDAR ones. Best viewed in color (zoom in for details.)



IEEE *Xplore* Resources and Help

Resources Search Resources and Help



Publication Dates

The Date of Publication for Journals and Standards on IEEE *Xplore* represents the very first instance of public dissemination. IEEE *Xplore* previously made distinctions between the online publication date, print publication date, etc. This was simplified to reflect a single publication date of record as defined above.

Conference proceedings in IEEE *Xplore* show "Date of Conference" (date of event) and also "Date Added to IEEE *Xplore*" (date proceedings were first published).

Courses show the month and year of publication. Some older courses include the label "Reaffirmed" to indicate the course was reevaluated to ensure its contents are up-to-date and relevant.

Books show the Copyright Year of publication.

IEEE Personal Account

[CHANGE USERNAME/PASSWORD](#)

[UPDATE ADDRESS](#)

Purchase Details

[PAYMENT OPTIONS](#)

[ORDER HISTORY](#)

[ACCESS PURCHASED DOCUMENTS](#)

Profile Information

[COMMUNICATIONS PREFERENCES](#)

[PROFESSION AND EDUCATION](#)

[TECHNICAL INTERESTS](#)

Need Help?

[US & CANADA: +1 800 678 4333](#)

[WORLDWIDE: +1 732 981 0060](#)

[CONTACT & SUPPORT](#)

Follow



[About IEEE *Xplore*](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved.



Estimation with Applications to Tracking and Navigation: Theory, Algorithms and Software

Author(s): Yaakov Bar-Shalom, X.-Rong Li, Thiagalingam Kirubarajan

First published: 4 January 2002

Print ISBN: 9780471416555 | Online ISBN: 9780471221272 | DOI: 10.1002/0471221279

Copyright © 2001 John Wiley & Sons, Inc.

About this book

Expert coverage of the design and implementation of state estimation algorithms for tracking and navigation

Estimation with Applications to Tracking and Navigation treats the estimation of various quantities from inherently inaccurate remote observations. It explains state estimator design using a balanced combination of linear systems, probability, and statistics.

The authors provide a review of the necessary background mathematical techniques and offer an overview of the basic concepts in estimation. They then provide detailed treatments of all the major issues in estimation with a focus on applying these techniques to real systems. Other features include:

- Problems that apply theoretical material to real-world applications
- In-depth coverage of the Interacting Multiple Model (IMM) estimator
- Companion DynaEst(TM) software for MATLAB(TM) implementation of Kalman filters and IMM estimators
- Design guidelines for tracking filters

Suitable for graduate engineering students and engineers working in remote sensors and tracking, *Estimation with Applications to Tracking and Navigation* provides expert coverage of this important area.

Table of Contents

[Home](#) [Autonomous Robots](#) [Article](#)

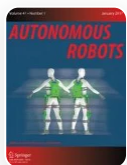
Model based vehicle detection and tracking for autonomous urban driving

Published: 01 April 2009

Volume 26, pages 123–139, (2009) [Cite this article](#)

[Download PDF](#) 

Access provided by NorthEast Research Libraries (NERL)



Autonomous Robots

[Aims and scope](#)

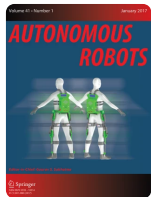
[Submit manuscript](#)

[Anna Petrovskaya](#)  [Sebastian Thrun](#)

 **4463** Accesses  **311** Citations  **3** Altmetric [Explore all metrics](#) →

Abstract

Situational awareness is crucial for autonomous driving in urban environments. This paper describes the moving vehicle detection and tracking module that we developed for our autonomous driving robot Junior. The robot won second place in the Urban Grand Challenge, an autonomous driving race organized by the U.S. Government in 2007. The module provides reliable detection and tracking of moving vehicles from a high-speed moving platform using laser range finders. Our approach models both dynamic and geometric properties of the

[Home](#) [Autonomous Robots](#)

Autonomous Robots

Publishing model

Hybrid

[Submit your manuscript](#)[Editorial board](#)[Aims and scope](#)[Journal updates](#)

Overview

Autonomous Robots is a journal focusing on the theory and applications of self-sufficient robotic systems.

Features papers that include performance data on actual robots in the real world.

Reports on learning and adaptation in robots, human-robot interaction, and multi-robot systems.

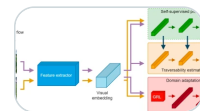
Covers a wide range of topics, including planning and navigation, studies of autonomous robot systems, and self-calibration and self-repair for robots.
Known for its high Impact Factor in Robotics and AI.

Editor-in-Chief
Gaurav Sukhatme

-  Impact factor
3.5 (2022)
-  5 year impact factor
4.6 (2022)
-  Submission to first decision (median)
46 days
-  Downloads
349,712 (2023)

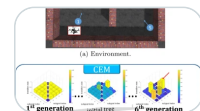
Latest articles

Terrain traversability prediction through self-supervised learning and unsupervised domain adaptation on synthetic data



OriginalPaper | Open access | 30 March 2024 | Article: 4

Maximal coverage problems with routing constraints using cross-entropy Monte Carlo tree search



OriginalPaper | 30 January 2024 | Article: 3

Collocation methods for second and higher order systems



OriginalPaper | Open access | 28 January 2024 | Article: 2

copyright of the article to the Publisher.

Offprints

Offprints can be ordered by the corresponding author.

Color illustrations

Online publication of color illustrations is free of charge. For color in the print version, authors will be expected to make a contribution towards the extra costs.

Proof reading

The purpose of the proof is to check for typesetting or conversion errors and the completeness and accuracy of the text, tables and figures. Substantial changes in content, e.g., new results, corrected values, title and authorship, are not allowed without the approval of the Editor.

After online publication, further changes can only be made in the form of an Erratum, which will be hyperlinked to the article.

Online First

The article will be published online after receipt of the corrected proofs. This is the official first publication citable with the DOI. After release of the printed version, the paper can also be cited by issue and page numbers.

[Back to top](#) ↑

Open Choice

Open Choice allows you to publish open access in more than 1850 Springer Nature journals, making your research more visible and accessible immediately on publication.

Article processing charges (APCs) vary by journal – [view the full list](#)