

Variable Baseline/Resolution Stereo

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Abstract

We present a novel multi-baseline, multi-resolution stereo method, which varies the baseline and resolution proportionally to depth to obtain a reconstruction in which the depth error is constant. This is in contrast to traditional stereo, in which the error grows quadratically with depth, which means that the accuracy in the near range far exceeds that of the far range. This accuracy in the near range is unnecessarily high and comes at significant computational cost. It is, however, non-trivial to reduce this without also reducing the accuracy in the far range. Many datasets, such as video captured from a moving camera, allow the baseline to be selected with significant flexibility. By selecting an appropriate baseline and resolution (realized using an image pyramid), our algorithm computes a depthmap which has these properties: 1) the depth accuracy is constant over the reconstructed volume, 2) the computational effort is spread evenly over the volume, 3) the angle of triangulation is held constant w.r.t. depth. Our approach achieves a given target accuracy with minimal computational effort, and is orders of magnitude faster than traditional stereo.

1. Introduction

Stereo is a well-studied problem in computer vision [14]. Recent work has been very successful in solving the correspondence problem, which is to decide which pixels in one image correspond to which pixels in another. Techniques employing graph cuts and belief propagation can achieve error rates of less than 1% (on laboratory data). However, for many applications the goal is ultimately not pixel correspondence but depth accuracy. Even with perfect correspondences, the depth error in traditional stereo grows quadratically with depth, which means that the accuracy in the near range far exceeds that of the far range. While the accuracy in the far range is unusably bad, the accuracy in the near range is unnecessarily high and comes at significant computational cost. Accuracy can be improved by incorporating multiple views. These views provide additional information which aids in the correspondence problem, but

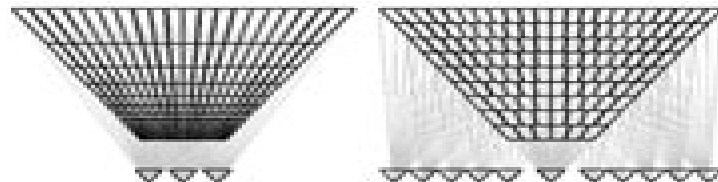


Figure 1. Left: Standard stereo. Note that the distance between depths increases quadratically. Right: Variable Baseline/Resolution Stereo. The distance between depths is held constant by increasing the baseline and selecting the appropriate resolution.

they can also improve the depth accuracy geometrically by increasing the angle of triangulation. In many applications, such as structure from motion from video [12], or recently reconstruction from community photo collections [4], the choice of views for stereo is quite flexible. Our technique focuses on selecting the best cameras, as well as the most appropriate sampling in the images, to compute a depthmap that meets the desired geometric accuracy with minimal computation. Specifically, we increase the baseline to increase accuracy in the far range, and we reduce the resolution (using a gaussian pyramid) to reduce computational effort in the near range. Additionally our novel algorithm is compatible with most matching and optimization strategies, and will work with any higher level post-processing typically used in stereo, e.g. depth fusion [10, 19].

Many applications today require accurate 3D models of real-world scenery. For example, mapping applications such as Google Earth and Microsoft Virtual Earth have recently incorporated textured 3D models of cities. These models are typically extracted from aerial and satellite images and lack ground level detail. Several research projects aim to produce 3D reconstructions of cities from photographs or video acquired from ground level. The amount of image data required to observe an entire city can be enormous. Therefore, processing speed, as well as accuracy, is an important consideration. Furthermore, scenes captured

Stereo And Multi Baseline Vision Smbv 2001 Proceedings

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Stereo and Multi-Baseline Vision (SMBV 2001): Proceedings of the 2001 IEEE Workshop ,2001 *IEEE Workshop on Stereo and Multi-Baseline Vision ,2001* Proceedings of the Fourth International Conference on Signal and Image Processing 2012 (ICSIP 2012) Mohan S,S Suresh Kumar,2013-01-11 The proceedings includes cutting edge research articles from the Fourth International Conference on Signal and Image Processing ICSIP which is organised by Dr N G P Institute of Technology Kalapatti Coimbatore The Conference provides academia and industry to discuss and present the latest technological advances and research results in the fields of theoretical experimental and application of signal image and video processing The book provides latest and most informative content from engineers and scientists in signal image and video processing from around the world which will benefit the future research community to work in a more cohesive and collaborative way *Proceedings of the International Conference on Aerospace System Science and Engineering 2022* Zhongliang Jing,Xingqun Zhan,Christopher Damaren,2023-02-25 The book collects selected papers presented at the 6th International Conference on Aerospace System Science and Engineering ICASSE 2022 organized by Shanghai Jiao Tong University China and hosted by University of Toronto Canada in July 2022 It provides a forum for experts in aeronautics and astronautics to share new ideas and findings ICASSE conference has been organized annually since 2017 and host in Shanghai Moscow and Toronto in turn where the three regional editors of journal Aerospace Systems are located This book presents high quality contributions in the subject area of Aerospace System Science and Engineering including topics such as Trans space vehicle systems design and integration Air vehicle systems Space vehicle systems Near space vehicle systems Opto electronic system Aerospace robotics and unmanned system Aerospace robotics and unmanned system Communication navigation and surveillance Dynamics and control Intelligent sensing and Information fusion Aerodynamics and aircraft design Aerospace propulsion Avionics system Air traffic management Earth observation Deep space exploration Bionic micro aircraft spacecraft **Stereo vision-based road condition monitoring** Brunken, Hauke,2021-05-12 When planning road construction measures it is essential to have up to date information on road conditions If this information is not to be obtained manually it is currently obtained using laser scanners mounted on mobile mapping vehicles which can measure the 3D road profile However a large number of mobile mapping vehicles would be necessary to record an entire road network on a regular basis Since 2D road damages can be found automatically on monocular camera images the idea was born to use a stereo camera system to capture the 3D profile of roads With stereo camera systems it would be possible to equip a large number of vehicles and regularly collect data from large road networks In this thesis the potential applications of a stereo camera system for measuring road profiles which is mounted behind the windshield of a vehicle are investigated Since this requires a calibration of the stereo camera system but the effort for the user should be kept low the camera self calibration for this application is also examined 3D reconstruction from stereoscopic images is a well studied topic but its application on

road surfaces with little and repetitive textures requires special algorithms. For this reason a new stereo method was developed. It is based on the plane sweep approach in combination with semi global matching. It was tested with different measures for pixel comparison. Furthermore the plane sweep approach was implemented in a neural network that solves the stereo correspondence problem in a single step. It uses the stereoscopic images as input and provides an elevation image as output. A completely new approach was developed for the self calibration of mono cameras and stereo camera systems. Previous methods search for feature points in several images of the same scene. The points are matched between the images and used for the calibration. In contrast to these methods the proposed method uses feature maps instead of feature points to compare multiple views of one and the same plane. To estimate the unknown parameters the backpropagation algorithm is used together with the gradient descent method. The measurements obtained by stereoscopic image processing were compared with those obtained by industrial laser scanners. They show that both measurements are very close to each other and that a stereoscopic camera system is in principle suitable for capturing the surface profile of a road. Experiments show that the proposed self calibration method is capable of estimating all parameters of a complex camera model including lens distortion with high precision.

Bei der Planung von Stra enbauma nahmen ist es unabdingbar ber aktuelle Informationen ber den Stra enzustand zu verf gen. Sollen diese Informationen nicht manuell gewonnen werden, werden derzeit Messfahrzeuge mit Laserscannern verwendet, welche das 3D Stra enprofil vermessen k nnen. F r die regelm ige Erfassung eines gesamten Stra ennetzes w re jedoch eine gro e Anzahl von Messfahrzeugen erforderlich. Da 2D Stra ensch den automatisch auf monokularen Kamerabildern gefunden werden k nnen, entstand die Idee ein Stereokamerasystem zur Erfassung des 3D Profils zu verwenden. Eine gro e Anzahl von Fahrzeugen k nnte damit ausgetestet werden und es k nnten regelm ig Daten von gro en Stra ennetzen erfasst werden. In dieser Arbeit werden die Einsatzm glichkeiten eines Stereokamerasystems zur Messung von Stra enprofilen untersucht, dass sich hinter der Windschutzscheibe eines Fahrzeugs befindet. Da hierzu das Stereokamerasystems kalibriert sein muss, der Aufwand f r den Anwender aber geringgehalten werden soll, wird au erdem die Selbstkalibrierung f r diesen Einsatzzweck untersucht. Die 3D Rekonstruktion aus stereoskopischen Bildern ist ein viel untersuchtes Thema, aber ihre Anwendung auf Stra enoberfl chen mit wenig und sich wiederholenden Texturen erfordert spezielle Algorithmen. Aus diesem Grund wurde ein neues Stereoverfahren entwickelt. Es basiert auf dem Plane sweep Ansatz in Kombination mit Semi global Matching. Es wurde mit verschiedene Ma en f r den Vergleich von Pixeln getestet. Dar ber hinaus wurde der Plane sweep Ansatz in einem neuronalen Netzwerk implementiert, das das Stereo Korrespondenzproblem in einem einzigen Schritt l st. Es verwendet die stereoskopischen Bilder als Eingabe und liefert als Ausgabe ein H henbild. F r die Selbstkalibrierung von Monokameras und Stereokamerasystemen wurde ein v llig neuer Ansatz entwickelt. Bisherige Methoden suchen nach Merkmalspunkten in mehreren Bildern der gleichen Szene. Die Punkte werden zwischen den Bildern zugeordnet und f r die Kalibrierung verwendet. Die vorgeschlagene Methode verwendet anstelle von Merkmalspunkten

Feature Maps um mehrere Ansichten derselben Ebene zu vergleichen Zur Schätzung der unbekannten Parameter wird der Backpropagation Algorithmus zusammen mit dem Gradientenabstiegsverfahren verwendet Die durch stereoskopische Bildverarbeitung erhaltenen Messungen wurden mit Messungen von industriellen Laserscannern verglichen Sie zeigen dass beide sehr nahe beieinander liegen und dass ein Stereokamerasystem für die Erfassung des Oberflächenprofils einer StraÙe grundsätzlich geeignet ist Experimente zeigen dass die neue Selbstkalibrierungsmethode in der Lage ist alle Parameter eines komplexen Kameramodells einschließlich der Linsenverzerrung mit hoher Präzision abzuschätzen

Stereo Vision Asim Bhatti, 2008-11-01 The book comprehensively covers almost all aspects of stereo vision In addition reader can find topics from defining knowledge gaps to the state of the art algorithms as well as current application trends of stereo vision to the development of intelligent hardware modules and smart cameras It would not be an exaggeration if this book is considered to be one of the most comprehensive books published in reference to the current research in the field of stereo vision Research topics covered in this book makes it equally essential and important for students and early career researchers as well as senior academics linked with computer vision

Proceedings of 3rd International Conference on Computer Vision and Image Processing Bidyut B. Chaudhuri, Masaki Nakagawa, Pritee Khanna, Sanjeev Kumar, 2019-10-31 This book is a collection of carefully selected works presented at the Third International Conference on Computer Vision Image Video Formation and Display Image Video Filtering Restoration Enhancement and Super resolution Image Video Coding and Transmission Image Video Storage Retrieval and Authentication Image Video Quality Transform based and Multi resolution Image Video Analysis Biological and Perceptual Models for Image Video Processing Machine Learning in Image Video Analysis Probability and uncertainty handling for Image Video Processing and Motion and Tracking

Creating Autonomous Vehicle Systems Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, 2022-11-10 This book is the first technical overview of autonomous vehicles written for a general computing and engineering audience The authors share their practical experiences of creating autonomous vehicle systems These systems are complex consisting of three major subsystems 1 algorithms for localization perception and planning and control 2 client systems such as the robotics operating system and hardware platform and 3 the cloud platform which includes data storage simulation high definition HD mapping and deep learning model training The algorithm subsystem extracts meaningful information from sensor raw data to understand its environment and make decisions about its actions The client subsystem integrates these algorithms to meet real time and reliability requirements The cloud platform provides offline computing and storage capabilities for autonomous vehicles Using the cloud platform we are able to test new algorithms and update the HD map plus train better recognition tracking and decision models This book consists of nine chapters Chapter 1 provides an overview of autonomous vehicle systems Chapter 2 focuses on localization technologies Chapter 3 discusses traditional techniques used for perception Chapter 4 discusses deep learning based techniques for perception Chapter 5 introduces the planning and control sub

system especially prediction and routing technologies Chapter 6 focuses on motion planning and feedback control of the planning and control subsystem Chapter 7 introduces reinforcement learning based planning and control Chapter 8 delves into the details of client systems design and Chapter 9 provides the details of cloud platforms for autonomous driving This book should be useful to students researchers and practitioners alike Whether you are an undergraduate or a graduate student interested in autonomous driving you will find herein a comprehensive overview of the whole autonomous vehicle technology stack If you are an autonomous driving practitioner the many practical techniques introduced in this book will be of interest to you Researchers will also find plenty of references for an effective deeper exploration of the various technologies

Creating Autonomous Vehicle Systems, Second Edition Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, 2022-05-31 This book is one of the first technical overviews of autonomous vehicles written for a general computing and engineering audience The authors share their practical experiences designing autonomous vehicle systems These systems are complex consisting of three major subsystems 1 algorithms for localization perception and planning and control 2 client systems such as the robotics operating system and hardware platform and 3 the cloud platform which includes data storage simulation high definition HD mapping and deep learning model training The algorithm subsystem extracts meaningful information from sensor raw data to understand its environment and make decisions as to its future actions The client subsystem integrates these algorithms to meet real time and reliability requirements The cloud platform provides offline computing and storage capabilities for autonomous vehicles Using the cloud platform new algorithms can be tested so as to update the HD map in addition to training better recognition tracking and decision models Since the first edition of this book was released many universities have adopted it in their autonomous driving classes and the authors received many helpful comments and feedback from readers Based on this the second edition was improved by extending and rewriting multiple chapters and adding two commercial test case studies In addition a new section entitled Teaching and Learning from this Book was added to help instructors better utilize this book in their classes The second edition captures the latest advances in autonomous driving and that it also presents usable real world case studies to help readers better understand how to utilize their lessons in commercial autonomous driving projects This book should be useful to students researchers and practitioners alike Whether you are an undergraduate or a graduate student interested in autonomous driving you will find herein a comprehensive overview of the whole autonomous vehicle technology stack If you are an autonomous driving practitioner the many practical techniques introduced in this book will be of interest to you Researchers will also find extensive references for an effective deeper exploration of the various technologies

Dynamic 3D Imaging Andreas Kolb, Reinhard Koch, 2009-08-28 This book constitutes the refereed proceedings of the Dynamic 3D Imaging Workshop Dyn3D 2009 held in Jena Germany as an associated event of DAGM 2009 the main international conference of the Deutsche Arbeitsgemeinschaft f r Mustererkennung The 13 revised full papers presented were carefully

reviewed and selected for inclusion in the book The papers cover a range of topics of current interest fundamentals of ToF sensors algorithms and data fusion and applications of dynamic 3D scene analysis This book is aimed at researchers interested in novel approaches in the field of real time range imaging *Computer Vision -- ECCV 2010* Kostas Daniilidis, Petros Maragos, Nikos Paragios, 2010-09-24 The 2010 edition of the European Conference on Computer Vision was held in Heraklion Crete The call for papers attracted an absolute record of 1 174 submissions We describe here the selection of the accepted papers Thirty eight area chairs were selected coming from Europe 18 USA and Canada 16 and Asia 4 Their selection was based on the following criteria 1 Researchers who had served at least two times as Area Chairs within the past two years at major vision conferences were excluded 2 Researchers who served as Area Chairs at the 2010 Computer Vision and Pattern Recognition were also excluded exception ECCV 2012 Program Chairs 3 Minimization of overlap introduced by Area Chairs being former student and advisors 4 20% of the Area Chairs had never served before in a major conference 5 The Area Chair selection process made all possible efforts to achieve a reasonable geographic distribution between countries thematic areas and trends in computer vision Each Area Chair was assigned by the Program Chairs between 28 32 papers Based on paper content the Area Chair recommended up to seven potential reviewers per paper Such assignment was made using all reviewers in the database including the conflicting ones The Program Chairs manually entered the missing conflict domains of approximately 300 reviewers Based on the recommendation of the Area Chairs three reviewers were selected per paper with at least one being of the top three suggestions with 99 *Computer Vision - ACCV 2006* P.J. Narayanan, Shree K. Nayar, Heung-Yeung Shum, 2006-01-14 These volumes present together a total of 64 revised full papers and 128 revised posters papers The papers are organized in topical sections on camera calibration stereo and pose texture face recognition variational methods tracking geometry and calibration lighting and focus in the first volume The papers of the second volume cover topics as detection and applications statistics and kernels segmentation geometry and statistics signal processing and video processing *Computer Vision: Concepts, Methodologies, Tools, and Applications* Management Association, Information Resources, 2018-02-02 The fields of computer vision and image processing are constantly evolving as new research and applications in these areas emerge Staying abreast of the most up to date developments in this field is necessary in order to promote further research and apply these developments in real world settings *Computer Vision Concepts Methodologies Tools and Applications* is an innovative reference source for the latest academic material on development of computers for gaining understanding about videos and digital images Highlighting a range of topics such as computational models machine learning and image processing this multi volume book is ideally designed for academicians technology professionals students and researchers interested in uncovering the latest innovations in the field **Computer Vision and Pattern Recognition in Environmental Informatics** Zhou, Jun, Bai, Xiao, Caelli, Terry, 2015-10-19 *Computer Vision and Pattern Recognition CVPR* together play an important role in the processes involved in environmental informatics

due to their pervasive non destructive effective and efficient natures As a result CVPR has made significant contributions to the field of environmental informatics by enabling multi modal data fusion and feature extraction supporting fast and reliable object detection and classification and mining the intrinsic relationship between different aspects of environmental data Computer Vision and Pattern Recognition in Environmental Informatics describes a number of methods and tools for image interpretation and analysis which enables observation modelling and understanding of environmental targets In addition to case studies on monitoring and modeling plant soil insect and aquatic animals this publication includes discussions on innovative new ideas related to environmental monitoring automatic fish segmentation and recognition real time motion tracking systems sparse coding and decision fusion and cell phone image based classification and provides useful references for professionals researchers engineers and students with various backgrounds within a multitude of communities

Advances in Visual Computing Richard Boyle,Bahram Parvin,Darko Koracin,Yoshinori Kuno,Junxian Wang,Pajarola Renato,Peter Lindstrom,Andre Hinkenjann,Miguel L. Encarnacao,Claudio T. Silva,Daniel Coming,2009-11-26 It is with great pleasure that we present the proceedings of the 5th International Symposium on Visual Computing ISVC 2009 which was held in Las Vegas Nevada ISVC offers a common umbrella for the four main areas of visual computing including vision graphics visualization and virtual reality The goal is to provide a forum for researchers scientists engineers and practitioners throughout the world to present their latest research findings ideas developments and applications in the broader area of visual computing This year the program consisted of 16 oral sessions one poster session 7 special tracks and 6 keynote presentations Also this year ISVC hosted the Third Semantic Robot Vision Challenge The response to the call for papers was very good were received over 320 submissions for the main symposium from which we accepted 97 papers for oral presentation and 63 papers for poster presentation Special track papers were solicited separately through the Organizing and Program Committees of each track A total of 40 papers were accepted for oral presentation and 15 papers for poster presentation in the special tracks All papers were reviewed with an emphasis on potential to contribute to the state of the art in the field Selection criteria included accuracy and originality of ideas clarity and significance of results and presentation quality The review process was quite rigorous involving two to three independent blind reviews followed by several days of discussion During the discussion period we tried to correct anomalies and errors that might have existed in the initial reviews

Computational Intelligence Paradigms S. Sumathi,Surekha Paneerselvam,2010-01-05 Offering a wide range of programming examples implemented in MATLAB Computational Intelligence Paradigms Theory and Applications Using MATLAB presents theoretical concepts and a general framework for computational intelligence CI approaches including artificial neural networks fuzzy systems evolutionary computation genetic algorithms and programming paradigms *3D-TV System with Depth-Image-Based Rendering* Ce Zhu,Yin Zhao,Lu Yu,Masayuki Tanimoto,2012-08-15 Riding on the success of 3D cinema blockbusters and advances in stereoscopic display technology 3D video applications have gathered momentum in recent

years 3D TV System with Depth Image Based Rendering Architectures Techniques and Challenges surveys depth image based 3D TV systems which are expected to be put into applications in the near future Depth image based rendering DIBR significantly enhances the 3D visual experience compared to stereoscopic systems currently in use DIBR techniques make it possible to generate additional viewpoints using 3D warping techniques to adjust the perceived depth of stereoscopic videos and provide for auto stereoscopic displays that do not require glasses for viewing the 3D image The material includes a technical review and literature survey of components and complete systems solutions for technical issues and implementation of prototypes The book is organized into four sections System Overview Content Generation Data Compression and Transmission and 3D Visualization and Quality Assessment This book will benefit researchers developers engineers and innovators as well as advanced undergraduate and graduate students working in relevant areas Computer Vision – ECCV 2018 Vittorio Ferrari, Martial Hebert, Cristian Sminchisescu, Yair Weiss, 2018-10-06 The sixteen volume set comprising the LNCS volumes 11205 11220 constitutes the refereed proceedings of the 15th European Conference on Computer Vision ECCV 2018 held in Munich Germany in September 2018 The 776 revised papers presented were carefully reviewed and selected from 2439 submissions The papers are organized in topical sections on learning for vision computational photography human analysis human sensing stereo and reconstruction optimization matching and recognition video attention and poster sessions *Neural Information Processing* Derong Liu, Shengli Xie, Yuanqing Li, Dongbin Zhao, El-Sayed M. El-Alfy, 2017-11-07 The six volume set LNCS 10634 LNCS 10635 LNCS 10636 LNCS 10637 LNCS 10638 and LNCS 10639 constitutes the proceedings of the 24rd International Conference on Neural Information Processing ICONIP 2017 held in Guangzhou China in November 2017 The 563 full papers presented were carefully reviewed and selected from 856 submissions The 6 volumes are organized in topical sections on Machine Learning Reinforcement Learning Big Data Analysis Deep Learning Brain Computer Interface Computational Finance Computer Vision Neurodynamics Sensory Perception and Decision Making Computational Intelligence Neural Data Analysis Biomedical Engineering Emotion and Bayesian Networks Data Mining Time Series Analysis Social Networks Bioinformatics Information Security and Social Cognition Robotics and Control Pattern Recognition Neuromorphic Hardware and Speech Processing *Artificial Intelligence in Data and Big Data Processing* Ngoc Hoang Thanh Dang, Yu-Dong Zhang, João Manuel R. S. Tavares, Bo-Hao Chen, 2022-05-18 The book presents studies related to artificial intelligence AI and its applications to process and analyze data and big data to create machines or software that can better understand business behavior industry activities and human health The studies were presented at The 2021 International Conference on Artificial Intelligence and Big Data in Digital Era ICABDE 2021 which was held in Ho Chi Minh City Vietnam during December 18 19 2021 The studies are pointing toward the famous slogan in technology Make everything smarter i.e. creating machines that can understand and can communicate with humans and they must act like humans in different aspects such as vision communication thinking feeling and acting A computer would deserve to be called

intelligent if it could deceive a human into believing that it was human Alan Turing

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