

Pose and Focal length Estimation using a Point and a Line with Known Camera Position

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ABSTRACT 2D-3D point or line correspondences are usually used to estimate the camera pose and intrinsic parameters, such as the focal length. There are many point-based methods and line-based methods, i.e., PnP solvers and PnL solvers. However, methods that use both point and line correspondences are not used widely. Hence, this paper proposed a new method to estimate the pose and focal length using a 2D-3D point correspondence and a 2D-3D line correspondence. In addition, the camera position is known as the prior knowledge to simplify the calculating process. In the world frame, the 3D point and camera position can determine a line, and the 2D projection of the 3D point and camera position can also determine a line in the camera frame. In fact, the two lines are the same line in space and their unit direction vectors can convert to each other using the rotation matrix from the world frame to the camera frame. In the world frame, the 3D line and camera position can determine a plane, and the 2D projection of the 3D line and camera position can also determine a plane in the camera frame. In fact, the two planes are the same plane in space and their unit normal vectors can also convert to each other using the rotation matrix from the world frame to the camera frame. Now there are two transformations of the direction vectors and the normal vectors. The transformations of vectors can be regarded as the transformations of 3D-3D point correspondences when the world frame and camera frame have the same origin. This is the key point in this paper and then the pose can be estimated efficiently. What's more, the angle between the line passing through the 3D point and camera position, and the plane passing through the 3D line and camera position in the world frame, is equal to the angle between the line passing through the 2D projection of the 3D point and camera position, and the plane passing through the 2D projection of the 3D line and camera position in the camera frame. This is another key point to estimate the focal length. Experiments show our proposed method has good performance in numerical stability, noise sensitivity and computational speed with synthetic data and real scenarios. In addition, compared with other SOTA (state-of-the-art) methods, our method has a single solution and performs better.

INDEX TERMS camera position, direction vector, focal length, line correspondence, normal vector, point correspondence, pose estimation.

1. INTRODUCTION

Many methods of camera pose estimation have been proposed and are still being studied. With the development of neural networks, pose estimation based on deep learning is becoming more and more popular [1-5]. However, deep learning requires large-scale training sets and hence it is difficult to be applied in scenes without training sets, such as in the field of weapon testing, where it is difficult to obtain large-scale training sets. In addition, the accuracy of pose estimation using deep learning is far from meeting the requirements of weapon testing. In these scenarios, traditional pose estimation methods are widely used.

Traditional pose estimation methods do not need large-scale training sets, and only need a few accurate inputs. In the relevant algorithms, 2D-3D point correspondences and line correspondences are commonly used to estimate the pose, called PnP [6-8] and PnL [9-11] solvers. However, there are few studies on methods that use both the point and line simultaneously [12]. This kind of methods can be used as a supplement to PnP and PnL methods to expand the range of use of pose estimation, which is the main reason why we do the work in this paper. Therefore, this paper proposed a new pose estimation method based on a 2D-3D point correspondence and a 2D-3D line correspondence. Using

Real Time Camera Pose And Focal Length Estimation

Haruo Takemura, Kiyoshi Kiyokawa



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Computer Vision – ECCV 2016 Bastian Leibe, Jiri Matas, Nicu Sebe, Max Welling, 2016-09-16 The eight volume set comprising LNCS volumes 9905 9912 constitutes the refereed proceedings of the 14th European Conference on Computer Vision ECCV 2016 held in Amsterdam The Netherlands in October 2016 The 415 revised papers presented were carefully reviewed and selected from 1480 submissions The papers cover all aspects of computer vision and pattern recognition such as 3D computer vision computational photography sensing and display face and gesture low level vision and image processing motion and tracking optimization methods physics based vision photometry and shape from X recognition detection categorization indexing matching segmentation grouping and shape representation statistical methods and learning video events activities and surveillance applications They are organized in topical sections on detection recognition and retrieval scene understanding optimization image and video processing learning action activity and tracking 3D and 9 poster sessions

Field and Service Robotics Marco Hutter, Roland Siegwart, 2017-11-01 This book contains the proceedings of the 11th FSR Field and Service Robotics which is the leading single track conference on applications of robotics in challenging environments This conference was held in Zurich Switzerland from 12 15 September 2017 The book contains 45 full length peer reviewed papers organized into a variety of topics Control Computer Vision Inspection Machine Learning Mapping Navigation and Planning and Systems and Tools The goal of the book and the conference is to report and encourage the development and experimental evaluation of field and service robots and to generate a vibrant exchange and discussion in the community Field robots are non factory robots typically mobile that operate in complex and dynamic environments on the ground Earth or other planets under the ground underwater in the air or in space Service robots are those that work closely with humans to help them with their lives The first FSR was held in Canberra Australia in 1997 Since that first meeting FSR has been held roughly every two years cycling through Asia Americas and Europe

3D Trajectory Extraction from 2D Videos for Human Activity Analysis Zeyd Boukhers, 2017 The present dissertation addresses the problem of extracting 3D trajectories of objects from 2D videos The reason of this is the theory that these trajectories symbolise high level interpretations of human activities A 3D trajectory of an object means its sequential positions in the real world over time To this end a generic framework for detecting objects and extracting their trajectories is proposed In simpler terms it means obtaining the 3D coordinate of the objects detected on the image plane and then tracking them in the real world to extract their 3D trajectories Lastly this dissertation presents applications of trajectory analysis to understand human activities in crowded environments In this context each phase in the framework represents independent approaches dedicated to solving challenging tasks in computer vision and multimedia

Fundamentals of Wearable Computers and Augmented Reality Woodrow Barfield, 2015-07-29 Data will not help you if you can't see it where you need it Or can't collect it where you need it Upon these principles wearable technology was born And although smart watches and fitness trackers

have become almost ubiquitous with in body sensors on the horizon the future applications of wearable computers hold so much more A trusted refer *Computer Vision - ECCV 2020* Andrea Vedaldi,Horst Bischof,Thomas Brox,Jan-Michael Frahm,2020-10-09 The 30 volume set comprising the LNCS books 12346 until 12375 constitutes the refereed proceedings of the 16th European Conference on Computer Vision ECCV 2020 which was planned to be held in Glasgow UK during August 23 28 2020 The conference was held virtually due to the COVID 19 pandemic The 1360 revised papers presented in these proceedings were carefully reviewed and selected from a total of 5025 submissions The papers deal with topics such as computer vision machine learning deep neural networks reinforcement learning object recognition image classification image processing object detection semantic segmentation human pose estimation 3d reconstruction stereo vision computational photography neural networks image coding image reconstruction object recognition motion estimation *The 3rd European Conference on Visual Media Production (CVMP 2006)* ,2006 **New Trends in Computer Technologies and Applications** Chuan-Yu Chang,Chien-Chou Lin,Horng-Horng Lin,2019-07-10 The present book includes extended and revised versions of papers presented during the 2018 International Computer Symposium ICS 2018 held in Yunlin Republic of China Taiwan on December 20 22 2018 The 86 papers presented were carefully reviewed and selected from 263 submissions from 11 countries The variety of the topics include machine learning sensor devices and platforms sensor networks robotics embedded systems networks operating systems software system structures database design and models multimedia and multimodal retrieval object detection image processing image compression mobile and wireless security **Pattern Recognition and Computer Vision** Qingshan Liu,Hanzi Wang,Zhanyu Ma,Weishi Zheng,Hongbin Zha,Xilin Chen,Liang Wang,Rongrong Ji,2023-12-25 The 13 volume set LNCS 14425 14437 constitutes the refereed proceedings of the 6th Chinese Conference on Pattern Recognition and Computer Vision PRCV 2023 held in Xiamen China during October 13 15 2023 The 532 full papers presented in these volumes were selected from 1420 submissions The papers have been organized in the following topical sections Action Recognition Multi Modal Information Processing 3D Vision and Reconstruction Character Recognition Fundamental Theory of Computer Vision Machine Learning Vision Problems in Robotics Autonomous Driving Pattern Classification and Cluster Analysis Performance Evaluation and Benchmarks Remote Sensing Image Interpretation Biometric Recognition Face Recognition and Pose Recognition Structural Pattern Recognition Computational Photography Sensing and Display Technology Video Analysis and Understanding Vision Applications and Systems Document Analysis and Recognition Feature Extraction and Feature Selection Multimedia Analysis and Reasoning Optimization and Learning methods Neural Network and Deep Learning Low Level Vision and Image Processing Object Detection Tracking and Identification Medical Image Processing and Analysis *Computer Vision - ACCV'98* Roland Chin,1998 Sepsis is a syndrome or sometimes it is a clinical condition evoked by uncontrolled endotoxin reactions These pathophysiological alterations can disturb the organism s homeostasis leading ultimately to a condition of severe organ dysfunction which in itself means a bad

prognosis for patient survival In the last decades researchers and clinicians have been involved in process directed to a better understanding of the basic mechanisms of sepsis and MODS The best goal will be the achievement of preventive measures and optimization of management in patients suffering severe infections and critical conditions This objective represents a true challenge at the dawn of the XXI century Proceedings, 2nd IEEE and ACM International Workshop on Augmented Reality (IWAR'99) ,1999 IEEE Virtual Reality 2000 Haruo Takemura,Kiyoshi Kiyokawa,2001 Annotation Contains 33 papers and 12 posters presented at the March 2001 conference that reviewed research progress in virtual reality and defined new research goals The main subjects are haptic display tracking and motion capture software and tools haptics and locomotion interface 3D displays applications human factors and haptic simulation Sample topics are a surface acoustic wave tactile display based on properties of mechanoreceptors fusion of vision and gyro tracking for robust augmented reality registration interactive texturing by polyhedron decomposition a washout filter designed for a motorcycle simulator and the effects of field of view on balance in an immersive environment No subject index c Book News Inc

Intelligent Autonomous Systems 8 Frans Groen,2004 Intelligent Autonomous systems are beginning to enter our daily life in ambient intelligence applications These systems can directly sense and act in their own environment without demanding detailed supervision form humans Many new challenges are emerging to create systems that can operate and interact in human inhabited environments The goal of IAS 8 is to exchange and stimulate research ideas about how to bring active intelligent systems into our daily lives This publications contains an excellent selection of papers that shows the research of autonomous systems today Subjects discussed are the designing of autonomous agents Artificial Emotional Creatures and Multi Robot Coordination in Highly Dynamic Environments Recognition, Analysis, and Tracking of Faces and Gestures in Real-time Systems ,2001 Annotation Twenty seven papers representing oral and poster presentations from the July 2001 conference in Vancouver British Columbia consider the abilities of computers to recognize and understand human faces and hands Their real time capabilities are emphasized Topics include the reconstruction of movies of facial expressions 3D face model reconstruction automatic learning of appearance face models Eigenfaces stereo tracking of multiple moving heads speech intent detection fast hand gesture recognition and learning visual models of social engagement Author index only c Book News Inc *Memoirs of the Institute of Scientific and Industrial Research, Osaka University* Ōsaka Daigaku. Sangyō Kagaku Kenkyūjo,2007 **11th International Conference on Image Analysis and Processing** Edoardo Ardizzone,V. Di Gesù,2001 **Computer Analysis of Images and Patterns** ,1997 IEEE International Conference on Intelligent Transportation Systems Proceedings ,2003 Virtual Environments ,1998 **Proceedings 1990 IEEE International Conference on Robotics and Automation** ,1990 **Proceedings of the IEEE International Conference on Industrial Technology (ICIT ...)** ,2004

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