Chapter 1 : CiteSeerX â€" Citation Query Active Computer Vision by Cooperative Focus and Stereo

A. N. Rajagopalan, S. Chaudhuri, An MRF Model-Based Approach to Simultaneous Recovery of Depth and Restoration from Defocused Images, IEEE Transactions on Pattern Analysis and Machine Intelligence, v n.7, p, July

The paper is organized according to the different processes in the system. Initially the fixation processes are described, followed by sections on pursuit and attention. Finally implementation details are considered and experime Finally implementation details are considered and experimental results are reported Show Context Citation Context There are, however, a few notable exceptions. In this work disparity and accommodation cues are integrated to enable reliable estimation of depth. Rivlin , " Foveated vision and two-mode tracking, as inspired by the human oculomotor system, are often used in active vision system. The purpose of this paper is to provide answers to the following basic questions which arise from implementations. First, is it beneficial to have foveated vision and what is th First, is it beneficial to have foveated vision and what is the optimal size of the foveal window? Second, is there a need for two con-trol mechanisms smooth pursuit and saccade for im-proved performance and how can one eficiently switch between them? In order to do so, a setup is proposed in which these strategies can be evaluated in a system-atic manner. It is shown that the fovea appears as a compromise between the tightness of the tracking spec-ifications and computational constraints. Introducing a model for the later and postulating some a priori knowledge of the target behavior, it is possible to com-pute the size of the fovea in an optimal way. The second mode, i. It is shown that a control strategy can indeed be defined so that this objective can be met under appropriate op-erating conditions. Christensen, Ruzena Bajcsy , " In general, we distinguish two kinds of behaviors: In the latter case the degree of coupling depends on the degree of cooperation between the agents. In this paper, however, we shall concentrate only on the first kind of behaviors, exemplified by gaze control. The visual capabilities of our agents at the moment comprise simple obstacle detection, target detection, and target tracking. The extraction of appropriate qualitative information from obtained sensory data allows us to develop some simple obstacle avoidance or target following strategies, or more general gaze control strategies. Kirkeby, Steen Kristensen, Lars Knudsen " For navigation in a partially known environment it is possible to provide a model that may e used or guidance in the navigation and as a basis for selective sensing. In this paper a navigation system for an autonomous mobile robot is presented. Both navigation and sensing is build around a graphics Both navigation and sensing is build around a graphics model, which enables prediction of the expected scene content. The model is used directly for prediction of line segments which through matching allow estimation of position and orientation. In addition the model is used as a basis for a hierarchical stereo matching that enables dynamic updating of the model with unmodelled objects in the environment. For short-terms path planning a set of reactive behaviours are used. The reactive behaviours include use of inverse perspective mapping for generation of occupancy grids, a sonar system and simple gaze holding for monitoring of dynamic obstacles. The full system and its component processes are described and initial experiments with the system are briefly outlined. Show Context Citation Context The focal length is changed to a maximum, which results in a minimum depth of field of view. The verification of depth is achieved through small scale changes of focus, which allow estimation of the presence of a local extrema in the criteria function. For the estimation of depth th

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A selective vision system sequentially collects evidence to support a specified hypothesis about a scene, as long as the additional evidence is worth the effort of obtaining it. Efficiency comes from processing the scene only where necessary, to the level of detail necessary, and with only the neces Efficiency comes from processing the scene only where necessary, to the level of detail necessary, and with only the necessary operators. The TEA-1 selective vision system uses Bayes nets for representation and benefitcost analysis for control of visual and non-visual actions. It is the high-level control for an active vision system, enabling purposive behavior, the use of qualitative vision modules and a pointable multiresolution sensor. TEA-1 demonstrates that Bayes nets and decision theoretic techniques provide a general, re-usable framework for constructi Wang, Jia Li, Robert M. Pattern Analysis and Machine Intelligence , " This paper describes a novel multiresolution image segmentation algorithm for low DOF images. The algorithm is designed to separate a sharply focused object-of-interest from other foreground or background objects. The algorithm is fully automatic in that all parameters are image independent. A multiscale approach based on high frequency wavelet coefficients and their statistics is used to perform context-dependent classification of individual blocks of the image. Unlike other edge-based approaches, our algorithm does not rely on the process of connecting object boundaries. The algorithm has achieved high accuracy when tested on more than low DOF images, many with inhomogeneous foreground or background distractions. Compared with the state of the art algorithms, this new algorithm provides better accuracy at higher speed. Index TermsContent-based image retrieval, image region segmentation, low depth-of-field, wavelet, multiresolution image analysis Show Context Citation Context Yim and Bovik [22] have explored the possibility of depth perception using a sequence of images taken with different image plane distances. Yim and Bovik [22] have also provi I thank my family for the support and encouragement they have always given me. I thank my parents Les and Molly for their love and guidance. I thank my siblings, Jean, Joe, and John, or teaching me to love in the midst o stfie. I thank Robert Dodd or his continual support and encoura Cook, Piotr Gmytrasiewicz, Lawrence B. This paper describes a decision-theoretic approach to cooperative sensor planning between multiple autonomous vehicles executing a military mission. For this autonomous vehicle application, intelligent cooperative reasoning must be used to select optimal vehicle viewing locations and select optimal For this autonomous vehicle application, intelligent cooperative reasoning must be used to select optimal vehicle viewing locations and select optimal camera pan and tilt angles throughout the mission. Decisions are made in such a way as to maximize the value of information gained by the sensors while maintaining vehicle stealth. Because the mission involves multiple vehicles, cooperation can be used to balance the work load and to increase information gain. An MRF model-based approach to simultaneous recoveryofdepthandrestorationfromdefocusedimages. Abstractâ€"Depth from defocus DFD problem involves calculating the depth of various points in a scene by modeling the effect that the focal parameters of the camera have on images acquired with a small depth of field. In this paper, we propose a MAP-MRF-based scheme for recovering the depth and the focused image of a scene from two defocused images. The space-variant blur parameter and the focused image of the scene are both modeled as MRFs and their MAP estimates are obtained using simulated annealing. The scheme is amenable to the incorporation of smoothness constraints on the spatial variations of the blur parameter as well as the scene intensity. It also allows for inclusion of line fields to preserve discontinuities. The performance of the proposed scheme is tested on synthetic as well as real data and the estimates of the depth are found to be better than that of the existing window-based DFD technique. The quality of the space-variant restored image of the scene is quite good even under severe space-varying blurring conditions. Index Termsâ€"Depth from defocus, space-variant blur, space-variant image restoration, Markov random field, smoothness constraint, line fields, Gibbs distribution, maximum a posteriori, simulated annealing. Instead, two images of the object which may or may not be focused , acquired with different but known camera Performance characterisation in computer vision: The role of statistics in testing and design by P. Thacker - Imaging and Vision Systems: Theory, Assessment and Applications. We consider the relationship between the performance characteristics of vision algorithms and algorithm design. In the first part we discuss the issues involved in testing. A description of good practice is given covering test objectives, test data, test metrics and the test protocol. In the second part we discuss aspects of good algorithmic design including understanding of the statistical properties of data and common algorithmic operations, and suggest how some common problems may be overcome. Are there experiments that show algorithms are stable and work as expected? This can be tested with simulated data in order to show that the quantitative estimation of depth for correct matches has the expected behaviour []. The collection of additional redundant image Tsotsos , " The task of sensor planning for object search is formulated and a strategy for this task is proposed. The searcher is assumed to be a mobile platform equipped with an active camera and a method of calculating depth, like a stereo or laser range finder. The formulation casts sensor planning as an opt The formulation casts sensor planning as an optimization problem: The search region is thus characterized by the probability distribution of the presence of the target. The control of the sensing parameters depends on the current state of the search region and the detecting abilities of the recognition algorithm. In order to efficiently determine the sensing actions over time, the huge space of possible actions is reduced to a finite set of actions that must be considered. The result of each sensing operation is used to update the status of the search space. Show Context Citation Context Recently, more and more work on sensor planning for computer vision has appeared. Abidi, Senior Member, Mongi A. Part I of this paper introduced a new automatic contrast enhancement technique: GLG is a general and powerful technique, which can be conveniently applied to a broad variety of low-contrast images and outperforms conventional contrast enhancement techniques. However, the basic GLG method still has limitations and cannot enhance certain classes of low-contrast images well, e. The basic GLG also cannot fulfill certain special application purposes, e. In order to break through these limitations, this paper introduces an extension of the basic GLG algorithm, selective gray-level grouping SGLG , which groups the histogram components in different segments of the grayscale using different criteria and, hence, is able to enhance different parts of the histogram to various extents. This paper also introduces two new preprocessing methods to eliminate background noise in noisy low-contrast images so that such images can be properly enhanced by the S GLG technique. The extension of S GLG to color images is also discussed in this paper. SGLG and its variations extend the capability of the basic GLG to a larger variety of low-contrast images, and can fulfill special application requirements. SGLG and its variations not only produce results superior to conventional contrast enhancement techniques, but are also fully automatic under most circumstances, and are applicable to a broad variety of images. Index Termsâ€"Contrast enhancement, gray-level grouping, histogram, noise reduction. The Tenengrad criterion is based on gradient magnitude maximization. It is considered one of the mo In this paper, we show how an active binocular head, the IIS head, can be easily calibrated with very high accuracy. Our calibration method can also be applied to many other binocular heads. In addition to the proposal and demonstration of a four-stage calibration process, there are three major cont In addition to the proposal and demonstration of a four-stage calibration process, there are three major contributions in this paper. Second, a calibration method for the MFL camera model is proposed in this paper, which separates the estimation of the image center and effective focal length from the estimation of the camera orientation and position. This separation has been proved to be crucial; otherwise, the estimates of camera parameters would be very noise-sensitive. Thirdly, we show that, once the parameters of the MFL camera model is calibrated, a nonlinear recursive least-square estimator This paper presents a dynamic sensor planning system, capable of planning the locations and settings of vision sensors for use in an environment containing objects moving in known ways. The key component of this research is the computation of the camera position, orientation, and optical settings to The key component of this research is the computation of the camera position, orientation, and optical settings to be used over a time interval. A new algorithm is presented for viewpoint computation which ensures that the feature detectability constraints of focus, resolution, field-of-view, and visibility are satisfied. The results of these experiments, demonstrating the use of this system in a robot work-cell, are presented. The research described in this paper was performed while this author was at the Columbia University Department of Computer Science. The system is then sufficiently focused for a range of depths from D 1 , the far limit of the depth of field, to D 2 , the near limit.

Chapter 3 : Cooperative Stereo Vision

Active Computer Vision by Cooperative Focus and Stereo Series: Springer Series in Perception Engineering This book addresses an area of perception engineering which deals with constructive.

 Abstract Autonomous on-orbit servicing is expected to play an important role in future space activities. Acquiring the relative pose information and inertial parameters of target is one of the key technologies for autonomous capturing. In this paper, an estimation method of relative pose based on stereo vision is presented for the final phase of the rendezvous and docking of noncooperative satellites. The proposed estimation method utilizes the sparse stereo vision algorithm instead of the dense stereo algorithm. The method consists of three parts: Compared to the dense stereo algorithm, the proposed method can avoid degeneracy when the target has a high degree of axial symmetry and reduce the number of sensors. The validity of the proposed method is verified by numerical simulations. Introduction The autonomous on-orbit servicing is expected to be one of the most challenging and exciting space activities in the future [1 , 2]. In the past, many expensive satellites were out of service in orbit due to various failures, such as solar panel undeployment and gyro malfunction. However, in these cases, most of the other parts of the satellites were still functional [3 , 4]. The on-orbit servicing, which is the execution of repair, refueling, orbit maintenance, and reorbiting, can extend the life of malfunctioned satellites and save a large amount of expense. Therefore, more and more attentions have been paid to the technologies of autonomous on-orbit servicing. Several on-orbit servicing projects including on-orbit servicing demonstration experiments and conceptual on-orbit servicing systems have been carried out [5 , 6]. As malfunctioned satellites are generally noncooperative targets tumbling in space and have no equipment which can be used for relative pose measurement [7], it is necessary to develop the method of relative pose measurement without the cooperation of target satellites. For example, the purpose of the Spacecraft for the Universal Modification of Orbits SUMO program is to demonstrate the integration of machine vision, robotics, mechanisms, and autonomous control algorithms to accomplish autonomous rendezvous and grapple of a variety of interfaces traceable to future spacecraft servicing operations [8]. In the SUMO program, the main concept is to be able to capture an unaided target satellite; that is, target satellite is equipped without special facilities such as grapple fixtures or reflectors which is compatible with the SUMO. Similarly, DEOS Deutsche Orbitale Servicing Mission project focuses on finding and evaluating the procedures and techniques for rendezvous, capture, and deorbiting of a noncooperative target satellite [10]. In the automatic mode, a number of images are taken and dumped to the ground segment, and then target motion is estimated by the control software in the ground station. The relative pose information of two involved satellites is of vital importance for the end-effector to successfully grasp the tumbling satellite. If the dynamic model of the target is known, a filter can be designed to suppress the measurement noise and estimate the states which cannot be measured directly. Furthermore, the dynamic model can also be used to predict the motion of the target satellite, and then the optimal path planning can be conducted to guide a robotic manipulator to capture the tumbling target at a rendezvous point with the same velocity [11]. A nonlinear estimator was developed to estimate the HST body rates by using vision-based sensors which can output relative quaternion [15 , 16]. A 6-DOF pose estimation was demonstrated in Robotic Refueling Mission in order to augment the traditional overlays [17]. Tweddle described a new approach to solve a SLAM problem for unknown and uncooperative objects that are spinning about an arbitrary axis. Lichter and Dubowsky proposed an important and effective architecture of estimating dynamic state, geometric shape, and model parameters of objects in orbit [19]. A team of cooperating 3D vision sensors captures sequences of range images to determine the rough target poses before filtering. The relative positions and orientations between sensors mounted on different satellites are required to be known with high accuracy, which is perhaps a cost and operation burden for on-orbit servicing. A model-based pose refinement algorithm was proposed to perform the relative pose estimation of a floating object from the visual information of a stereo-vision system [20]. In this paper, the problem of relative pose estimation for the final phase of the rendezvous and docking of noncooperative satellites is investigated. Instead of the dense stereo algorithm presented in the literature [17], here the relative pose estimation method is based on the sparse stereo algorithm. The body-fixed coordinate system of the target satellite is reestablished by utilizing the natural features on the target surface. Then, a standard Kalman filter is designed to estimate the translational states and the location of the mass center. An extended Kalman filter EKF and an unscented Kalman filter UKF are designed, respectively, to estimate the rotational states and the moment-of-inertia ratios including the ratios of product of inertia, and their performances are compared with each other. This paper is structured as follows. Section 2 defines the coordinate systems and transformation matrixes used in the relative pose estimation. Section 3 presents two algorithms for relative attitude measurements including the scheme for updating the target feature coordinate system when target is tumbling. Then, an approach based on Kalman filter to estimate the location of mass center and translation parameters is proposed in Section 4. Numerical simulation is conducted to verify the proposed algorithm and results are discussed as well in Section 6. The last section contains conclusions. Coordinate Systems and Transformation Matrixes As various physical quantities are usually defined in different coordinate systems, the coordinate systems and coordinate transformation matrixes are defined to illustrate the relative geometrical relationship between the target and chaser. The relative geometrical relationship and coordinate systems are illustrated in Figure 1. Geometrical relationship and coordinate systems. Inertial Coordinate System The origin of the inertial coordinate system is centered on Earth, the axis is aligned with the rotation axis, and the axis is defined to point toward the Vernal equinox. The axis completes the right-handed orthogonal coordinate system. The attitude of target satellite and service satellite can be described as the rotation from the inertial frame to the body frame. The axis is in the opposite direction of the Earth center, the axis is in the flight direction, and the axis which completes the right-handed orthogonal coordinate system is in the direction of the angular momentum of the orbit. Similarly, the local orbital coordinate system is attached to target satellite. The rotation matrix between the two satellite orbital frames is denoted as. As two satellites are almost in the same orbit and the service satellite is very close to the target, is nearly a identity matrix. For instance, if the target is a leading satellite in the circular orbit of km altitude and the chaser is m behind the target in the same orbit, the rotation angle between two orbital fames is only about. Chaser Body-Fixed Coordinate System The origin of chaser body-fixed coordinate system lies in the mass center of service satellite, and the three body axes of symmetry are defined as three coordinate axes ,.

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He uses stereo and focus to obtain distance By information, and to eventually develop cooperative combining techniques. means of a stereo system with verging cameras, it is demonstrated that the distance measurements can be significantly improved by combining two sources.

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