Publications Bibliography: Perceptual Robotics Technical Reports

COINS Technical Report 86-07

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This bibliography compiles together technical reports, published at the Department of Computer and Information Science (COINS) at the University of Massachusetts, which describe the ongoing research in robotics, robotics-related vision, and robotics-related brain theory. For more information about these and other technical reports, contact the Department of Computer and Information Science, Graduate Research Center, Room A305, University of Massachusetts, Amherst, Mass 01003 (413) 545-2744. Use the enclosed order form for purchasing any of these technical reports.

82-22 Processing Translational Motion Sequence, Daryl Lawton

This paper presents a procedure for processing real world image sequences produced by relative translational motion between a sensor and environmental objects. In this procedure, the determination of the direction of sensor translation is effectively combined with the determination of the displacements of image features and environmental depth. It requires no restrictions on the direction of motion, nor the location and shape of environmental objects. It has been applied successfullly to real-world image sequences from several different task domains.

The processing consists of two basic steps: Feature Extraction and Search. The feature extraction process picks out small image areas which may correspond to distinguishing parts of environmental objects. The direction of translational motion is then found by a search which determines the image displacement paths along which a measure of feature mismatch is minimized for a set of features. The correct direction of translation will minimize this error measure and also determine the corresponding image displacement paths for which the extracted features match well.

82-27 Motion Analysis via Local Translational Processing, Daryl Lawton

The first part of this report presents a procedure for processing real world image sequences produced by relative translational motion between a sensor and environmental objects. In this procedure, the determination of the direction of sensor translation is effectively combined with the determination of the displacements of image features and environmental depth. It requires no restrictions on the direction of motion, nor the location and shape of environmental objects. It has been applied successfully to real-world image sequences from several different task domains.

In the second part we extend this procedure to less restricted cases of rigid body motion. Part of the robustness of the technique is that it can work with reasonable precision even when applied to small image areas containing a few features. This allows more general image motion to be locally approximated as translations of small areas in the environment. Given such an approximation, we then show how to recover the parameters of camera motion.

83-01 Determining the Instantaneous Axis of Translation from Optic Flow Generated by Arbitrary Sensor Motion, J. H. Rieger and D. T. Lawton

This paper develops a simple and robust procedure for determining the instantaneous axis of translation from image sequences induced by unconstrained sensor motion. The procedure is based upon the fact that difference vectors at discontinuities in optic flow fields generated by sensor motion relative to a stationary environment are oriented along translational field lines. This is developed into a procedure consisting of three steps: 1) locally computing difference vectors from an optic flow field; 2) thresholding the difference vectors; and 3) minimizing the angles between the difference vector field and a set of radial field lines which correspond to a particular translational axis. This method does not require a priori knowledge about sensor motion or distances in the environment. The necessary environmental constraints are rigidity and sufficient variation in depth along visual directions to endow the flow field with discontinuities. The method has been successfully applied to noisy, sparse, and low resolution flow fields generated from real world image sequences. Experiments are reviewed which indicate that the human visual system also utilizes discontinuities in optic flows in determining self-motion. In addition, due to the computational simplicity of the procedure, hardware realization for real-time implementation is possible.

83-10 Computer Interfaces and Operating Instructions for a Prototype Cartesian Machine, J. Franklin

This technical report is an examination of the prototype General Electric In-House Cartesian Machine of the Perceptual Robotics Laboratory of the COINS Department at the University of Massachusetts at Amherst. The machine was donated to this laboratory by the General Electric Company of Schenectady, New York. The report describes the machine, the alterations made to it by the group, and its operation, and it directs the reader to research projects using this machine. It also refers the reader to related technical reports and to manuals which describe various system components in greater detail. Additional components for the system such as its sensors and the computer system are also discussed. Finally, controlling algorithms are described and the FORTH language and code for the algorithms are briefly examined.

83-11 Recovering 2-D Motion Parameters in Scenes Containing Multiple Moving Objects, G. Adiv

A method for extracting the motion parameters of several independently moving objects from displacement field information is described. The method is based on a generalized Hough transform technique. Some of the problems of this technique are addressed and

appropriate solutions are proposed. A modified multipass Hough transform approach has been implemented, where in each pass windows are located around objects and the transform is applied only to the displacement vectors contained in these windows. The windows are determined by the degree to which the displacement field is locally inconsistent with previously found motion transformations. Thus, the sensitivity of the Hough transform to local events is increased and the motion parameters of small objects can be detected even in a noisy displacement field. We also use a multi-resolution scheme in both the image plane and the parameter space and thus reduce the computational cost of the technique. The method is demonstrated by experiments based on artificial images with four parameters of 2-D motion; rotation, expansion and translation in both axes.

83-22 Robot Programming Languages: A Study and a Design T. Noyes

This report is intended to familiarize members of the Laboratory for Perceptual Robotics (LPR) at the University of Massachusetts at Amherst with different robot programming languages. It is meant to provide insight into desirable characteristics of robot programming languages in order to facilitate future development of our own software environment. This report examines three of the more advanced languages, AL, AML and VAL, and extracts the unusual features, good qualities, and shortcomings of each.

Since FORTH is the low-level language we are presently using, we will examine its features. The final chapter discusses the current state of the Laboratory for Perceptual Robotics, the research being done in dynamic sensing and control, the use of FORTH as a base language for our proposed Perceptual Robotics Language, and the design philosophy of this language. Finally, this chapter defines possible elements of our language.

The intention here is not to reproduce the robotics languages in full, and the reader is assumed to have some familiarity with other high-level programming languages.

83-24 Perceptual Systems for Robots, M. Arbib, K. Overton, and D. Lawton

This paper presents a sampling of recent research on the design of perceptual systems for robots, with special emphasis on pattern recognition based on an array of touch sensors, and "optic flow" techniques for depth extraction and navigation based on a sequence of visual images. It not only presents specific work in machine vision, machine touch and robotics, but also illuminates what we believe to be general principles for the design of perceptual systems for an animal or human as well as for a robot.

83-25 Coordinated Control Programs for Movements of the Hand, M. Arbib, T. Iberall, and D. Lyons

We use perceptual and motor schemas to postulate coordinated control programs for hand movements involved in reaching to grasp an object, reaching to lift a mug, and putting down an object. We sketch an articulated language in which to develop precise models of human and animal performance subject to behavioral and neurophysiological testing. We offer evidence for the concept of the virta finger as a hierarchical substracture in hand control. We provide a brief introduction to simulation methodology. We discuss neural and behavioral correlates of schemas with special attention to concurrency and localization of schema activation, new experimental support for the Pitts-McCulloch paradigm for distributed motor control, and a two phase analysis of descrete activation feedforward.

83-35 A Summary Of Image Understanding Research at the University of Massachusetts, E. M. Riseman, and A. R. Hanson

The major focus of our research program revolves around issues of static and dynamic image understanding. Our principle objective in this work is to confront fundamental problems in computer vision in the context of a large scale experimental system for interpretation of complex images. In this report we briefly review the current status of the VISIONS image understanding system, focussing on the extraction of syntactic descriptions of images, on the representation of knowledge in a form suitable for use in the interpretation process, on strategies for utilizing modular knowledge sources to link the sensory data to semantic hypotheses, on inference mechanisms for integrating ambiguous and partial evidence from multiple sources, and on control methodologies for both data-directed and schema-based knowledge directed interepretation processes.

Our work in dynamic image interpretation (motion) is concerned with techniques for recovery of environmental information, such as depth maps of the visible surfaces, from a sequence of images produced by a sensor in motion. Algorithms that appear robust have been developed for constrained sensor motion such as pure translation, pure rotation, and motion constrained to a plane. Interesting algorithms with promising preliminary experimental results have also been developed for the case of general sensor motion in images where there are several significant depth discontinuities, and for scenes with multiple independently moving objects. A general hierarchical parallel algorithm for efficient feature matching has also been developed for applications in motion, stereo, and image registration. In addition, we have been designing a highly parallel architecture that integrates aspects of both parallel array processing and associative memories for real time implemen-

tation of motion algorithms.

84-05 Processing Dynamic Image Sequences from a Moving Sensor, D. Lawton

A fundamental problem in motion processing research has been the discrepancy between the precision and reliability with which image displacements can be determined and the sensitivity of inference procedures to noise and resolution errors. There are also indications that these inference procedures are inherently unstable and, in some cases, ambiguous. The approach of this thesis has been to deal with restricted cases of motion for which the inference of the motion parameters, image displacements, and environmental depth, can be combined into a single, uniform, and mutually constraining computation. These restricted cases of motion are sufficient for a wide range of real-world tasks, especially since other associated sensing devices can be used to ascertain the other parameters of motion. We then apply the procedure developed for translational motion to local portions of image sequences to process general sensor motion as if it were composed of independent local environmental translations. The resulting representation can considerably simplify the processing of less restricted and general motion.

The procedure for processing translational motion robustly combines the determination of image displacements with the extraction of the direction of sensor motion. We present several experiments showing its behavior in a variety of situations. We also consider various extensions to this procedure for such things as developing it as a hierarchical computation; processing translational blur patterns; dealing with multiple independently moving objects; and using the translational procedure in the control of an autonomous vehicle.

Results are presented for two other restricted cases of motion: pure sensor rotation and motion constrained to a known plane. The results are similar to the translational case except that certain simple cases of planar motion are found to be inherently ambiguous.

We then process less restricted and general sensor motion by applying the procedure for translational motion processing to local areas of images. This results in a low level description of motion called the Environmental Direction of Motion Field (or EDMF) which associates a direction of environmental motion with extracted image features. This representation can greatly simplify the recovery of sensor motion parameters. We also develop the constraints associated with object rigidity in determining the inference of sensor motion parameters, and then show how these constraints are simplified by information in the EDMF.

We conclude with a summary of the major results of the thesis and mention future

work, chiefly in the areas of architectures for real time motion processing, and applications to more challenging and specific domains.

84-07 Determining 3-D Motion and Structure from Optical Flow Generated by Several Moving Objects, G. Adiv

A new approach for the interpretation of optical flow fields is presented. The flow field, which can be produced by a sensor moving through an environment with several, independently moving, rigid objects, is allowed to be sparse, noisy and partially incorrect. The approach is based on two main stages. In the first stage the flow field is segmented into connected sets of flow vectors, where each set is consistent with a rigid motion of a roughly planar surface. In the second stage sets of segments are hypothesized to be induced by the same rigidly moving object. Each of these hypotheses is tested by searching for 3-D motion parameters which are compatible with all the segments in the corresponding set. Once the motion parameters are recovered, the relative environmental depth can be estimated as well. Experiments based on real and simulated data are presented.

84-08 The Acquisition, Processing, and Use of Tactile Sensor Data in Robot Control, K. Overton

Robots are machines capable of interacting with their environments in intelligent manners. In order for such capabilities to exist, these machines must be able to act relative to their environments, sense quantities about both themselves and their environments, and make decisions guided by the sensor input. This dissertation is directed toward developing a sense of touch for robot systems. Robot senses are discussed and a classification scheme developed with particular attention paid to the definition of tactile sensors. Current tactile sensors in use in laboratories are presented along with the design of the sensor developed in this work. Issues surrounding the response characteristics of the sensor and static and dynamic tactile image processing are presented and several experiments discussed. An approach to the utilization of sensory information in high-level control provides the topic for the chapter on schemas. Conclusions drawn from this work as well as directions for future research in tactile sensation are provided in the final section and appendices.

84-17 Towards Perceptual Robotics, T. Iberall, D. Lyons

This paper investigates some of the ways in which the study of human anatomy, physiology and behavior can contribute to the design of a versatile robot system. In particular

it concentrates on the integration of dynamic sensory information into motor activity. We use schema theory for analyzing perceptual structures and distributed motor control. A computing scheme and control architecture based on this approach is broadly outlined, and then is applied to the control of a dextrous robot hand. We call this approach Perceptual Robotics.

84-26 An Optical Tactile-Array Sensor, S. Begej

This paper describes a new type of tactile sensor intended for robotic applications. It is based upon the frustration of total internal reflection at an optical surface caused by an opaque elastic membrane. An optical image is created in which the intensity is monotonically related to the strains or pressures created by an impressed object. This image is subsequently converted to digital form by a CID camera. The performance characteristics of two planar tactile array sensors are presented.

The first sensor is a tactile "table" with an active area measuring 7×12 cm. A 128×128 pixel CID camera is used to image a 3.3×3.3.cm section of the active area, thereby resulting in an effective tactile element density of 1500 taxels/sq-cm. The second sensor is a small, compact unit designed for use on robot gripper fingers. A coherent cable of optical fibers convey the strain image to a remotely-located CID camera, resulting in a tactile element density of 54 taxels/sq-cm over an active area measuring 2.2×2.5cm. Such optical tactile sensor arrays are seen to offer significant promise in the area of robotics where they can provide the advantages of high spatial resolution and non-planar sensor geometries (e.g. cylindrical and hemispherical).

84-27 Extraction of Tactile Features by Passive and Active Sensing, R. Ellis

Tactile sensors which are mounted on a robot gripper are typically much smaller than the objects they touch. If the robot system is to use a tactile sensor to perform such tasks as object recognition, parts inspection, or manipulation, then integration of features extracted from multiple sensing incidents will be necessary.

This paper describes ways of acquiring tactile features that may be used in such tasks. Extraction of such features requires knowledge of the inherent advantages and limitations of tactile array sensors, and how the information they provide can be combined with information from position and force sensors. A number of tactile features (such as edge radii and object deformation) are best acquired by active sensing, in which the sensor is moved with respect to the object in a known fashion. Some strategies for extraction of

tactile features, in both passive and active sensing paradigms, are presented and discussed.

84-28 Processing Differential Image Motion, J. Rieger, D. Lawton

The inference of 3-D camera motion parameters and the layout of a scene from image flows becomes particularly simple from a computational point of view if the scene contains depth variations. Under this condition image sequences obtained from an arbitrarily moving camera can be processed robustly. Our results may have relevance to human motion perception, which also seems to rely upon depth variation in processing image motion.

84-29 Extracting Straight Lines, J. Burns, A. Hanson, E. Riseman

This paper presents a new approach to the extraction of straight lines in intensity images. Pixels are grouped into line-support regions of similar gradient orientation, and then the structure of the associated intensity surface is used to determine the location and properties of the edge. The resulting regions and extracted edge parameters form a low-level representation of the intensity variations in the image that can be used for a variety of purposes. The algorithm appears to be more effective than previous techniques for two key reasons: 1) the gradient orientation (rather than gradient magnitude) is used as the initial organizing criterion prior to the extraction of straight lines, and 2) the global context of the intensity variations associated with a straight line is determined prior to any local decisions about participating edge elements.

84-32 Computing Dense Displacement Fields with Confidence Measures in Scenes Containing Occlusion, P. Anandan

Matching successive frames of a dynamic image sequence using area correlation has been sutdied for many years by researchers in machine vision. Most of these efforts have gone into improving the speed and the accuracy of correlation matching algorithm. We also provide an improved matching algorithm which performs particularly well near occlusion boundaries. We demonstrate these with experiments performed on real image sequences taken in our robotics laboratory.

85-06 A Tactile Sensing System and Optical-Sensor Array for Robotic Applications, Stefan Begej

The development of a modular sensing system (TSS) intended for robotic applications

is described. The TSS consists of a preprocessor module for tactile data acquisition and preprocessing, and a planar, optical tactile sensor array (TSA) module. The motivation behind development of the TSS was: to give researchers unobstructed access to tactile data in a laboratory or industrial environment; to provide a versatile processor module capable of interfacing to many TSA technologies, to remove a significant computational burden from the main robot controller (host computer); and to develop a promising new optical TSA technology relying upon the frustration of total internal reflection (TIR).

The preprocessor module is based upon the DEC T-11 microprocessor, and is housed in a small, cabinet-mountable enclosure. It performs the functions of tactile data acquisition, calibration, correction, preprocessing, and threshold monitor ing under direction from the host. Tactile data preprocessing functions included calculation of the taxel sum for the imprint array, the first moment, and changes in the sum or first moment in comparison to a stored reference imprint. Communication with the host is over a serial line and includes only high-level information such as command codes, computational results (which might also include taxel-level data), and threshold violation data. The preprocessor module is quite general and is designed to interface with any TSA module that conforms to its simple communication protocal.

The TSA module consists of a compact, high-density TIR-TSA with 100 taxels/sq-cm and an active area measuring 31 x 31 mm. The visual imprint representing the contact pressure distribution is conveyed to an optical interface via a coherent optical fiber cable, and transduced into digital form by a 32 x 32 pixel CCD camera. The effective gray scale force resolution is 5 bits, and the force response range of each taxel is approximately 0 - 0.4 N (0 - 42 gm). The development history of the TIR-TSA is reviewed, and includes a description of a large-area tactile sensor with a very high taxel density (1500 taxels/sq-cm), an early prototype of the TSA developed in this project, and a non-planar, fingertip-shaped sensor intended as a prototype for sensors to be eventually used on a complex 9 DOF mechanical hand.

The TSS performance speeds range from 18 Hz for simple data acquisition functions down to approximately 5 Hz for more time-consuming functions such as calculation of first moments. Directions for future research are mentioned, and include: increasing the calculational speed of the preprocessor through the addition of hardware multiplication, division, and array (convolution) operations; increasing the memory size, addition of functions to extract tactile features such as surfaces, edges, holes, and texture; and creation of compact fingertip-shaped TIR sensors for use on complex mechanical hands.

85-18 A Multiple-Scale Measure of Static Tactile Texture,R. E. Ellis

A method is proposed for extracting features useful in the classification of tactile texture. It is shown that accumulation of simple statistics on step edges and local extrema, calculated at multiple scales of resolution, can provide linearly separable features. The scale can be varied continously, thus facilitating adjustment of the scale parameters to optimise the effectiveness of the method for a given tactile array sensor.

85-19 Opposition Space as a Structuring Concept for the Analysis of Skilled Hand Movements, T. Iberall, G. Bingham, and M. Arbib

This paper describes an initial approach to problems in the control of prehensile movements through the use of coordinated control programs involving both parallel and sequential activation of perceptual and motor structures called schemas. A method of functionally partitioning the hand based on virtual fingers as functional units describes ways in which schemas control preshaping of the hand in anticipation of a grasp. Opposition space is developed as a description of the functional capabilities of the hand for executing stable grasps and object manipulations. The goal is to develop a method for mapping between task requirements formulated in terms of object degrees of freedom and a functionally constrained space of manipulator degrees of freedom. The space is developed from an analysis of the generic physical constraints corresponding the functional requirements of a grasp. Functionally constrained interactions between competing and cooperating schemas control movements and establishes stable postures within opposition space via virtual finger formation and control. Parameters for these control structures are discussed in terms of specific preshaping schemas.

85-20 An Approach to the Integration of Vision and Touch for Robot Control, R. E. Ellis

Advanced, flexible robotic systems require multiple sensors to successfully perform tasks in changing or unfamiliar environments. The data from these sensors must be integrated dynamically, in a coherent fashion, if the robot is to respond promptly and appropriately and complete its assigned task.

This paper describes a methodology for the integration of two robotic senses - vision and touch. Integration is performed by augmenting the usual structural models of the object in the robot's world with functional information. These functional attributes, which describe how an object relates to other objects in the world, facilitates the process of inferring from

multiple sensors and thus in controlling the robot's motions.

85-28 Depth and Detours: An essay on Visually Guided Behavior, M. Arbib, D. House

Motivated by data on the way in which a toad will sidestep around a barrier to get to prey, we offer a number of alternative models for the neural networks underlying such phenomena. First, we introduce a one-dimensional model, and then compare it to experiments which show that the animal must make use of the depth of objects in determining its course of action. On this basis, we review earlier work on depth perception in toad. We then turn to two models for the use of this information in detour behavior. The first builds on the one-dimensional model to indicate how the animal might 'choose' to turn to the end of a barrier or directly towards a worm. The second model indicates how the animal might come to represent in its head trajectories or a series of landmarks which can determine an overall path of action, rather than a single initial target.

85-30 A Task-Level Model of Distributed Computation for Sensory-Based Control of Complex Robot Systems, Damian Lyons, M. Arbib

We describe the development of a task-level model of distributed computation specifically designed for complex robot systems. We start by describing two fundamental problems which characterize the complex robot domain, and then describe four examles by which our model can be judged. Emphasizing that the formal exploration of behavior is as important as the specification of behavior, we describe the syntax and semantics of our model. Noting that our emphasis in this paper is on representation, we detail the implementation of each of the four examples introduced earlier. We conclude by analysing our implementations and outlining future work on this model.

85-31 Dominic: A Domain-Independent Program for Mechanical Engineering Design, A.Howe, J.Dixon, P.Cohen, M.Simmons

Dominic is a program that implements a domain-independent structure for solving mechanical engineering design problems. Given a problem, Dominic constructs an initial design and iteratively improves it using knowledge about the dependent relationship between the design goals and the design variables. In this paper, we describe Dominic's architecture, and demonstrate and analyze its performance on two classes of problems.

Dominic designs by a cycle of evaluation and redesign. Its input is a set of problem parameters describing phyusical constraints on the design, a set of performance goals, and an initial design procedure. Dominic evaluates the initial design and identifies its weaknesses. Theprogram then selects a design variable, proposes a change in the variable, assesses the overall effect of the change, and implements it if the effect is positive. The evaluate-and-redesign cycle continues until the design is judged acceptable.

Dominic has been tested in two domains: design of standard v-belt drive systems and design of aluminum extruded heat sinks.

85-35 Interpreting Optical Flow, G. Adiv

A new approach for the interpretation of optical flow fields is presented. The flow field, which can be produced by a sensor moving through an environment with several, independently moving, ridig objects, is allowed to be sparse, noisy and partially incorrect. The approach is based on two main stages. In the first stage the flow field is partitioned into connected segments of flow vectors, where each segment is consistent with a rigid motion of roughly planar surface. Such a segment is assumed to correspond to a part of only one rigid object. This initial organization of the data is utilized in the second stage without the assumption of planar surfaces, and segments are now grouped under the hypothesis that they are induced by a single rigidly moving object and/or by the camera motion. Each hypothesis is tested by searching for 3-D motion parameters which are compatible with all the segments in the corresponding group. Once the motion parameters are recovered, the relative environmental depth can be estimated as well. Experiments based on real and simulated data are presented.

Two inherent ambiguities, which may arise due to the presence of noise in the flow field, are analyzed and demonstrated. First, motion parameters of the sensor or a moving object may be extremely difficult to estimate because there may exist a large set of significantly incorrect solutions which induce flow fields similar to the correct one. Second, the decomposition of the flow field into sets corresponding to independently moving objects may be ambiguous because two such objects may induce optical flows which are compatible with the same motion parameters. These ambiguity analyses are general in the sense that they are algorithm- independent. Constraints and parameters which can be recovered even in ambiguous situations are presented.

85-36 Levels of Modelling of Neural Interactions Underlying Visuomotor Coordination, M. A. Arbib

Models of the neural interactions underlying visuomotor coordination are constrained by three types of data: ethological, physiological and anatomical. Modelling proceeds both "top-down", seeking to explain behaviour in terms of intermediate-level functional units called "schemas"; and "bottom-up", analyzing the interactions of networks of neurons. We introduce perceptual and motor schemas as units for the functional description of behaviour intermediate between a purely phenomenological description and an account of the detailed neural mechanisms of behaviour. The language of coordinated control programs expresses how such schemas are orchestrated in visually and tactilely guided behaviour. We exemplify how top-down analysis is constrained by both behavioural and lesion data by offering a schemá-theoretic analysis of anuran detour behaviour when confronted by barriers between the animal and its prey. We exemplify how bottom-up analysis is constrained by anatomical and physiological data by analyzing a family of models of the ineraction of cells in frog tectum during prey-predator discrimination and draw some general conclusions for the fruitful interaction between theory and experiment.

85-37 A Simple Set of Grasps for a Dextrous Hand, D. Lyons

This paper describes a high-level control mechanism for a dextrous hand. It overviews a distributed envoronment for robot control currently under development. A simple flexible set of grasps for a dextrous hand is then suggested and their implementation discussed. Finally the paper speculates about the role the grasp can play in obstacle avoidance and vice-versa.

85-40 Refinement of Environmental Depth Maps Over Multiple Frames, S. Bharwani, E. M. Riseman, A. R. Hanson

In this paper we examine the task of constructing a reliable depth map of the environment from a sequence of images obtained from a camera undergoing translational motion. Even when the motion of the camera is known, local ambiguities occur in the matching of features from one frame to the next leading to ambiguity in the recovery of environmental depth. This paper first examines the sources of error in computing depth and then proposes mechanisms to obtain coarse estimates of depth, predict displacements and refine the depth map for selected feature points. The technique iteratively improves the accuracy of the depth estimates over a sequence of frames, while maintaining constant computational

limits on processing between frames. Both start-up and updating strategies follow as part of a hierarchical spatial and temporal processing paradigm. The results of a preliminary implementation are presented and discussed.

85-47 Analysis of an Algorithm for Detection of Translational Motion, I. Pavlin, E. M. Riseman, and A. R. Hanson.

This report presents an extensive testing of an algorithm for the recovery of translational motion parameters of a sensor moving through a static environment. The algorithm has been evaluated using synthetic images in terms of the number of feature points matched between frames, the relative angle between camera orientation and direction of translation, uncorrelated and correlated noise, and computational cost.

The algorithm appears to be robust across a very wide range of camera translations, using only as few as 8 feature points. When the angle between the direction of translation and the direction of view is in certain range of angles the algorithm experiences difficulties.

In addition, an improvement in the speed and possibly the accuracy of the search is suggested. By the reasonable assumption of smoothness in the error surface, many stages of iterative search may be avoided.

85-52 A Review of Motion and Stereopsis Research, P. Anandan

This report contains a review of some of the major approaches described in the computer vision literature for the anlaysis of motion and stereopsis. The report is intended to introduce a researcher in the field of computer vision to the state of the art in these areas. The major research approaches have been organized and classified in a coherent manner and the basic ideas contained in them are described. This is not intended to be an exhaustive survey, although an attempt has been made to refer to most of the relevant techniques found in the literature.

86-07 Publications Bibliography: Perceptual Robotics Technical Reports

This bibliography compiles together technical reports, published by COINS, which describe the ongoing research in robotics, robotics-related vision, and robotics-related brain theory. For more information about these and other technical reports, contact the Dept. of Computer and Information Science, Graduate Research Center, Room A305, University of Massachusetts, Amherst, Mass 01003 (413) 545-2744.

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