Published by FESB-Split

Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture
University of Split
R. Boškovića b.b.
HR-21000 Split
Croatia

Text design: H. Dujmić

Production organizer: B. Burmaz

Printed in Croatia by Tiskara Franjo Kluz, Split

CIP - Cataloging in Publication Dataž
UDK 621.39 : 681.324](063)(082)

University Library, Split

SoftCOM '98 Conference Proceedings

1998. -649 pages.; 24cm.

Bibliographies, references, index of authors

ISBN: 953-6114-29-1

ISBN: 953-6114-29-1

INTERNATIONAL CONFERENCE ON
SOFTWARE IN TELECOMMUNICATIONS AND
COMPUTER NETWORKS

SoftCOM '98

Sponsored by:

IEEE COMMUNICATIONS SOCIETY (COMSOC),
TECHNICAL COMMITTEE OF COMMUNICATIONS SOFTWARE
(Technical Cosponsor)

MINISTRY OF SCIENCE AND TECHNOLOGY
REPUBLIC OF CROATIA

UNIVERSITY OF SPLIT

Organized by:

FACULTY OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE
FESB SPLIT

Under the patronage of:

CROATIAN POST AND TELECOMMUNICATIONS
TELECOMMUNICATIONS CENTER SPLIT

WORLD TRADE CENTER SPLIT

TECHNOLOGY CENTER SPLIT

October 14-17, 1998
Split, Dubrovnik, Croatia
Bari, Italy

ORGANIZATION COMMITTEE

J. Buzolić (General Chair) Croatian Post and Telecommunications Telecommunications Center Split

B. Lukšić, Governor of the County of Split and Dalmatia

I. Mandić, Vice Minister of Science and Technology

N. Vidošević, President of the Croatian Chamber of Commerce

I. Babić, Head of the University of Split

I. Škarić, Mayor of the Town of Split

I. Duplančić, The Dean of FESB, Split

PROGRAM COMMITTEE

N. Rožić (Chair), University of Split, Split, Croatia

B. Burmaz (Vice Chair), HPT-TKC, Split, Croatia

G.W.R. Luderer (Vice Chair), Arizona State University, USA

D. Begušić, (Vice Chair), University of Split, Split, Croatia

F. Grenez, Universite Libre de Bruxelles, Belgium

G. Kandus, J. Štefan Institute, Ljubljana, Slovenia

A. Ljolje, AT&T, New Jersey, USA

I. Mijačka, Ericsson - Nikola Tesla, Split, Croatia

M. Mikuc, University of Zagreb, Zagreb, Croatia

Z. Milić, World Trade Center, Split, Croatia

J.F. Mollenauer, Technical Strategy Associates, USA

N. Pavešić, University of Ljubljana, Slovenia

B. Souček, IRIS, Bari, Italy

Ž. Sutlar, HPT, Zagreb, Croatia

R. Walters, SATIN, Fosseway, Great Britain

Foreword

The Sixth International Conference on Software in Telecommunications and Computer Networks SoftCOM'98 was held from 14 to 17 October 1998 in the pleasant ambience of the luxury ship Marko Polo on the route Split-Bari-Dubrovnik. It was organized by the University of Split (Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture), HPT-TKC (Croatian Post and Telecommunications) Split, WTC (World Trade Center) Split and Technology center Split. The Conference was sponsored by the Ministry of Science and Technology of the Republic of Croatia, the University of Split and by the IEEE Communications Society (COMSOC) Technical Committee Of Communications Software.

The papers submitted for presentation at SoftCOM'98 have been reviewed by recognized scientists from universities, institutes and companies from Croatia, Italy, USA, Slovenia, and UK. Each paper has been reviewed by three reviewers and all submitted papers have been carefully selected based on their contribution, relevance, conceptual clearness and overall quality. Nearly 80% of papers have been recommended for presentation within the technical program. We believe that reviewers' suggestions and comments to authors, have considerably contributed to the quality of the SoftCOM'98 Proceedings. We would like to thank them all for their very well done job.

The papers accepted for presentation were classified into 7 groups: Software architecture, Design and Applications; ATM Networks; Wireless Communications, Advanced Services; Network Design, Management and Control; Signal Processing and Coding; Circuit Design and Electromagnetic Compatibility. The whole technical program was held through 9 sessions. The Technical Committee has also invited several outstanding experts both from Croatia and abroad to present the state of the art in the most interesting areas such as trends in development of telecommunication systems and services, new directions in network management, re-inventing the communication structure, universal and satellite communications, spoken queries systems in European languages and quantum mind networks. In addition, five tutorials were held by well known experts. We believe that themes of tutorials such as software architecture in digital cellular systems, high bandwidth access to the home, multimedia applications on Internet, quantum mind networks and an overview of EU R&D projects, could find a great interest of professionals engaged in development and design of advanced communication systems and services. The SoftCOM'98 Conference days also include a group of panel discussions in the framework of the Professional Circle session.

This year we continue with a practice of organizing some events related to SoftCOM. This year we organize two workshops dealing with recently really hot topics: intelligent transport systems and communication/information systems in healthservice and telemedicine.

We believe that the Conference help all of us to keep step with a very dynamic and complex development of modern communications, software architectures, multimedia services and related technologies.

Split, October 1998

N.Rožić

measures in compression system which removes temporal redundancy between frames. In compressed video system, which removes temporal redundancy, distortion is a function of picture content. In this system quality measurements using test waveforms do not characterise the picture degradation due to compression and temporal characteristics of the system are not explored. But objective measures have good correlation with subjective results in compressed video system, which reduce only spatial redundancy within single frame. Objective measurements are repeatable and do not depend on viewing conditions or the mood of the viewers.

In real video sequences many picture defects are hidden by the picture transition or content with which they arė associated. Therefore subjective measures are needed. But, subjective measures of picture quality depend on viewing conditions. The measurement takes a large amount of time and resources and the results are not always repeatable. Ideally, a combination of subjective and objective test methods is the most effective way to test video compression system.

REFERENCES

[1] ITU-R Rec.BT.601:"Encoding Parameters of Digital Television for Studios", ITU, Geneva, 1993.
[2] G.K.Wallace:"The JPEG Still Picture Compression Standard", Comm.ACM, vol.34, No.4, Apr.1991, p.p.31-44.
[3] ITU-T Recommendation H.261:"Video Codec for Audio-Visual Services at Px64 kbit/s", Mar.1993.
[4] ISO/IEC IS 11172-2:"Information Technology-Coding of Moving Picture and Associated Audio for Digital Storage Media at up to about 1.5 Mbit/s: Video", Aug.1993.
[5] ISO/IEC IS 13818-2:"Information Technology-Generic Coding of Moving Pictures and Associated Audio Information: Video", Draft, Mar.1994.
[6] M.Drury:"Picture Quality Issues in Digital Video Compression", IBC'95, Conf. Pub. No. 413, Amsterdam, 1995, p.p.13-18.
[7] B.Zovko-Cihlar, S.Bauer, D.Modrić:"Coding Techniques in Multimedia Communications", 2nd International Workshop on Image and Signal Processing, Budapest, 1995, p.p.24-32.
[8] S.Bauer, B.Zovko-Cihlar, M.Grgić:" The Influence of Impairments from Digital Compression of Video Signal on Perceived Picture Quality", 3rd International Workshop on Image and Signal Processing, Manchester, Nov.1996.
[9] N.Jayant, P. Noll: "Digital Coding of Waveforms: Principles and Applications to Speech and Video", Prentice Hall, Washington, 1984.
[10] B.Zovko-Cihlar: "Noise in Radiocommunications", Školska knjiga, Zagreb, 1989.
[11] L.E. Weaver:"Television Video Transmission Measurements", Marconi Instruments, 1973.
[12] R.O. Onvural:" Asynchronous Transfer Mode Networks: Performance Issues", Artech House, 1994.
[13] M.Ardito, M.Visca:"Correlation between Objective and Subjective Measurements for Video Compressed Systems", IBC'95, Conference Publication No. 413, Amsterdam,1995, p.p.7-12.
[14] ITU-R Rec. BT. 500:"Methods for the Subjective Assessment of the Quality of Television Pictures"
[15] ITU-R Rec.BT.710:"Subjective Assessment Methods for Image Quality in HDTV"
[16] ITU-R Rec. BT.811-1:"Subjective Assessment of Enhanced PAL and SECAM Systems"
[17] ITU-T Rec. P.80:"Methods for Subjective Determination of Transmission Quality"
[18] ITU-T Rec.P.910:"Subjective Video Quality Assessment Methods for Multimedia Application"
[19] ITU-T Rec. P.920:" Interactive Test Methods for Audio-Visual Communications"
[20] ITU-T Rec. P.930:"Principles of Reference Impairments System for Video"

IMAGE DISPLACEMENT VECTOR DETERMINATION BY FUZZY SET COMPARATOR

Mirjana Bonković, Darko Stipaničev
Laboratory for Robotics and Intelligent Systems
Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture
University of Split
Ruđera Boškovića bb
e-mail: mirjana@fesb.hr

Abstract: *Principles of digital picture analysis and image understanding techniques make computer vision system applicable. Abundance in interpretation of analysed information involved by presence of noise, absence of contrast, sensor distortion etc., can be avoided using principles of Fuzzy Set Theory.*

In this paper FSC (Fuzzy Set Comparator) is used for object displacement vector determination. 2D fuzzy set of displaced images: up, down, right, left and centre, are defined in learning process from one image of a scene. The displacement vector is determinated on the basis of the differences between new scene and defined fuzzy set of displaced .scenes, The displacement vector is determinated.

Theoretical results are evaluated experimentally using "off-line" mode of FSC digital image processing.

KEYWORDS: displacement vector, pattern recognition, fuzzy set theory

INTRODUCTION

A mapping between one frame from an image sequence and the preceding or following frame can be represented as a displacement vector field [1], or as Weng defined [2], the displacement vectors between the corresponding image points are the results of image matching, used as input for 3D motion estimation. Based on existing techniques for image matching, which roughly fall into two categories: continuos and discrete [2], the displacement vectors appropriately model the scene structure.

In the continuous approaches, the interframe motion is approximated by motion velocity and, therefore, to achieve for such an approximation to be reasonable the interframe motion must be very small and the intensity function is smooth and well behaved [3]. The displacement vectors are given as optical flow.

The discrete approach techniques treat the images as samples of the scene taken at discrete times, and select discrete features as tokens that are to be matched. For example, points with high grey value variation can be defined as matching tokens [4]. Other features used for matching include edges for stereo matching [5], lines for stereo matching, correlation of intensity patterns [6], etc. Generally speaking, discrete approaches allow either small motion or relatively large motion and more accurately models which actually happen than the continuous approach.

As the concept of fuzzy sets fits very naturally in the framework of discrete image matching techniques, in this work FSC (Fuzzy Set Comparator) is used for object vector displacement determination. 2D fuzzy set of displaced images: up, down, right, left and centre are defined in learning process from one image of a scene. Based on differences between new scene and defined fuzzy set of displaced scenes, the displacement vector is determined. Theoretical results are evaluated experimentally using "off-line" mode of FSC digital image processing.

1. THE LEARNING PROCEDURE AND A DISPLACEMENT VECTOR DETERMINATION

The displacement vector determination is usually based on sophisticated procedures for overlapping recognised shapes in a sequence of analysed images [8], [9]. Fuzzy set comparator board (Fig.1.) enables hardware comparison for patterns that are stored in the available memories without prior image shape identification. The results of the comparison are stored in registers accompanied to the memories and could be sent to the neural net gate which is responsible for finding the winning memory pattern, i.e. it makes the decision which of the memory patterns is the most similar to the referent one. Also, the degrees of similarity are determined, too. Defining a unit step characteristic function (Fig.2) whose values Ei are equal for all patterns in appropriate video memories damps the influence of noise on input data.

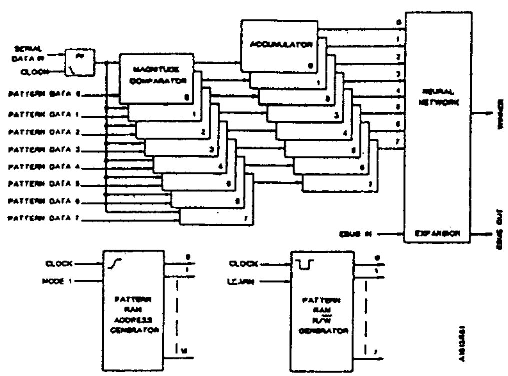

Fig.1. Schematic representation of the FSC board

The size of each FSC video memory is adapted to the NTSC standard. For continuous video input from camera, only the even field of video is used, and only 192x132 pixels are saved. Each pixel is represented by two bits, so a total of four grey levels can be achieved.

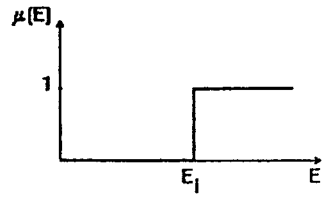

Fig.2. The shape of the error threshold characteristic function

In the learning process, the image of monitored scene has to be processed to define 2D fuzzy sets of displaced images named: up, down,left, rights and centre. Those fuzzy sets are stored in five external pattern memories as fuzzy matrices with appropriate pixel grey values. The characteristic function of those fuzzy sets is also 2D function with the same values scaled to [0,1] interval. The data from the new image of a scene is entered serially into the FSC device, where it is formatted into bit fields and compared, one field at a time, with data stored in external pattern memories. The result is an accumulation of errors across all of the fields. These error sums represent a set of closeness values. If the smallest closeness value of a particular comparison is also less than a characteristic function threshold value, then the best match is found between the known and unknown image of a scenes patterns. The displacement vector is determined by the four-step procedure. The first one is calculation of the degrees of fulfilment. Each displacement has its own degree of fulfilment, which is reciprocal to the error sums. If an error sum is equal to zero, than the stored pattern is identically equal to the compared one. Therefore, the degree of fulfilment has maximum value, which is equal to 1. Contrary, the highest value of an error sum means the weakest match between grabbed and stored patterns resulting with zero degree of fulfilment. Consequently, the degree of fulfilment is a vector, whose each element is calculated by the formula

$$\text{if } E_i = \text{maxErr} \quad \lambda_i = 0$$
$$\text{else if } E_i = \text{minErr} \quad \lambda_i = 1$$
$$\text{else } \lambda_i = \frac{\max\text{Err} - \min\text{Err}}{\max\text{Err}} * E_i$$

where maxErr is the maximal error sum. Similarly minErr is minimal error sum between compared new image of a scene and stored pattern memories, E_i is appropriate error sum, and "i" represents the i-th element of the fuzzy vector.
The second step is determination of the output fuzzy set

$$d^* = \vee_i (\lambda_i \wedge d_i^*)$$

where d_i^* are fuzzy sets of displacement depicted on Fig.3b.

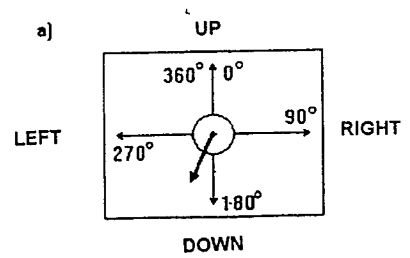

Fig.3a. Defining the meaning of the direction fuzzy sets

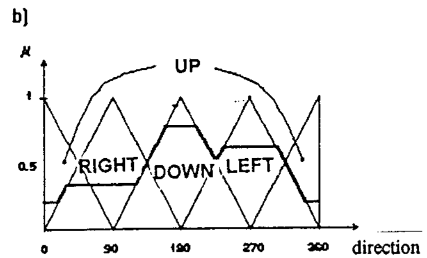

Fig.3b. Mapping functions of the direction fuzzy sets

The third stage is interpretation of the output fuzzy set resulting with displacement vector direction. Its crisp value is calculated using centre of gravity method

$$d_v = \frac{\sum_{d=0}^{360} d * d^*}{\sum_{d=0}^{360} d^*}$$

The final stage is determinated by displacement vector magnitude. The idea was based on the following procedure: the higher the degrees of fulfilment are, the displacement vector looks more like the displacement created and stored in the pattern memories during the learning phase. It is important that only two displacements are relevant which have maximum values of degrees of fulfilment. For example depicted on Fig 3a, it is displacement "down" and "left".

As the image of a scene is always compared with a image patterns constructed partly with the moving object interesting part (etc. "up" part - symbolising move in the down direction; "right" part - symbolising move in the left direction and similar) and with a background, this method would perform in the same way using different (non-uniform and/or textured) background or texture covered object.

The same considerations probably could not be applied to big oscillations in size/scale of the object but described experiment is performed having in mind that the same techniques will be applied for final positioning of the robot manipulator where oscillations in size of the image objects are neglected.

This method for displacement vector determination could be applied in a control algorythm, because the obtained results are quite satisfactory as the experiment, described in the next section, will show.

2. EXPERIMENTAL RESULTS

The experimental results were obtained "off line" as the camera standard (CCIR) and used FSC board (NTSC) were incompatible. The images grabbed with camera MICAM HRS were stored in the additional frame buffer, which belongs to the system CYCLOPE 2-I. There, the image was processed and adapted for comparison on the FSC. Afterwards, the 2D fuzzy sets of displacement vectors were established and stored in appropriate memories. Its absolute values of grey level are visible on the Fig.4a, 4b, 4c, 4d and 4e. The new grabbed image with displaced object was compared with the stored patterns and the comparison results appeared on the screen. The object was moved to the right, so the error sum of the fifth pattern memory had the lowest value and consequently $\lambda_5 = 1$.

3. CONCLUSIONS

Comparing the known image patterns with the new image of a scene, it is possible to define the object displacement vector. Although the results were obtained only "off line", the speed and precision in displacement vector determination were respectable and indicated that the described method applied on compatible equipment has to be seriously considered in real time detection, tracking and/or control of a moving object.

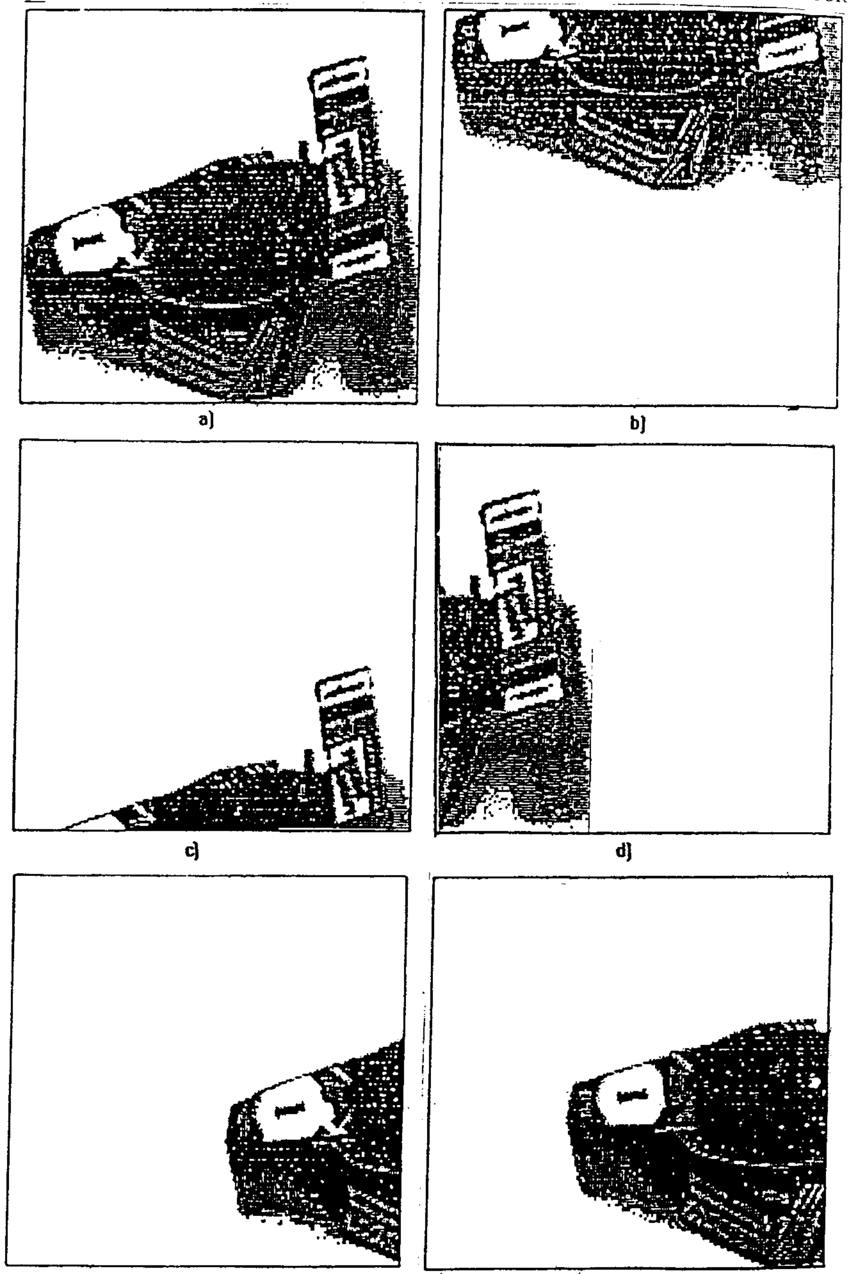

Fig.4. Images captured by CCIR camera and adapted to the NTSC standard; the images of the defined displacement: center 4a, up 4b,down 4c, right 4d and left 4e; the image of the moved object 4f.

M. BONKOVIĆ: IMAGE DISPLACEMENT VECTOR DETERMINATION BY FUZZY SET COMPARATOR

The special advantage of this method is that the obtained displacement vector could be directly used as an input to control algorythm. Typical applications could be the control of a robot manipulator, mentioned before, or the control of the camera movement to keep the object in the image center all the time.

4. LITERATURE

[1] Hans-helmut Nagel, W. Enkelmann: An Investigation of Smoothness Constraints for the Estimation of Displacement Vector Fields from Image Sequences, Computer Vision Principles, pp. 498-526, Eds. R.Kasturi and R.C.Jain, IEEE Computer Society Press, 1991.

[2] J.J.Weng: 3D Motion Analysis from Image Sequences Using Point Correspodences, Handbook of Pattern Recognition and Computer Vision, pp.395-441, Eds. C.H.Chen, L.F. Pau, P.S.P. Wang, Worls Scientific Publishing Company, 1993.

[3] B.K.P.Horn: Robot Vision, MIT Press, 1981.

[4] L.Dreschler, H-H. Nagel: Volumetric Model and 3-D Trajectory of a Moving Car Derived from Monocular TV frame Sequences of a Street Scene, Comp. Graph. Image Process. 20, pp.199-228, 1982.

[5] Y. Ohta, T.Kanade: Stereo by Intra- and Inter- scaline Search Using Dynamic Programming, IEEE Trans. Pattern Anal. Mach. Intell. 7, pp. 349-385, 1981.

[6] M.Cecić, I.Visković, Z.Ćukušić: Vehicle position detection by using video camera signal processing (in Croatian), pp. 220-223, KOREMA, Zagreb, 1993.

[7] Bernd Jahne: Digital Image Processing, Springer-Verlag, 1991.

[8] A.K.Jain: Fundamentals of Digital Image Processing, Prentice Hall International Editions, 1989.