Computational Intelligence and Industrial Applications

Proceedings of ISCIIA2006

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Welcoming Message from Headmaster of Guangdong Polytechnic Normal University ISCIIA2006 General Chair

Ladies and Gentlemen,

It is a great pleasure for me to be here. On behalf of all the teachers and students of Guangdong Polytechnic Normal University, I would like to extend our warmest welcome to all the participants to Guangzhou on the occasion of the International Symposium on Computational Intelligence and Industrial Applications (ISCIIA2006).

Welcome to the beautiful city-Guangzhou-in south China. It is a famous city with a history of more than two thousand years.

Our university, founded 50 years ago, is a comprehensive university, which focuses on both subject education and applied research. Meanwhile, our university is also characterized by nationality education and teachers cultivation for vocational colleges. In our university, there are nearly 15,000 full-time students in 20 departments that are subdivided into bachelor's degree in 40 majors and master's degree in 4 majors. In particular, we have set up an Industrial Training Centre, which can offer students the advanced equipments, interdisciplinary and comprehensive project training.

Our university has established the projects of cooperation and set up academic exchanges with many famous universities at home and abroad. Therefore, I think that ISCIIA not only plays an important role in the development of multimedia technology, computational intelligence, and industrial robots, but also offers us a good opportunity to learn worldwide application trends and cooperate with other universities, research institutes, and companies. We are also looking forward to cooperating and communicating with many experts and scholars.

Finally, I do wish that this symposium will be highly successful. Thank you!

Lefu Wang

Welcoming Message from General Chair

Ladies and Gentlemen,

I feel honored to be the chair of the conference. On behalf of the organizing committee of the International Symposium on Computational Intelligence and Industrial Applications 2006 (ISCIIA2006), I warmly welcome all participants and their spouses to Guangzhou, China.

The symposium is the 2nd one of the series of biannual symposiums ISCIIA, which offers us a very good communication platform. We are looking forward to discussing all participants' latest research findings. The topics of conference cover Computer Information and Multimedia Technology, Motion Control, Robot Control, Applied Mathematics, and others. By presentation of papers and communication, we hope to provide you valuable information about the issues concerned by the experts in these fields and the researches of these advanced subjects. With the cooperation of all the hard-workers, I am proud to announce that we have improved on all counts ranging from the numbers of submissions, the scope of research topics covered to the research level of the participants. All of these will be a good beginning for the success of the symposium.

I am very proud to welcome our distinguished plenary speakers, namely Prof. Kaoru Hirota and Prof. Tan Guan Hong. This good start does indeed encourage all of us. With your continued contribution, ISCIIA will definitely grow and become a leading symposium in the field of the intelligent technologies. I would like to take this opportunity to express our sincere gratitude to them.

I want to thank President Lefu Wang and local committees: Fengmei Zhang, Jin Zhang, Jianxiong Zhang. And I also want to thank Dr. Fangyan Dong and Mr. Raymond. They have worked tirelessly for nearly one year. The symposium will never become a reality without their hard working.

At last, I do hope that this symposium will be highly successful and all of you can enjoy your stay in Guangzhou. Thank you for coming. Thank you!

Shibin Zhao

Greetings from Program Committee Chairs

Dear Authors

Thank you very much for submitting papers to the 2nd International Symposium on Computational Intelligence and Industrial Applications (ISCIIA2006).

Thanking to authors, we received a lot of paper submissions. Each submitted paper has been reviewed by two reviewers. Papers contents are evaluated by two reviewers from viewpoints of technical quality, technical originality, and relevance to the conference with five grades, i.e., excellent, good, average, poor, and unacceptable. Based on the review results 63 papers have been accepted.

The two best papers and the two best student papers are chosen by the ISCIIA2006 committee from the 63 papers, and some papers are recommended to special issues of the Journal of Advanced Computational Intelligence and Intelligent Informatics (JACIII). In addition, during this ISCIIA2006, 15 sessions are set for presenters and the best presenter is expected to be chosen in each session.

We would like to thank reviewers for spending your valuable time reviewing a lot of papers, and also thank session chairs for organizing the session for the ISCIIA2006.

Thank you again for your cooperation and participation for ISCIIA2006.

Program Committee Chairs

Fangyan Dong and Shinichi Yoshida

Greetings from Local Organizing Committee

Ladies and Gentlemen,

Thank you for coming to the 2nd International Symposium on Computational Intelligence and Industrial Applications (ISCIIA2006),

We believe that ideas and research findings in your reports will be very stimulating and inspiring.

This year all members of Local Organizing Committee have been extremely busy in making preparation for ISCIIA2006. We worked very hard for this and we are so glad that the symposium is being successfully held today.

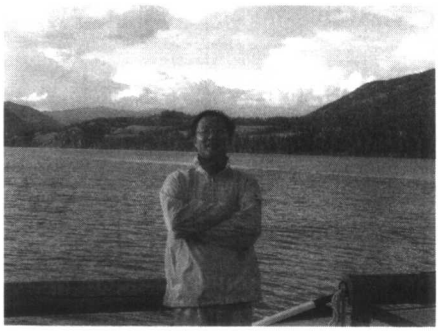
We should thank General Chair Lefu Wang, Kaoru Hirota, Raymond Tay. And we also want to thank ISCIIA2006 Program Committee. The symposium will never become a reality without their hard working.

We hope that this symposium will be highly successful and all of you can enjoy your stay in Guangzhou. Thank you!

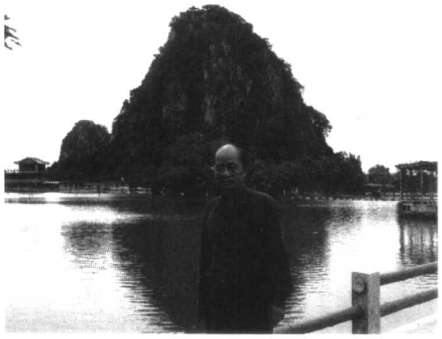
Local Organizing Committee

Fengmei Zhang, Shibin Zhao, Jin Zhang, Jianxiong Zhang

Shibin Zhao



Jin Zhang



Jianxiong Zhang

Fengmei Zhang

Plenary Talk I

Title: Emergence of Machine to Machine Systems for Ubiquitous Industrial Applications

By: Dr Tan Guan Hong, President of Singapore Industrial Automation Association

Abstract

With explosive growth of the Internet and wire-less communications together with the miniaturization of electronics trends, the market demand for smart devices and sensors is growing as the prices keep reducing with global competition. When these technologies converged into new applications, a new market starts to emerge as a Machine to Machine (M2M) market which leverage on known technologies and established communication infra-structures to deploy many applications to help industry to improve their Quality, Productivity and Flexibility in various process and services. This has created many new business opportunities for bring technologies into the market faster at a lower cost than previously possible. The presentation will show some case studies and deployments together with opportunities and challenges in this growing market.

Short CV of Dr Tan Guan Hong
President of Singapore Industrial Automation Association
Managing Director of SysEng(S) Pte Ltd

Industrial Research Experience to bring University R&D to commercialization

He graduated in B. Eng (Electrical & Electronics) in 1976 from the University of Sheffield, England. Then he was awarded an Industrial Ph.D. scholarship from the Wolf Safety Lamp Company to develop 250 watts High Speed Turbo Generator from a 55 watts product with the same size, weight and packaging. This gave that company an edge over their competitors globally within a short period, and today, it is still a product on sale. He presented two Research Papers in Universities Power Engineering Conferences, England for his work.

Multi-National Experience to manage a Global Engineering Group

He joined Philips Electronics Singapore, in 1980 as a Product Designer and also set up CAD/CAM and measurement systems. He was promoted to Chief Engineer in 1983. In June 1984, he was the Head of Department for Quality Control with 80 staff, and responsible for Factory Quality. He helped raised the Factory Quality Levels of 96% to 99% within 1.5 years and setup Quality feedback system from major overseas clients in Europe and USA. In 1986, he was the Production Engineering Manager responsible for Just-In-Time Production, Automatic Production and Testing. In 1998, he was the Engineering Manager, with a total staff of 110, responsible for the Annual Factory Investments and Production Facility transfer globally. He was an advisory board member in many government committees and polytechnic.

Small Medium Enterprise (SME) Start up Experience to grow to a Leading Technology Company

In 1994, he founded SysEng (S) Pte Ltd, a **Sys**tem **Eng**ineering Company, to Develop Test and Measurement Systems. In 1996, he was an Adjunct R&D Associate Professor in the Nanyang Technological

University, Singapore and a Board Member to the Technopreneurship & Design Center in Ngee Ann Polytechnic.

In 1998, SysEng expanded to the Automated Measuring Systems used in the Civil Engineering sector. In 2004, he expanded the business to a growing Machine to Machine (M2M) market. In April 2005, the International Telecommunication Union Workshop on Ubiquitous Network Societies on "Case of Republic of Singapore" featured SysEng's Real Time M2M System, eMs, as one of Singapore's Technological Development. This eMs was selected by the Taiwan Ministry of Economic Affairs as an "Innovative Application Case Study 2006" in its publication. He has presented in many International Conferences on Automated Remote Monitoring systems.

Business Community Activities for SME

He joined Singapore Industrial Automation Association (SIAA) in 2004, elected as Vice-President in 2005 and President in 2006. He started the SIAA M2M consortium in 2004 to gather different SMEs to come together to focus on M2M market.

Plenary Talk II

Title: Development of Fuzzy Controlled Robots

By: Prof. Kaoru Hirota, Vice President of International Fuzzy Systems Association

Abstract

The outline of if-then rule based fuzzy control and its industrial applications are surveyed with a lot of industrial application examples. Then the application examples to robotics field, especially examples developed mainly at the author's group, are introduced with DVD video images such as Conveyor Belt Robot, 2D Ping Pong Robot, Flower Arrangement Robot, Grasping 2D Irregular Moving Object, Yo-Yo Robot, Model Helicopter Hovering, Prototype of Biped Robot, Irregular Moving Basket Shooting, Darts & Pin Ball Shooting, and Moving Robots in Schools. Finally a part of on going project by the author's group, i.e., Development Project for a Common Basis of Next-Generation Robots sponsored by NEDO of Japan, is also mentioned.

Short CV of Prof. Kaoru Hirota
Vice President and Fellow of International Fuzzy Systems Association
Professor at Tokyo Institute of Technology

Kaoru HIROTA was born in Niigata Pref. Japan on January 6, 1950. He received the B.E., M.E., and Dr. E. degrees in electronics from Tokyo Institute of Technology, Tokyo, Japan, in 1974, 1976, and 1979, respectively. From 1979 to 1982 he was with the Sagami Institute of Technology, Fujisawa, Japan. From 1982 to 1995 he was with the College of Engineering, Hosei University, Tokyo. Since 1995, he has been with the Interdisciplinary Graduate School of Science and Engineering, Tokyo Institute of Technology, Yokohama, Japan. He has experienced (twice) a department head professor of Department of Computational Intelligence and Systems Science. His research interests include fuzzy systems, intelligent robot, image understanding, expert systems, hardware implementation and multimedia intelligent communication. Dr. Hirota is a member of IFSA (International Fuzzy Systems Association (Vice President 1991-1993 and 2005-2007, Treasurer 1997-2001, secretary 2003-2005, Fellow awarded in 2003)), IEEE (Associate Editors of IEEE Transactions on Fuzzy Systems 1993-1995 and IEEE Transactions on Industrial Electronics 1996-2000, IEEE CIS Distinguished Lecturer) and SOFT (Japan Society for Fuzzy Theory and Systems (Vice President 1995-1997, President 2001-2003)), and he is an editor in chief of Int. J. of Advanced Computational Intelligence and Intelligent Informatics. A Banki Donat Medal, Henri Coanda Medal, Grigore MOISIL Award, SOFT best paper prize in 2002, Acoustical Society of Japan best paper prize in 2006, honorary professorship at de La Salle University, and honorary doctorate at Bulacan state university were awarded to Dr. Hirota. He also organized many international conferences/symposiums as a general chair or a program chair such as FUZZ-IEEE'95, InTech2002, and SCIS2002 (more than 10 in total).He has been publishing more than 180 journal papers and more than 400 conference papers in the field of computational intelligence.

CONTENT

Tracking Object Contour Using an Improved Snake Algorithm

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***Abstract* - In some cases, when we use the Snake algorithm to track moving object, it's a difficulty of Snake that how to select initial points and constraint condition. In order to solve this problem, we propose an improved algorithm which uses the difference of three frames and Snake algorithm. Firstly, we get the initial points of Snake by the difference of three frames. Then the Snake enlarges these points to locate object boundary, so we can get the contour quickly. In other ways, this system uses a new method to record the movement of aim in text file, which only needs a little memory. It is a suitable method for long time tracking. By the experiment, we prove that this system can do real-time tracking and get an exact contour, besides it can record the trail of motion in text file.**

Index Terms* - *snake algorithm, track moving object, difference algorithm, record trail in text file.

I. INTRODUCTION

In recent computational vision research, it is very important that the method of motion tracking. The purpose of tracking is to find the interest information, such as transformation and movement. The dominance of Snake (or active contours) algorithm is it can conform to an object boundary or other desired features within an image. The Snake is an energy- minimizing curve guided by external forces and influenced by image forces that pull it toward object boundary. In this paper, the improved algorithm which we research uses the results of difference algorithm to initialize the Snake. This algorithm simplifies the Snake and reduces the times of iteration. Besides our system uses a new record method, which records object's trail in text file using Hausdorff distance, so it only needs a little memory. By the experiment, we know this system can do real-time tracking, get exact contour and record motion trail in text file.

II. THE FRAME OF ALGORITHM

A. *The Algorithm of Difference of Three Frames*

In the algorithm of difference of three frames, $f_{t-1}(x,y), f_t(x,y), f_{t+1}(x,y)$ are three consecutive frames. $d_t(x,y)=f_{t+1}(x,y)-f_t(x,y)$ is the difference of two frames, the intersection of d_t and d_{t-1} is the moving object $D_o(x,y)$, Fig.1 shows the sketch map of difference algorithm.

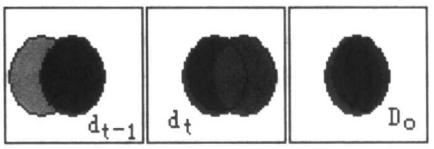
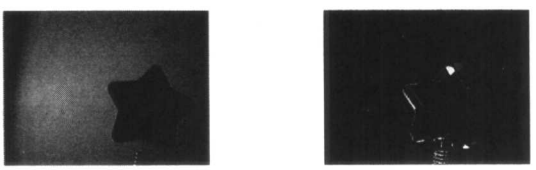


Fig. 1 The sketch map of difference algorithm.

By the experiment, we know that the difference algorithm is simple and fast, so it can track objects real-time. But the disadvantage is the contour which it gets can't be used directly, because it is in-complete and many factors will affect the effect. Fig.2. a shows the moving object and Fig.2. b shows the result of difference algorithm.



a. The moving object. b. Result of difference algorithm.

Fig. 2 Result of difference algorithm.

B. *Active Contours Algorithm*

The Snake is a curve defined within an image domain that can move under the influence of internal forces within the curve itself and external forces derived from the image data. The result is an active model that falls into the desired solution when placed near object's edge. Snake have been proved is effective.

A Snake is parametrically defined as $v(s)=(x(s), y(s))$, where $x(s)$ and $y(s)$ are x, y coordinates along the contour and s represents the arc-length with values in [0,1]. The function can be written as:

$$E_{snake}=\frac{1}{2}\int_{\Omega}\left[E_{\text{int}}(v(s))+E_{ext}(v(s))+E_{field}(v(s))\right]ds \quad (1)$$

E_{int} is internal energy; E_{ext} is image energy; E_{field} is external energy.

However, Snake have some limits. Such as it depends on the initialization and the region which it can search is small. Not only because hollows are difficult to find, curves often fall into extremum; but also can't use topological changes. Otherwise, when the external energy is very small, curves will shrink to a point. To solve the problem of initialization, some papers use genetic algorithm. Because it can minimize energy entirely, but the disadvantage is that it isn't a suitable algorithm for real-time tracking.

C. *Hausdorff Distance*

Given two sets of points $A=\{a_1, a_2, ..., a_p\}$ and $B=\{b_1, b_2, ..., b_p\}$, the Hausdorff distance is defined as:

$$H(A,B)=\max(h(A,B), h(B,A)) \quad (2)$$

The forward and the reverse Hausdorff distance are defined as:

$$h(A,B)=\max_{a\in A}\min_{b\in B}\|a-b\| \quad (3)$$

$$h(B,A)=\max_{b\in B}\min_{a\in A}\|b-a\| \quad (4)$$

where $\|\bullet\|$ is the Euclidean norm.

The Hausdorff distance, $H(A,B)$, is the measurement of mismatch between two sets of points, as it reflects the distance of the point of A that is farthest from any point of B and vice versa.

III. IMPROVED TRACKING ALGORITHM

We know that the difference algorithm is very simple and fast. But it can't find a complete contour. The Snake can get an exact and complete contour, but it is complex and initialization is difficult, so it isn't a suitable algorithm for real-time tracking

The improved algorithm in this paper, syncretize these two algorithms. Firstly, we AND the difference of three frames, then filter the result to get initial points. Simultaneously, the algorithm counts the gradient of the middle frame, and then sets the parameters of Snake. So Snake can enlarge the curve and get object boundary. Fig.3 shows the improved algorithm's framework.

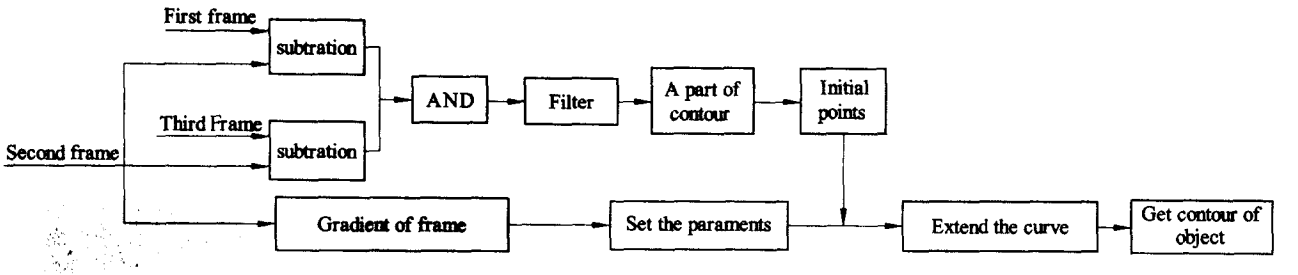


Fig. 3 Improved tracking algorithm.

Fig. 4 shows the method of getting object boundary.

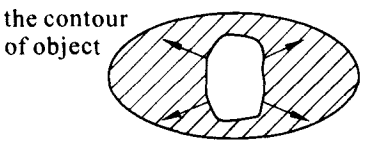


Fig. 4 Sketch map of improved algorithm.

The ellipse in this image represents the real contour of object; the abnormal curve in the ellipse is a part of the object which is got by the difference algorithm. When get initial points which are equidistant, we should enlarge the inside curve, in this paper, we use Snake to do this.

The extended forces in Fig. 4 are consisted of three terms in the right of equation (1). The first item, E_{int} is internal energy, it can be written as:

$$E_{\text{int}}(v(s)) = w_1(s)|v_s(s)|^2 + w_2(s)|v_{ss}(s)|^2 \qquad (5)$$

In this equation $v_s \equiv \partial v/\partial s, v_{ss} \equiv \partial^2 v/\partial s^2$. Where $v_s(s)$ is the first derivative and $v_{ss}(s)$ is the second derivative with respective to s. The first term is treated as elastic energy, which causes the Snake to extend like an elastic rubber band. The second term is bending energy, which is defined as the sum of squared curvature of the contour. Bending energy makes the Snake to behave like a thin metal strip and is responsible for smoothness of the contour.

In our algorithm, the image energy is got by image gradient, it can be defined as:

$$E_{ext} = -|\nabla I(x,y)|^2 \qquad (6)$$

The image energy is derived from the image data over which the Snake lies. This energy functional attracts Snake to salient features in image such as lines and edges.

In order to accelerate the extension, we take advantage of the external energy. It sets a point in the middle of object, and then sets reverse forces which show in Fig. 4. The external energy can be written as equation (7), the $Volcano(x,y)$ is the position of the point.

$$E_{field} = -k|(v(x,y) - Volcano(x,y))|^2 \qquad (7)$$

This algorithm uses E_{int}, E_{ext} and E_{field} to enlarge the contour. The function of E_{snake} has a minimum only if the algorithm finds the real contour of object.

IV. IMPROVED RECORDING ALGORITHM

In this system, we make use of two text file to record object's motion, which only need a little memory. The first records the object's figure and the second records the trail of target.

In order to observe the state of aim, we record the figure of object in a text. The system applies the Hausdorff distance measurement to measure the similarity between a model and object in every frame; the models are got by typical shapes. So when system plays the recording we will see a regular object which is moving on screen.

System makes use of Hausdorff distance, $h(M,I)$,to matching. Where M is a set of points of model, I is the points of the object which to be matched. The Snake can get a set of points of complete contour, so this algorithm needn't pretreatment. Usually, the number of points in object I is much larger than the number of points in the shape model M. From the equation (3) of forward Hausdorff distance, we need to find a minimum distance from every point in set M to all the points in set I, and the model which has the minimum distance between two sets is the one we want in this frame. And then system will count up the number of times that each model appears. If a model appears much more than others, we think it is the model we want, then the set of points in this model will be saved in the first text.

Another text saves the positions of barycenters in every frame. When system plays the recording, the curve which is composed of barycenters could be regarded as the trail of motion. Meanwhile we can calculate the model's position where it should be in this frame. When it displays on screen, we will see the object which we track is moving in its recorded trail.

TABLE Ⅰ

COMPARISON OF TWO RECORDING METHOD'S MEMORY

time of recording	memory of avi file	memory of txt file
1 min	13863 KB	6 KB
5 min	462632 KB	10 KB
10 min	921579 KB	18 KB

As shown in TABLE Ⅰ, we see that the improved recording algorithm solve the problem of recording memory. This method only uses approximate 0.001% of usual video recording method in avi file. The method can be used on rigid object tracking and some long time tracking which mainly want to observe the trail of motion.

Ⅴ. THE RESULTS OF EXPERIMENT

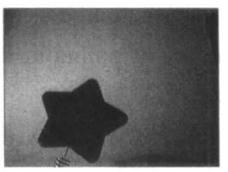
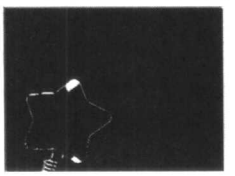
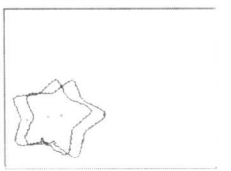
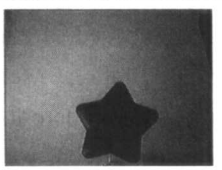
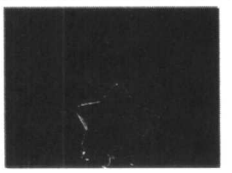
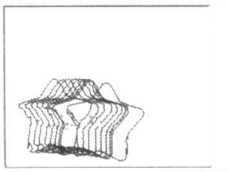
In order to prove the effect of our improved algorithm, we choose an experiment that the system tracks a pentacle. The experiment system consists of a computer with Pentium4 2.00 GHz CPU and 256MB memory, a PC camera and a video card, the programmer is developed by Visual C++ 6.0. The experiment proves that this system can do real-time tracking and record the trail of motion. TABLE Ⅱ shows some results in the experiment.

TABLE Ⅱ shows the second, eighth and sixteenth frame in the experiment. The second row shows the frames which we actually get. The third row shows the difference of three frames, we can see clearly the difference algorithm can't get complete contour, so it couldn't be used directly. The results of improved algorithm are shown in the last row. In this experiment the Snake iterates 30 times in every frame, if we don't use the proposed algorithm the iteration time mainly depends on the selection of initial points, in experiments the average time is 80. In the images of last row, the red points are the contour points which the improved algorithm get and the red dots in pentacle are the barycenters. In order to observer, we connect adjacent points with blue line.

By the experiment results we could see the improved algorithm reduces the iterative times of Snake. In other ways, this tracking algorithm can get a set of points which could be used in the Hausdorff distance measurement directly. So we can say this algorithm simplifies the Snake, solves the problem of initialization, besides it can track object real-time and get an exact contour.

TABLE Ⅱ

RESULTS OF IMPROVED TRACKING ALGORITHM

	Actual frame	Results of difference algorithm	Results of improved tracking algorithm
The second frame			
The eighth frame			
The sixteenth frame