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Editorial

This is the 25th Bulletin of the International Graphonomics Society, BIGS 13, 1.

The IGS Board is proud to announce that the special double issue of *Acta Psychologica*, Volume 100 (1-2), has recently been published. This major publication resulting from IGS '97, the 8th Biennial Conference of our Society held in Genova, Italy in 1997, forms the twelfth major publication of the IGS. The publishers of *Acta Psychologica*, Elsevier Science, offers IGS members who want to purchase the volume a 40% discount; see the separate flyer enclosed in this BIGS mailing.

This BIGS issue presents the results of the Calls for Papers for the 9th International Conference of the IGS, which will be held in Singapore, 28-30 June 1999. An overview of currently accepted papers that will be presented at IGS99 is given. You are invited to use this overview to mobilise potential participants to IGS99 of whom you may know they have not made a final decision yet about attending our next meeting in Singapore: it promises to be most interesting conference.

World Scientific Publishing Company in Singapore has recently published several publications on automatic handwriting recognition. The titles and contents of these publications are specified in this BIGS issue.

The present BIGS also contains a summary of the recently completed PhD thesis by Stefan Jäger on the retrieval of dynamic information from static handwriting traces. Additionally, a summary is given of the results of a search for information on handwriting accessible on the Internet and the results of an electronic search for journal publications relevant to the IGS.

The IGS office has recently constructed an electronic archive of BIGS, which is accessible via the IGS homepage on Internet (see Further News in this issue).

Enclosed in the present BIGS mailing you will find the new, updated IGS Membership Directory. At present, the IGS has 111 members. Their addresses, telephone and fax numbers, and email addresses are summarised in the directory alongside abbreviated indications of the fields of interest of each member.

As usual, BIGS is completed with the updated conference agenda, the list of recent and forthcoming workshops and conferences relevant to the IGS. Finally, this issue contains the financial overview of the IGS for 1998.

Ruud Meulenbroek
Réjean Plamondon
Editors



Message from the President

Montreal, April 15th 1999

Dear IGS members,

In a few weeks from now, we will meet again, in Singapore this time. For most of us, it will be like a family gathering, brothers and sisters coming back from a long trip. This is one of the most exciting aspects of the IGS conferences: meeting with people, developing friendships all over the world, sharing our multidisciplinary interests.

Specialists from different fields, motor control, pattern recognition, education rehabilitation, forensic sciences, will take a break, away from their daily problems, to meet and exchange ideas about various aspects of one of the most stimulating research domains: handwriting.

Everything is ready for a successful conference. Graham Leedham and his team have been working very hard to make this happen. It is up to us now to materialize their dream and I do hope that most of us will attend the conference. Welcome to Singapore!

To conclude, I remind you of my announcement made in the former BIGS issue (BIGS, 12, 2, November 1998) that some board members will complete their term next June. Any IGS member who would like to be considered as a potential candidate for a three-year term, please send a short curriculum vitae to the IGS secretariat as soon as possible since we will proceed to the selection of some new Board Members in Singapore. If you cannot participate this time, but would like to nominate someone, please feel free to do so by sending us a short letter supporting your nominee.

Looking forward to meeting you in Singapore,

Best regards,

Réjean Plamondon
IGS President



IGS News Items

Publications Following the Eighth IGS Conference

Special double issue of Acta Psychologica following IGS '97

Recently the special double issue of Acta Psychologica (Vol. 100, 1-2) entitled *Neuromotor Control in Handwriting and Drawing* has been published. Gerard van Galen and Pietro Morasso, whom the IGS Board would like to thank for their time and effort they put into this project edited the volume. The volume resulted from IGS97, the 8th international conference of our Society, held in Genova, Italy. It forms the twelfth major publication of the IGS. For a complete list of major IGS publications, see the IGS homepage on Internet: www.socsci.kun.nl/psy/igs. The names of the authors and titles of the papers in Acta Psychologica, 100, were already specified in the previous BIGS issue (BIGS 12, 2, p. 25). IGS members who are interested in buying the volume are offered a 40% discount by the Publisher of Acta Psychologica, Elsevier Science Publishers B.V. They can contact the Publishers directly by following the instructions specified in the separate flyer enclosed in this BIGS mailing.

Special Issue of Intelligent Automation and Soft Computing

A special issue of the journal Intelligent Automation and Soft Computing, edited by Francesco Masulli, Réjean Plamondon and Anna-Maria Colla is now in the final stage of preparation. The issue will contain approximately six articles based on papers presented at IGS'97.

Journal of Forensic Document Examination

A separate section of the Journal of Forensic Document Examination (JFDE) is currently in preparation. The section will be devoted to three selected papers from IGS '97 under the editorship of Marvin Simner and Patricia Girourard. The titles and authors of these papers are: 'Intra-individual changes in handwriting features depending on handwriting velocity' by Petra Halder-Sinn and Karin Funsch, 'The automatic extraction of pseudodynamic information from static images of handwriting based on marked grayvalue segmentation' by Katrin Franke and Gerhard Grube, and 'The origin of class characteristics: An empirical investigation of a major principle in forensic document examination' by Marvin L. Simner. The publication of these papers in JFDE is anticipated soon.



IGS99 - The Ninth IGS Conference 1999

Conference site and accommodation

The ninth IGS conference will be held in Singapore, 28-30 June 1999. The conference site will be the York Hotel, 21 Mount Elizabeth, Singapore 228516, Tel: (65) 830-1127, Fax: (65) 732-1217, Email: yorkhtl@singnet.com.sg, Webpage: www.yorkhotel.com.sg. The York hotel is located centrally in Singapore near to the Orchard district and about 25 minutes by taxi from the airport. The daily room rates for delegates are as follows:

Superior : S\$125 nett (Single)
Superior : S\$135 nett (Twin)
Deluxe : S\$165 nett (Single)
Deluxe : S\$175 nett (Twin)
Breakfast : Included

Registration

Registration rates for the conference will be

Before 1st May 1999	
Member	S\$580
Non-member	S\$630
After 1st May 1999	
Member	S\$630
Non-member	S\$680

These rates include the conference package consisting of one copy of the bound conference proceedings and information pack, attendance at all conference sessions, lunch and refreshments on each of the three conference days, conference banquet and social programme.

Note that the current exchange rates are approximately US\$1.00 = S\$1.73; Sterling £1.00 = S\$2.78; AUS\$1.00 = S\$1.09; CAN\$1.00 = S\$1.15; Dutch Guilder NLG1.00 = S\$0.85; HK\$1.00 = S\$0.22; Yen ¥1000 = S\$14.30; Yuan1.00 = S\$0.21.

Booking forms for accommodation and registration for the conference have been posted to the authors of accepted papers. These forms and further information about accepted papers are also available on the conference web page <http://www.ntu.edu.sg/sas/events/igs99>. Further details such as the provisional programme will be posted on the conference web page and sent by regular mail to the authors soon. If you wish to receive more information about the conference or register for the conference please contact the conference organisers. (Address given below)



Programme

All aspects of the science and technology of handwriting and related graphic skills will be represented at the conference. The special theme of IGS99 will be: Written Oriental Languages. The following papers have been accepted for oral presentation at IGS99 (preliminary categorized):

Written Oriental Languages

- Indexing and retrieval of digitized Arabic scripts and calligraphy - Suliman Al-Hawamdeh and Abdus Sattar Chaudhry
- A range free skew detection technique for digitized Gurmukhi script documents - G.S. Lehal and Renu Dhir
- Recognition of handwritten Bengali characters: A novel multistage approach - A.F.R. Rahman and R. Rahman
- Handwritten Chinese character recognition through contextual vector quantization and hidden Markov models - Patrick Chan Khue Hiang and Sevki S Erdogan
- Segmentation of machine printed Gurmukhi script - A.K. Goyal, G.S. Lehal, S.S. Deol
- Design of Kanji definition language based on systematization of the stroke order - Kazuaki Maeda
- An off-line signature verification method based on a hidden Markov model using column images as features - Tomohiro Konda, Mitsu Yoshimura, Taizo Umezaki and Isao Yoshimura
- Emotional effects associated with writing of Chinese calligraphy on non-Chinese people - Mabel Yum, Henry S. R. Kao
- Effects of practising Chinese calligraphy on visual-spatial ability and pictorial memory in normal aged people - Henry S. R. Kao, Gao Ding-guo, Jenny Chiu
- Effects of physical and mental practice of Chinese calligraphy and viewing on visual-spatial ability and reaction Time - Henry S.R. Kao, Kenneth Leung, Grace Tam, Gao Ding-guo
- Calligraphic treatment of schizophrenic patients - Fan Zuo-shu, Henry S. R. Kao, Wang Yan-ling
- Distortion modeling of handwritten Oriental character - Patrick Chan Khue Hiang and Sevki Erdogan

Automatic Processing And Recognition

- Implementation of distributed handwriting with electronic white board - Dan Xiao and Eng Chong Tan
- Feature extraction for handwritten Chinese character recognition based on elastic meshing and directional decomposition techniques - Lianwen Jin and Gang Wei
- A new multiple expert framework for decision fusion - A.F.R. Rahman and M.C. Fairhurst
- New method of feature extraction based on fractal behaviour - Yu Tao, Yuan Y. Tang, Zhikui Chen
- Woodtree: a pen based editor of short texts - M. Ancona and D. Comes
- Contextual neural fusion for multiple handwritten character classifiers - Chan Khue Hiang, Sevki S. Erdogan
- Automatic signature verification: A report on a large-scale public experiment - Rejean Plamondon, Wacef Guerfali and Marc Lalonde
- Maximum likelihood segmentation for handwritten word recognition - A. Harvey B. Eastwood, A. Jennings
- A new menu system based on human motor control knowledge - Kimiyasu Kiyota and Hans-Leo Teulings
- Evolutionary learning for handwriting recognition: Performance evaluation - Claudio De Stefano, Antonio Della Cioppa and Angelo Marcelli



- NUSCAL - A Java-based tool for the analysis of on-line cursive script - Colin A. Higgins and Jochan Sauter
- Use of handwriting recognition features in handwriting identification - Venu Govindaraju, Sagur N. Srihari and Yong-Chul Shin
- Incremental training of neocognitron using neocognitron trainer - Geok See Ng and Harcharan Singh
- Handwriting slant detection using the Hough transform - Abhimanyu Poddar and Vijay Sagar

Motor Control

- Variability of pen-tip displacements and joint excursions in spatially and temporally constrained drawing - Ruud G. J. Meulenbroek, Chris F. Bouwhuisen, Arnold J. W. M. Thomassen and David A. Rosenbaum
- Graphics tablets as cursor control devices - James G. Phillips, Tom J. Triggs and Lisa G. McCormick
- Facilitation of writing by the non-dominant hand under bimanual conditions - Arnold J. W. M. Thomassen, Ruud G. J. Meulenbroek and Chris F. Bouwhuisen
- Nonspecific motor preparation during the foreperiod in a line-drawing task - C. Elisa Van Den Heuvel, Arend W. A. Van Gemmert and George E. Stelmach
- Muscles act as low-pass filters on neuromotor noise - Willem P. De Jong and Gerard P. Van Galen
- A three-dimensional motion tracking method in graphonomic research: Using rigid bodies and object-oriented programming - Chris F. Bouwhuisen and Ruud G. J. Meulenbroek

Development and Education

- Relationship between first-grade teachers' informal evaluations of childrens' printing and childrens' second grade performances in reading, spelling, and arithmetic - Marvin L. Simner
- A comparison of style characteristics in Canadian and Dutch cursive writing - Marvin L. Simner, Bouwien C. M. Smits-Engelsman
- The nature of dysgraphic handwriting in grade-1 children - Michelle R. Eidlitz and Marvin L. Simner
- Axial and pen grip pressure in the handwriting of children - Elspeth H. Froude and Douglas K. Rogers
- Influence of the lexical and syntactic structure of verbal numerals on the handwriting of Arabic numerals - Aliette Lochy, Xavier Seron and Pascal Zesiger
- Mirror writing in left- and right-handed subjects - Oliver Tucha, Steffen Aschenbrenner, Christian Smely and Klaus W. Lange
- Automatic analysis of the temporal structuring of children's drawings - Celine Remi, Mounir Amara, Pierre Courtellemont, Denis De Brucq and Daniel Mellier
- Development of handwriting as a domain of skilled performance - E. Adil-Japha and N. H. Freeman
- A letter model generator to assist in teaching handwriting - Salim Djeziri, Rejean Plamondon, Jean-Marc Robert

Disorders

- Tremor and its effect on handwriting performance under conditions of low and intermediate physical stress - Mitchell G. Longstaff and Richard A. Heath
- Hemodynamic parameter maps - Jagath C. Rajapakse
- Using handwriting to assess fine motor control in Alzheimer's dementia - Charles E. Wright, Patricia G. Lindemann and Malcolm C. Dick
- Methylphenidate-induced impairment of handwriting movements in hyperactive children - Oliver Tucha, Steffen Aschenbrenner, Christian Smely and Klaus W. Lange
- The effect of smokeless tobacco in joint coordination - Jose L. Contreras-Vidal, Felipe Vargas-Villamil, Hans L. Teulings and George E. Stelmach



- Effects of Alzheimer's disease on basic drawing processes - Charles E. Wright, Susie Hsieh and Malcolm C. Dick
- Is the planning of action more impaired in schizophrenic patients than in depressed patients? The effects of conflicting graphic production rules - Bea J. M. Jogems-Kosterman, Wouter Hulstijn, Jacques J. M. Van Hoof and Arnold J. W. M. Thomassen
- Parkinsonian patients reduce their stroke size in anticipation of increased programming load - Arend W. A. Van Gemmert, Hans-Leo Teulings and George E. Stelmach
- Signatures of persons with Parkinsonism and liver failure as comparison standards - Carl E. Anderson, M. Patricia Fisher

Forensics

- Detection of deception for forensic purposes using motor responses measured with OASIS - David Dick and Douglas Rogers
- Changes in simulated handwriting pressure: Can the forger capture the original writer's dynamics? - Jodi Sita and Doug Rogers
- A pilot study for validating forensic handwriting examiners 'Expertise': Signature examinations - Bryan Found, Jodi Sita and Doug Rogers
- Forged and altered computer documents - Bonnie L. Schwid
- Impact of speed and practice upon line quality and spatial correspondence during tracing and freehand signature reproduction - James G. Phillips, Soula Noutsis, Chris Hughes and Doug Rogers
- A prototype toolset for interactive questioned document examination - Ching Ping Lee and Graham Leedham

Special Volume

The IGS has recently come to an agreement with the journal **Pattern Recognition** to edit a Special Issue of selected papers from IGS99. Réjean Plamondon and Graham Leedham will act as editors of this volume.

Important dates

Camera-ready Papers Due from authors: **1st May 1999**
Conference: **28th-30th June 1999**

If you have any questions or suggestions on any aspect of IGS99 and related matters please do not hesitate to contact us:

Secretariat: igs99@ntu.edu.sg, Fax: +(65) 793 0997; Conference chair: asgleedham@ntu.edu.sg; or by post to the IGS99 Secretariat: Nanyang Technological University, Conference Management Centre, Administration Annex #04-06, Nanyang Avenue, Singapore 639798.

You might also like to visit our Web page, which is updated as soon as any new information is available, at: <http://www.ntu.edu.sg/sas/events/igs99>.

I do hope as many IGS members as possible will be able to join us for the conference and I look forward to welcoming you to Singapore.

Graham Leedham
IGS99 Conference chair



Publications

Special Issue of PAA on Document Image Analysis and Recognition

The Pattern Analysis and Applications (PAA) Journal (Springer-Verlag) will publish a special issue on the state-of-the-art of Document Image Analysis and Recognition (DIAR) systems in 1999. Optical Character Recognition and document image analysis have become very important areas of research. Advanced computer and communication technologies now offer better ways to store, retrieve, and distribute this information. Document Image Analysis and Recognition (DIAR) research provides the technology for automated systems extracting and organising information from paper based documents. Generally, these applications apply image processing and pattern recognition techniques. A document image may contain text, graphics, pictures, or a combination of these. Some commercial products are already available such as OCR systems for reading pages of machine printed text, but research is still required to improve their performance and the full range of real world variability in typography, image quality, and context. Performance evaluation of DIAR systems requires experimental design, a large train of test database, and sophisticated analysis of results. More information about the PAA Journal and the special issue on DIAR systems can be found on Internet at site: <http://www.dcs.exeter.ac.uk/paa> or by contacting Dr. Adnan Amin at the School of Computer Science and Engineering, University of South Wales, Sydney, NSW 2052, Australia, Tel: 61.9385.3973, Fax: 61.2.9385.5995, E-mail: amin@cse.unsw.edu.au.

Advances in Oriental Document Analysis

Seong-Wan Lee, Yuan Y Tang and Patrick S.P. Wang (Editors) (1999). *Advances in Oriental document analysis and recognition techniques*. Singapore: World Scientific Publ. Co.. Readership: Researchers and graduate students in computer science and electrical engineering. 268pp (approx.), Publication date: January 1999; ISBN 981-02-3744-8; Price: US\$58 / £41. Order by sending email to: sales@wspc.com.sg.

In recent years rapid progress has been made in computer processing of Oriental languages and the research developments in this area have resulted in tremendous changes in handwriting processing, printed Oriental character recognition, document analysis and recognition, automatic input methodologies for Oriental languages, etc.. Advances in computer processing of Oriental languages can also be seen in multimedia computing and the World Wide Web. Many of the results in those domains are presented in this book. Contents: Intriguing aspects of Oriental languages (C.Y. Suen et al.), The generation of riental characters: New perspectives for automatic handwriting processing (R. Plamondon et al.), A new synthesizing method for handwriting Korean scripts (D-H. Lee & H-G. Cho), Differentiating between Oriental and European scripts by statistical features (L. Lam et al.), Gray-scale nonlinear shape normalization method for handwritten Oriental character



recognition (S-Y. Kim & S-W. Lee), Distributed autonomous agents for Chinese document image segmentation (J. Liu & Y.Y. Tang), Ink matching of cursive Chinese handwritten annotations (D.P. Lopresti et al.), On-line handwritten Chinese character recognition directed by components with dynamic templates (X. Xiao & R. Dai), A reliability design methodology for Chinese character recognition (Y.S. Huang et al.), Typeface identification for printed Chinese characters (Y-H. Tseng et al.), A self-organizing hierarchical classifier for multi-lingual large-set Oriental character recognition (H-S. Park et al.), printed Chinese character similarity measurement using ring projection and distance transform (P.C. Yuen et al.), Segmentation and recognition of continuous handwriting Chinese text (C. Hong et al.), Network-based approach to Korean handwriting analysis (B-K. Sin & J.H. Kim), Comparison of feature performance and its application to feature combination in off-line handwritten Korean alphabet recognition (K. Seo et al.).

Advances in Handwriting Recognition

Seong-Whan Lee (Editor) (1999), *Advances in Handwriting Recognition*. Singapore: World Scientific Publ. Co.. Readership: Researchers and graduate students in computer science and electrical engineering. 600pp (approx.); Publication date: Summer 1999; ISBN 981-02-3715-4; Price: US\$108 / £75. Order by email to: sales@wspc.com.sg.

This volume in the series of Machine Perception and Artificial Intelligence (Vol. 34) contains selected key papers from the 6th International Workshop on Frontiers in Handwriting Recognition (IWFHR '98), held in Taejon, Korea from 12 to 14, August 1998. Most of the papers have been expanded or extensively revised to include helpful discussions, suggestions or comments made during the workshop. Contents: Invariant recognition of hand-drawn pictograms using HMMs with a rotating feature extraction (S. Muller et al.), Towards a universal approach to background removal in images of bankchecks (K. Franke & M. Koeppen), Combining different classifiers and level of knowledge: A first step towards an adaptive recognition system (D. Ollivier et al.), Architecture for handwritten text recognition systems (G. Kim et al.), A method for the determination of features used in human reading of cursive handwriting (L. Schomaker & E. Segers), Global methods for stroke segmentation (S. Mori et al.), An advanced segmentation technique for cursive word recognition (G. Dimauro et al.), Diacritical processing using efficient accounting procedures (G. Seni & J. Seybold), Document understanding based on maximum a posteriori probability estimation (T. Akagi & H. Mizutani) and other papers.

State-of-the-art in Document Analysis

Hull, J.J. & Taylor, S.L. (Editors, 1999). *Document Analysis Systems II*. Singapore: World Scientific Publ. Co.. Readership: Computer scientists and researchers in artificial intelligence, image processing & computer vision and document image analysis. 540pp. Publication date: April 1998, ISBN 981-02-3103-2, Price: US\$86 / £60. Order by email to: sales@wspc.com.sg.



This book provides an overview of the state of the art in research and development of systems for document image analysis. Topics covered include a variety of systems and architectures for processing document images as well as methods for converting those images into formats that can be manipulated by a computer. The chapters are written by recognized experts in the field and describe Systems and architectures, recognition techniques, graphics analysis, document image retrieval, and World Wide Web applications. Contents: Document de-blurring using maximum likelihood methods (T. Pavlidis), Language identification in complex, unoriented, and degraded document images (D-S. Lee et al.), Language-independent and segmentation-free techniques for optical character recognition (J. Makhoul et al.), Priming the recognizer (G. Nagy & Y.H.Xu), A multi-layer corroboration-based checked reader (G.F. Houle et al.), A system for copying oversize documents (J.F. Cullen), SPAM: A scientific paper access method (A.L. Spitz), Documents on the move: DA&IR-driven mail piece processing today and tomorrow (U. Miletzki), Evaluating the performance of techniques for the extraction of primitives from line drawings composed of horizontal and vertical lines (J.F. Arias et al.), Prediction of OCR accuracy using a neural network (J. Gonzalez et al.), DocBrowse: A system for textual and graphical querying on degraded document image data (M.Y. Jaisimha et al.), The development of a general framework for intelligent document image retrieval (D. Doermann et al.), Evaluating Japanese document recognition in the Internet/Intranet environment (T. Hong et al.), Document analysis and the World Wide Web (D. Lopresti & J. Zhou) and other papers.

PhD Thesis

Recovering Dynamic Information from Static, Handwritten Word Images¹ by Stefan Jäger

Interactive Systems Laboratories, University of Karlsruhe and Carnegie Mellon University, E-Mail: stefan.jaeger@ira.uka.de, Am Fasanen-garten 5, 76131, Karlsruhe, Germany. 126 pp. ISBN 3-923532-80-6. A Postscript version can be downloaded from the site: <http://isl.ira.uka.de/ISL.publications.html#phd>.

Researchers working in the field of handwriting recognition typically divide their research into two separate areas: off-line recognition and on-line recognition. Despite some similarities in preprocessing and recognizing, both areas have been tackled independently of each other and there are only a few approaches trying to combine both disciplines. There seems to be a gap between the off-line domain where handwritten symbols are represented as

¹ The work outlined in this abstract is part of a PhD thesis supported by the Daimler-Benz Research Center in Ulm, Germany. The on-line recognition experiments were carried out at the University of Karlsruhe.



images, e.g., binary or gray-scale images, and the on-line domain where handwritten data is captured by special hardware and stored as coordinates over time.

Postal mail sorting is a typical example of off-line recognition. Handwritten addresses on envelopes are automatically scanned, then processed in an Optical Character Recognition (OCR) system, and finally routed to the appropriate sorting bins according to the recognition results of the handwriting recognizer. The only input available to off-line recognizers in this domain are the static images of handwritten addresses. Any information about stroke order is lost. Off-line recognition rates vary with the size of the lexicon, the country, etc. However, it can be said that the state of the art for writer independent off-line recognition is around 95% for lexica containing a few hundred entries. Context information and redundancy can be utilized to increase recognition rates. For instance, the redundancy between city names and zip codes is exploited in postal automation.

A typical example of on-line recognition is Personal Digital Assistants (PDAs). These are small handheld computers accepting pen-based input and combining agenda, address book and telecommunication facilities. A PDA captures the dynamic information of handwritten symbols, which is not available in static off-line images, e.g., the position of the pen at a given time, the velocity of the pen, or the pressure on the writing surface. Dynamic information complicates recognition with variations that are not apparent in static images. For instance, the on-line strokes making up the capital letter "E" have no fixed order but their static image will look the same no matter which order has been chosen by the writer. Nevertheless, dynamic information provides important data that helps improving recognition accuracy. In general, on-line recognition rates are higher than off-line recognition rates and they are often based on larger dictionaries. Writer independent on-line recognition rates of 98% for lexica with 1000 entries have been reported.

One of the main goals of the work outlined in this thesis was to bridge the gap between on-line and off-line handwriting recognition. The underlying assumption was that on-line and off-line recognition could benefit from each other. Off-line data may help improving on-line recognition rates by providing global pictorial information and overcoming the dynamic variations in on-line data. Conversely, on-line data may provide additional information that can be exploited by off-line recognizers. A unified view of handwriting allows a single optimized algorithm to be applied to different applications. It may provide a deeper insight into aspects of human motor control and the motor process involved in the production of handwriting. Before we can get a unified view of handwriting recognition we have to provide methods that allow us to extract on-line information from off-line data and, vice versa, off-line information from on-line data. While it is not very difficult to derive off-line information from on-line data, extracting on-line information from off-line data is a lot more complicated. Off-line data can be easily computed from on-line data by painting pixels black along the trajectory describing the writing trace. Extracting on-line information from off-line information, however, is not trivial and only a few approaches with this goal have been reported up to now.



The approach presented here is a method for recovering the original trajectories from scanned, binary images. This method recovers a sequence of ordered on-line coordinates from an off-line image that corresponds to the original trajectory. An on-line recognizer can directly process these coordinates. The key assumption guiding the whole approach is that the human writing process is directly related to a global optimization process. In particular, it is assumed that the trajectory of a handwritten word corresponds to a path with the minimum energy or, in more general terms, to a path with the minimum cost. In the framework of this approach, costs are deviations from the straight writing line at certain points of the writing trace, e.g. at intersections of the writing trace. This is based on the assumption that writers tend to write smoothly (good continuity criterion). Consequently, a straight line has zero cost and deviations of 90° from the straight line represent the highest cost. To minimize the overall deviation and to find a path with the minimum deviation, recovering dynamic information from off-line images is formulated as a graph-theoretical problem based on the skeleton. The skeleton is a mathematical construct, a graph, comprising nodes and edges. It can be regarded as a mathematical abstraction of the written word coinciding in most areas with the centerline of the writing trace, where edges correspond to parts of strokes and nodes correspond to intersections or end points. The pictorial skeleton is transformed to an abstract graph-theoretical representation allowing us to apply graph-theoretical methods for finding the path with the minimum cost, which is supposed equivalent to the original on-line trajectory. In fact, recovering the original trajectory of an off-line word is reduced to the traveling salesman problem (TSP), which is a well-known problem in computer science. It describes the search for the shortest cycle that visits every node of a weighted, complete graph exactly once.

The graph-theoretical approach for recovering original trajectories as it is introduced here can be proved to be NP-complete. Informally, this means that this approach falls into a class of problems that have the same high complexity. Since all attempts of finding efficient polynomial algorithms for NP-complete problems have failed so far, the proof that a problem is NP-complete implies that no efficient algorithm is known for this problem according to the current state of the art. Further, because of the large number of unsuccessful attempts to find efficient methods for solving NP-complete problems it is nowadays believed that it is impossible to solve such problems in polynomial time. Nevertheless, recovering original trajectories by solving the TSP can be efficiently accomplished by splitting the word into subparts containing only a moderate number of nodes and edges (divide and conquer). In order to do so, one can specify two features that characterize splitting edges dividing an off-line word into independent subparts. The TSP can be independently solved for every subpart and the global solution can be put together by simply appending the trajectories of every subpart.

An advantage of this approach is the ability to recover trajectories that traverse an edge of the writing trace more than two times. Note that a simple length minimization could not take account of this possibility. One has to say, however, that writing traces that are composed of more than one intersecting stroke, e.g. a "t", are only approximated up to now. Nevertheless, this



approach bears the possibility to recover traces consisting of several intersecting strokes because it is fair to assume that motions between a pen-up and a pen-down, i.e. the pen tip has no contact with the writing surface, are also subject to minimizing deviations.

To evaluate the presented method, off-line images can be generated from genuine on-line data by simply connecting the on-line coordinates and painting the missing pixels black. These off-line images can be skeletonized in the same way as scanned images. This provides us with a test set containing skeletons with ordered edges corresponding to the original trajectories. The recovered trajectories can be compared to the original trajectories using the Levenshtein distance, or some refined version of it, which is the smallest number of operations (e.g., insertions or deletions of edges) necessary to transform a recovered trajectory into an original trajectory. The average Levenshtein distance measured in the evaluation is approximately 4 and is based on an average of about 17 edges per trajectory.

In another experiment, an existing on-line recognizer is trained and tested with recovered on-line trajectories extracted from addresses containing handwritten American City names. The on-line recognition rates based on the recovered on-line data reach the state of the art in postal automation in the early nineties (about 75% based on a dictionary containing a few hundred words). Hence, recovering dynamic information from static word images is not only of theoretical significance but also feasible and of practical importance.

From a theoretical point of view, it is remarkable that a handwritten pattern can be successfully recognized by solving the traveling salesman problem, a graph-theoretical problem. In discrete mathematics, it is a well-known fact that many graph-theoretical problems can be implemented by means of the same algebraic structure, which is called dioid. The solution to these problems can be derived by a repeated multiplication of a matrix by itself until a fixed point is reached. These problems include some of the processing steps for transforming skeletons into appropriate graph-theoretical representations before the TSP is finally solved, as mentioned above. For instance, the search for connected components or shortest paths and even the Viterbi algorithm, which is a main processing step in many handwriting recognizers, can be accomplished using dioids and a repeated multiplication until a fixed point is reached. This mechanism resembles basic cybernetic principles like recursion and feedback. Moreover, it is justified to say that linearity is a basic feature of this approach because the main processing steps can be solved by multiplying matrices. Even though the practical realization may differ, these theoretical features are basic characteristics of this approach.

In summary, recovering trajectories from handwritten off-line images is understood as a global optimization process that can be solved using graph-theoretical methods. In particular, the original trajectories are supposed equivalent to traveling salesman tours in graphs derived from skeletons in several processing steps. Basic theoretical features of this approach are recursion, feedback and linearity. This approach should be considered as a step towards a unified view of handwriting recognition combining on-line as well as off-line aspects.



Forthcoming thesis

Zhang, XiaoJun (February 1999). *User specific aspects of pen-based computer input for identity verification*. Thesis submitted for the Degree of Philosophy at The Australian National University. Supervisor: Dr. Iain Macleod.

Further News

BIGS Archive on IGS Homepage

The IGS office has recently constructed a generally accessible electronic archive of BIGS. The archive can be found in the BIGS entry at the bottom of the IGS homepage on the Internet. The first 22 BIGS Issues (11 Volumes, two issues per volume) can be downloaded as zipped files. Each zip-file contains image files (JPG format) and an HTML file which can be used to browse through BIGS means of a regular Web browser. The most recent BIGS volumes (Volume 12, Issues 1 and 2) consist of PDF files. These can be read by means of Adobe Acrobat reader. OCR specialists are invited to provide the IGS office with the BIGS volumes in errorless text format while preserving the correct layout. The IGS office repeats its announcement that as of January 1st, 1999, the IGS homepage on the Internet has been given a new address. The new address is:

<http://www.socsci.kun.nl/psy/igs>

On January 28th, 1999, a generally accessible visit counter was added to the IGS homepage. The counter shows that in the first four months of 1999 our homepage has been visited about 20 times per week.

Results from Search for Information on the Internet

Information which is relevant to IGS members and which can be accessed on World Wide Web Internet services is summarised in BIGS regularly. The aim is to provide IGS members who have access to WWW with addresses of interesting sites. IGS members who have no facilities to access WWW are updated through this summary. The present overview contains site addresses that resulted from a broad search for new information by using the keyword *handwriting*.

<http://www-poleia.lip6.fr/connex/hwr/>

This Web page provides information about Remus, a prototype for on-line user-independent connected handwriting word recognition. It has been jointly developed by the "Institut National des Télécommunication" and the "Laboratoire d'Informatique de Paris 6".



<http://www.paragraph.com/products/internetink/calligrapher/>

This page contains ParaGraph's NetCalif online handwriting recognition demo based on the CalliGrapher technology. To see the demo, select 'Try Recognition Online' when having accessed the website.

<http://www.draft.net/services/index.htm>

Computer Aided Drafting (CAD) is fast becoming the standard method of drawing production for architecture and building related companies in North America. DraftNet's array of interactive web design and CAD drafting services offer a dynamic solution for project development and management. Architects, engineers, landscape architects, interior designers, and contractors benefit from DraftNet's services. DraftNet is located in Boston, Massachusetts and offers services to business, organizations, and individuals in North America and Canada. DraftNet was developed in 1998. For more information about DraftNet you can send an email to draft@draft.net

<http://www.firstct.com/fv/oldhand.html>

Not only have our words and their meanings changed throughout the years, the way we form the letters have too. This webpage provides an on-line tutorial to decipher and put meaning into the symbols we see on documents or papers such as old Bible, census, courthouse, archive and Church records.

<http://www.cedar.buffalo.edu/Linguistics/>

This webpage refers to research focusing on the use of human language models in performing handwriting recognition. The research holds promises for pen-based human-computer communication, handwritten document recognition and use of language models in handwritten sentence and phrase recognition. Principal investigator: Rohini K. Srihari.

<http://wallstreet.colorado.edu/Napkin>

The Electronic Cocktail Napkin is a pen-based drawing environment written in Macintosh Common Lisp to support designing hand-drawn sketches and diagrams. The aim is to make it easy to make expressive drawings - as easy as pencil and paper - that can also be managed and interpreted by the program. The goals of the developers of the Electronic Cocktail Napkin are: (1) to support designers making hand drawn diagrams and sketches, (2) to support the management of drawings (notebooks, search, tracing), (3) to support interpretation of drawings in context of the design domain. Contact: Mark D. Gross, Environmental Design, College of Architecture and Planning, University of Colorado at Denver, Boulder, CO 80309, mdg@cs.colorado.edu; Ellen Yi-Luen Do, College of Architecture, Georgia Institute of Technology Atlanta, GA 30332, ellendo@cc.gatech.edu.

<http://www.research.ibm.com/handwriting/papers.html>

This website contains a selection of papers that were presented at international conferences by members from the IBM handwriting group. The abstracts of these papers can be read or the postscript version of some of the full papers can be retrieved. Six of these abstracts are given next.



Optimization of training texts for writer-dependent handwriting recognition John F. Pitrelli, Jayashree Subrahmonia, Michael P. Perrone and Krishna S. Nathan (1998). In this paper, we address the problem of determining the best training text for large-vocabulary, writer-dependent, unconstrained English handwriting recognition. Our goal is to achieve maximum recognition accuracy, while minimizing the duration and tedium of the user's task of writing training text. We explore recognition accuracy as a function of three dimensions of training text: length, choice of character-coverage criterion, and relative priority of keeping the text interesting vs. optimizing to the chosen character-coverage criterion. Our results show various advantages to using coverage criteria based on (1) balancing occurrences of character unigrams and (2) incorporating most-common bigrams.

Writer dependent recognition of on-line unconstrained handwriting by Jayashree Subrahmonia, Krishna Nathan and Michael P. Perrone (1996). In this paper, we present a framework for adapting a writer independent system to a user from samples of the user's writing. The writer independent system is modeled using hidden Markov models. Training for a writer involves recomputing the topology and parameters of the hidden Markov models using the writer's data. The framework uses the writer independent system to get an initial alignment of the writer's data.

Duration modeling results for an on-line handwriting recognizer by Andrew Senior, Jayashree Subrahmonia and Krishna Nathan (1996). This paper describes a series of experiments that have been conducted to investigate the effect of duration modeling in a hidden Markov model (HMM) based on-line handwriting recognition system. The issues discussed include parametric vs. non-parametric distributions to model duration, different methods for training transition probabilities and the effect of weighting on duration terms.

Initialization of Hidden Markov Models for unconstrained on-line handwriting recognition by Krishna Nathan, Andrew Senior and Jayashree Subrahmonia (1996). In a hidden Markov model system, the initialization of the model parameters is critical to the performance of the model after retraining. This paper proposes a number of new approaches to the problem of initialization, and demonstrates that a method of smooth alignment results in the best performance.

Parameter tying in writer dependent recognition of on-line handwriting by Krishna Nathan, Jayashree Subrahmonia and Michael P. Perrone (1996). In this paper, we describe experiments on a writer dependent large vocabulary (20,000) handwriting recognition system. The goal was to investigate the effects of different degrees of tying (and hence, of the number) of parameters on the error rate. The system recognizes cursive, printed or any combination thereof of script in $\{\em real\ time\}$ on small PC platforms. Baseline results for a writer independent system are also included. Since we are only interested in the shape models no language models were used. Error rates decrease by more than a factor of 2 when the system is augmented by a statistical bigram language model.



Real-time on-line unconstrained handwriting recognition using statistical methods by Krishna S. Nathan, Homayoon S. M. Beigi, Jayashree Subrahmonia, Gregory J. Clary and Hiroshi Maruyama (1995). We address the problem of automatic recognition of unconstrained handwritten text. Statistical methods, such as hidden Markov models (HMMs) have been used successfully for speech recognition and they have recently been applied to the problem of handwriting recognition as well. In this paper, we will discuss a general recognition system for large vocabulary, writer independent, unconstrained handwritten text. 'Unconstrained' implies that the user may write in any style e.g. printed, cursive or in any combination of styles. This is more representative of typical handwritten text where one seldom encounters purely printed or purely cursive forms. Furthermore, a key characteristic of the system described in this paper is that it performs recognition in real-time on 486 class PC platforms without the large amounts of memory required for traditional HMM based systems. We focus mainly on the writer independent task. Some initial writer dependent results are also reported. An error rate of 18.9% is achieved for a writer-independent 21,000-word vocabulary task in the absence of any language models.

<http://www.research.ibm.com/handwriting/>

Handwriting is a very natural medium for human computer interaction. Nearly everyone learns to use a pen at an early age, and continues to write every day for the rest of their life. The IBM Pen Technologies team at the Thomas J Watson Research Center has developed a writing tablet that allows users to write on paper and store their handwritten notes and drawings in their computers for later use. Software at the server allows the user to view, index, search and organize the handwritten information. Handwriting recognition software developed at Watson can, if needed, transform handwritten ink into text. The technology for the tablet has been licensed to A T Cross and is currently marketed in 2 forms factors. The product is called CrossPad. The CrossPad comes with the IBM Ink Manager software that contains IBM's state-of-the-art large-vocabulary unconstrained on-line handwriting recognition software. The software also has tools for adapting the recognizer for a individual's handwriting style, which results in a significant improvement in the recognition accuracy. The main technique used in handwriting recognition engine is that of hidden Markov models. A model is built for each character that needs to be recognized- typically all the keyboard symbols, though this varies from language to language. A model is trained by collecting statistics from a large number of examples of such letters contained in our handwriting database. This has been created by collecting samples of handwriting from a large number of people with a wide range of handwriting styles. Having created the models with these statistics, new words are recognized by comparing them with models for whole words, created by concatenating individual letter models.



<http://www.papassoc.com/>

This page contains the Fonix Handwriting Recognition Web site. Fonix corporation designs and develops solutions for mobile computing and communications featuring a world-class handwriting recognizer designed for the emerging personal communications market. Customers include PDA vendors, telecommunications equipment corporations and consumer electronics companies. For additional information about handwriting recognition or PenVoice integration, contact: Fonix corporation, 600 West Cummings Park, Woburn, MA 01801, Te: +01.781.935.5656, E-mail: papyrus@fonix.com

<http://www.me.cmu.edu/faculty1/stahovich/SketchIT/sketchit.html>

SketchIT is a computer program that can transform a rough sketch of a mechanical device into multiple new design alternatives. SketchIT is also described in two publications that can be downloaded. Contact: Thomas F. Stahovitch, CMU dept. of Mechanical Engineering, Pittsburgh, PA, Randall David and Howard Shrobe at MIT Artificial Intelligence Laboratory, Cambridge, MA.

<http://www.birmingham.ac.uk/english/bibliography/handwriting/hwbiblio/hwbiblio.htm>

This is a fully analysed and fully keyworded hypertext bibliography of books and articles in English on forensic handwriting analysis and related topics. It contains about 1,500 references that can be searched by using keywords.

<http://home.svm.nl/schoolmuseum/tentoon.htm>

The National Schoolmuseum in Rotterdam, The Netherlands, in collaboration with the Museum for the Book and the Scription Museum (in The Hague and Tilburg, respectively, both also in The Netherlands), have announced 1999 as The Year of Handwriting (see BIGS 12, 2. P. 32). Between March, 26th and October, 3rd, 1999, the National Schoolmuseum will organize an exhibition on the History and the Future of Handwriting. Information about the activities during the Year of Handwriting can be obtained by writing to the National Schoolmuseum, P.O. Box 21536, Nieuwemarkt 1A, 3011 HP, Rotterdam, The Netherlands. Tel: +31.10.4045. 425; Fax: +31.10.2331.801.



Recent publications

In this section of BIGS the bibliographical details of recent publications relevant to the IGS are reported. In addition to publications by IGS members that were reported to the IGS office, the results of searches in Psyclit and Medline are given that were directed at papers on handwriting and related graphic skills which were published during the six months prior to the distribution of BIGS. IGS members are invited to report the bibliographic details of their recent publications to the IGS office.

- Berninger, V., Abbott, R., Rogan, L., Reed, E., Abbott, S., Brooks, A., Vaughan, K., & Graham, S. (1998). Teaching spelling to children with specific learning disabilities: The mind's ear and eye beat the computer or pencil. *Learning Disability Quarterly*, 21(2), 106-122.
- Bezrukikh, M.M.(1998). Central mechanisms of regulation of voluntary movements in six ten-year-old children: Electrophysiological analysis of movement performance in right handed children. *Human Physiology*, 24(3), 287-293.
- Delazer, M., & Denes, G. (1998). Writing Arabic numerals in an agraphic patient. *Brain and Language*, 64(2), 257-266.
- Foulin, J-N. (1998). To what extent does pause location predict pause duration in adults' and children's writing? *Cahiers de Psychologie Cognitive (Current Psychology of Cognition)*, 17(3), 601-620.
- Koelman, J.H., Struys M.A., Ongerboer de Visser, B.W., & Speelman J.D. (1998). Writer's cramp treated with botulinum injections. *Nederlands Tijdschrift voor Geneeskunde*, 142(31), 1768-1771.
- Lam, L.C., Chiu, H.F., Ng, KO, Chan, C., Chan W.F., Li S.W., & Wong, M. (1998). Clock-face drawing, reading and setting tests in the screening of dementia in Chinese elderly adults. *Journal of Gerontology*, 53(6), 353-357.
- Lange-Kuettner, C. (1998). Pressure, velocity and time in speeded drawing of basic graphic patterns by young children. *Perceptual Motor Skills*, 86(3), 1299-1310.
- Mati, Z.H., Zafiropoulou, M., & Bonoti, F. (1998). Drawing performance in children with special learning difficulties. *Perceptual Motor Skills*, 87(2), 487-497.
- McFadden, T.U. (1998). The immediate effects of pictographic representation on children's narratives. *Child Language Teaching and Therapy*, 14(1), 51-67.
- Moriguchi, K., & Morikawa, Y. (1998). Time course analysis of the reverse Stroop effect in Japanese Kanji. *Perceptual Motor Skills*, 87(1), 163-174.
- Naka, M. (1998). Repeated writing facilitates children's memory for pseudocharacters and foreign letters. *Memory and Cognition*, 26(4), 804-809.
- Sada, Y. (1998). Effect of active rest by oral reading on a mirror drawing task. *Perceptual Motor Skills*, 87(2), 635-642.
- Sakihara, H. (1998). A developmental study of letter copying in preschool children: Evaluation from the viewpoint of segmentation/construction. *Japanese Journal of Educational Psychology*, 46(2), 212-220.
- Sandyk, R. (1998). Reversal of the bicycle drawing direction in Parkinson's disease by AC pulsed electromagnetic fields. *International Journal of Neuroscience*, 95, 255-269.
- Wallen, M., Bonney, M., & Lennox, L. (1998). "Interrater reliability of the Handwriting Speed Test": Correction. *Occupational Therapy Journal of Research*, 18(2), 137.
- Weintraub, N. & Graham, S. (1998). Writing legibly and quickly: A study of children's ability to adjust their handwriting to meet common classroom demands. *Learning Disabilities Research and Practice*, 13(3), 146-152.



IGS Membership

New IGS Members

Mr. Duayne J. **Dillon**, Business-Document Services, P.O.Box 488 Court Station, Martinez, CA 94553 USA. Tel.: (925) 228-9292, Fax: (925) 228-9292, E-mail: ddillongd@AOL.com (Field: fs).

Mr. Lajos **Farkas**, Research Laboratory, Barczy Gusztav College of Special Education, Bethlen G. ter 2, Budapest 1071, Hungary. Tel.: 36 1 342 1379, Fax: 36 1 343 0444, E-mail: lajos@voyager.bghs.hu (Fields: ep).

Ms. Vassilia **Hatzitaki**, Physical Education & Sports Science, Aristotelian University Matsi 41, 546 36 Thessaloniki, Greece. Tel.: +30 31 992218, Fax: +30 31 992246, E-mail: Vasol@phed.auth.gr (Fields: ed np sp).

Mr. Allan A.J. **Herkt**, Document Examination Section, New Zealand Police, Victoria Street, P.O. Box 693, Wellington 6003, New Zealand. Tel.: 64 4 496 3908, Fax: 64 4 496 3916, E-mail: n2.doc.exam@xtra.co.n2 (Fields: fs).

Mrs. Alette **Lochy**, Psychology-Neco Université catholique de Louvain, 10, Place du Cardinal Mercier, 1348 Louvain-La-Neuve, Belgium. Tel.: +32 10 47 89 26, Fax: +32 10 47 37 74, E-mail: Lochy@neco-vcl.ac.be (Fields: cgs ep np).

Prof. Jean-Pierre **Orliaguet**, LPE-CNRS, Université Pierre Mendès-France, 1251 Avenue Centrale, B.P. 47, 38040 Grenoble, France. Tel.: (33) (0)476825673, Fax: (33) (0)476827834, E-mail: jean-pierre.orliaguet@upmf-grenoble.fr (Fields: cgs ep np sp).

Mrs. Patricia **Poluha**, Communication Sc. and Disorders, University of Wisconsin, Milwaukee, P.O. Box 413, Milwaukee, Wisconsin 53201, USA. Tel.: (414) 229 6398, Fax: (414) 906 3952, E-mail: ppoluha@vwn.edw (Fields: ep).

IGS Membership Dues

The IGS office kindly reminds IGS members who have not already done so, to effectuate their membership dues for the current year (1999) by following the instructions specified on the colourful payment slip which was enclosed in the previous BIGS mailing (BIGS, 12, 2). Please note that reductions, which the IGS obtains with respect to, for example, publications following IGS conferences, only apply to paying members.



Recent Conferences

Conferences which have already been announced in a previous BIGS issue are summarised by means of a brief, marked (*) entry

Reconnaissance de Formes, Images et Documents

25 March, 1999: Site: l'ENST, amphi GRENAT, 46, rue Barrault, Paris 13^e. Topic: One-day symposium on document analysis and recognition organized by 'Groupe de Recherche en Communication Ecrite' (GRCE) to honor J-C Simon. Speakers: J.P. Cretez, J.C. Simon, B. Dorizzi, N. Gorski, E. Augustin, M. Gilloux, C. Faure and E. Leilonet. Chair: Guy Lorette (lorette@irisa.fr) and Eric Lecilonet (elc@enst.fr).

Forthcoming Conferences

Conferences which have already been announced in a previous BIGS issue are summarised by means of a brief, marked (*) entry.

IWTS'99: International Wireless and Telecommunications Symposium*

17-21 May, 1999. Site: ITM Resort and Convention Centre, Shah Alam in Malaysia. Topics: Transmission Technologies, Coding and Multiple Access Techniques, High Speed Networks, ATM and Optical Networks, Multimedia Networks and Systems, Information Technologies, Signal and Image Processing, Transportation Information and Control Systems, Advanced Telecommunications in Medicine, Telecommunication in Education. More information: Faculty of Information Science and Technology (FTSM), National University of Malaysia (UKM), Bangi 43600, Selangor, Malaysia.

VI'99: Vision Interface*

18-21 May, 1999. Site: Hotel Delta, Trois-Rivieres, Quebec, Canada. Topics: computer vision and quality control by artificial vision, image processing and pattern recognition. Information: Marc Parizeau, Universite Laval, Laboratoire de vision et systemes numeriques, Departement de Genie Electrique et de Genie Informatique, Universite Laval, Ste-Foy (PQ), Canada, G1K 7P4. Web site: www.dmi.usherb.ca/conferences/VI-99/.



QCAV'99: Quality Control by Artificial Vision*

18-21 May, 1999. Site: Hotel Delta, Trois-Rivieres, Quebec, Canada. Topics: Defect detection and characterization; Control by infrared and near infrared thermography; Image sensors; Illumination modeling; Real-time image processing software development; Methods; Segmentation; Pattern recognition; Texture analysis; Wavelet transform; Genetic algorithm; Data fusion; Mathematical morphology; Stochastic modeling. Information: Dr. S. Kohler, Laboratoire LE2I, IUT Le Creusot, 12, rue de la fonderie, 71200 Le Creusot, FRANCE, Phone: (+33) (-0) 385 73 10 96, Fax: (+33) (-0) 385 73 10 99, Email: s.kohler@iutlecreusot.u-bourgogne.fr. Web site: www.dmi.usherb.ca/conferences/QCAV-99/.

IIA'99 and SOCO'99: Third International ICSC Symposia*

1-4 June, 1999. Site: Palazzo Ducale di Genova, Italy. Announcements and Call for Papers have been mailed in May 1998. Information: ICSC International Computer Science Conventions, P.O. Box 279 - Millet, AB T0C 1Z0 – Canada. Tel: +1.403.387.3546 (after January 25, 1999: +1.780.387. 3546); Fax: +1.403.387.4329 (after January 25, 1999: +1.780.387.4329); E-mail: operating@icsc.ab.ca; Website: www.icsc.ab.ca; web sites: www.icsc.ab.ca/ia99.htm and www.icsc.ab.ca/soco99.htm.

CIMA'99: International ICSC Congress on Computational Intelligence*

22-25 June, 1999. Site: Rochester Institute of Technology, NY, USA. Topics: Fuzzy logic and applications (ISFL'99), Advances in Intelligent Data Analysis (AIDA'99), Soft Computing in Biomedicine (SCB'99), and Soft Computing in Financial Markets (SCFN'99). Information: ICSC International Computer Science Conventions, P.O. Box 279 - Millet, AB T0C 1Z0 – Canada. Tel: +1.780.387.3546); Fax: +1.780.387.4329); E-mail: operating@icsc.ab.ca; Website: www.icsc.ab.ca. Web-sites: www.icsc.ab.ca/cima99.htm.

Performance Evaluation Issues in Multilingual OCR*

19 September, 1999. Site: New technology center of Bangalore, India. Topics: evaluation of methodologies for multilingual OCR systems. Information: Tapas Kanungo, Center for Automation Research, University of Maryland, College Park, MD 20742, E-mail: mlocr@cfar.umd.edu. Web-site: www.cfar.umd.edu/~kanungo/workshop/mlocr.html.



Handwriting Recognition Tutorial

19 September, 1999. Site: New technology center of Bangalore, India. The series of International Workshops on Frontiers in Handwriting Recognition and the International Conference on Document Analysis and Recognition (ICDAR'99) together with some new journals and special issues are now fulfilling the expectation of many researchers who have been attracted to Handwriting Recognition and are involving many Academic Institutions and Industrial Companies. In order to inform researchers working in the field about the new trends and to facilitate the introduction of new researchers into the field giving them both theoretically and practically powerful tools, it was decided to organise some high level teaching schools and tutorials in Handwriting Recognition. The tutorial will be held by some of the most expert and active working researchers working in the field and is organised on behalf of the Program Committee of ICDAR-99. Speakers: S. Impedovo, A.C. Downton, S.W. Lee, P.S.P. Wang, G. Lorette, L. Schomaker, K. Sakai and J. Subahmonia. Contact: Prof. Sebastiano Impedovo, Dipartimento di Informatica, Università di Bari, Tel: int+80.5443278, Fax: int+80.5443142, E-mail: icdar99_tutor_hw@is.du.uniba.it Web-site: <http://is.di.uniba.it>.

ICDAR'99: Fifth International Conference on Document Analysis and Recognition*

20-22 September, 1999. Site: New technology center of Bangalore, India. Topics: Image Processing, Segmentation, Feature Extraction, Handwriting Recognition, Drawings & Gestures, Pen-based Interface, Signature Verification, Graphics Recognition, Vectorization, Analysis of Maps, Engineering Drawings Interpretation, Diagrams, Symbol Recognition, Forms and Bank-Check Reading, Postal Automation, Musical Score Recognition, World Wide Web Applications, Document Analysis Systems, Text Analysis and Recognition, Use of Linguistic Knowledge, Use of Domain-Specific Knowledge, Multilingual Text Understanding, Performance Characterization and Evaluation, Image Degradation Models, Benchmarking, Research Databases, Standardization. Information: Center of Excellence for Document Analysis and Recognition (CEDAR), State University of New York at Buffalo, UB Commons, 520 Lee Entrance, Suite 202, Amherst, NY 14228-2567 (USA), Tel: +1.716.645-6162, Fax: +1.716.645-6176, E-Mail: icdar99@cedar.buffalo.edu, Web-site: www.cedar.buffalo.edu/icdar99.

WMC'99: Second World Manufacturing Congress*

27-30 September, 1999. Site: University of Durham, United Kingdom. Information: Jeanny S. Ryffel - Planning Division, ICSC International Computer Science Conventions, P.O. Box 279 - Millet, AB T0C 1Z0 - Canada. Email: planning@icsc.ab.ca; Tel: +1.780.387.3546; Fax: +1.780.387.4329). Web-site: www.icsc.ab.ca/wmc99.htm.



IJCN99: International Joint Conference on Neural Networks*

10-16 July, 1999. Site: Washington. Topics: Applications of Neural Networks to solving technological problems such as handwritten/printed text recognition. Information: <http://www.cas.american.edu/~medsker/ijcnn99/cfp.html>.

From Basic Motor Control To Function Recovery*

22-26 September 1999. Site: Black Sea, near Varna (Albena or Golden sands) in Bulgaria. Topics: 'Concepts, Theories and Models – Present State and Perspectives', tries to link clinical and theoretical point of views in Motor Control. Information: Nikolai Gantchev, UPR Neurobiologie et Movements, CNRS, 31 Chemin Joseph-Aiguier, 13402 Marseille cedex 20 FRANCE, Tel: +33.4.91.16.41.00, Fax: +33.4.91.77.50.84; Email: gantchev@Inf.cnrs-mrs.fr.

The Association of Forensic Document Examiners Annual Continuing Education Symposium

4-7 November, 1999. Site: Ramada Valley Hotel, Phoenix, Arizona. Program: Dynamic Features of Disguised Handwriting [Arend Van Gemmert, Ph.D.]; Linguistic-Based Author Identification [Carole E. Chaski, Ph.D.]; Objective Measurements of Handwriting Workshop [John Gorajczyk, Document Examiner]; The Psychology of Stalking and Analyzing Threat Letters [Thomas N. Thomas, M.D., Forensic Psychiatrist]; Ink dating: Does recycled paper influence the outcome? [Everett Grondin, Document Examiner]; Microscopical Approaches to Line Sequencing Problems [Joe Barabe, Microscopist]; The "Hand" in Handwriting [Trisha A. Wills, M.D., Document Examiner]; Following a Paper Trail [Investigator, Chase Bank]; The Paper Chase: Fraud Within the University Community [Ray Barrera, Document Examiner]; Computer Fraud [Gail Thackery, J.D.]; Discussion of electronic communications and the Privacy Act [Gail Thackery, J.D.]; Signature Workshop [Bonnie Schwid, Document Examiner]; Check Washing Workshop [John Hsueh and Tracy Chaney Plummer, Document Examiners]. Symposium Site: Ramada Valley Ho Hotel. For information: Write: John Gorajczyk, 5432 E. Karen Dr., Scottsdale, AZ 85254, USA; phone: Trisha Wills, 417-255-1699 [USA] or e-mail to: vwillard@ameritech.net



Financial Overview IGS, 1998

1. Guilders account (NLG)

Credit

Balance on 01-01-98		NLG	13,559.07
Membership dues	1,902.63		
			1,902.63
Bank Interest			<u>33.45</u>
Total credit in guilders		NLG	15,495.15

Debit

BIGS cover and printing costs	1,314.33		
IGS office	776.00		
BIGS shipment (1996, 1997)	654.00		
Bank charges	273.13		
ISBN	11.75		
Chamber of Commerce	68.40		
Total expenses in guilders			<u>3,097.61</u>

Credit balance on 12-31-98 NLG 12,397.54

2. Dollars account (USD)

Credit

Balance on 01-01-98		USD	5,689.92
Membership dues	156.77		
			156.77
Bank interest			<u>32.19</u>
Total credit in USD		USD	5,878.79

Debit

Total expenses in dollars			<u>0.00</u>
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Credit balance on 12-31-98 USD 5,878.79

On 31st December 1998, the mean exchange rate was USD 1.00 = NLG 1.8895. This results in a total credit balance, per 31st December 1998, of NLG 12,397.54 plus 1.8895 x 5,878.79 = NLG 23,505.51, or equivalently 5,878.79 USD plus 1/ 1.8895 x 12,397.54 = USD 12,440.07.

Nijmegen, 15 April, 1999

Ruud Meulenbroek