

Preface

This edited volume contains refereed and improved versions of select papers that were presented at the third IAPR¹ Workshop on Graphics Recognition (GREC'99), held at Rambagh Palace in Jaipur, India, 26–27, September 1999. The workshop was organized by the TC10 (Technical Committee on Graphics Recognition) of the IAPR. Edited volumes from the previous two workshops in this series are also available as *Lecture Notes in Computer Science* (volumes 1072 and 1389).

Graphics recognition is the study of techniques for computer interpretation of images of line drawings and symbols. This includes methods such as vectorization, symbol recognition, and table and chart recognition for applications such as engineering drawings, schematics, logic drawings, maps, diagrams, and musical scores. Some recently developed techniques include graphics-based information or drawing retrieval and recognition of online graphical strokes. With the recent advances in the field, there is now a need to develop benchmarks for evaluating and comparing algorithms and systems. Graphics recognition is a growing field of interest in the broader document image recognition community.

The GREC'99 workshop was attended by fifty-five people from fifteen countries. The workshop program consisted of six technical sessions. Each session began with a half-hour invited talk which was followed by several short talks. Each session closed with a half-hour panel discussion where the authors fielded questions from the other participants. Several interesting new research directions were discussed at the workshop.

After the workshop, all the authors were invited to submit enhanced versions of their papers for this edited volume. The authors were encouraged to include ideas that came up during question–answer sessions or at other occasions during the workshop. Each paper was reviewed by two researchers in the field. At least one of the two reviewers was physically present at the workshop. And, at least one of the reviewers was on the program committee of the workshop. A subset of the revised papers was accepted for publication in this post-workshop proceedings volume.

The book is organized into six main topics reflecting the six sessions in the workshop. The part on *vectorization* begins with Tombre et al.'s thorough exposition on how to select a vectorization method, or a sub-step of a method, based on the stability and robustness criteria, while minimizing the number of parameters. Elliman describes a vectorization algorithm that he contrasts with Dori's sparse pixel vectorization (SPV) method. Both methods operate by finding the medial axis of a line and both try to identify junction regions that are problematic to vectorize. SPV finds the medial axis using sub-sampling; Elliman proposes using contours of a stroke (which he calls “crack following”) to find the medial axis. Adam et al. present a sequence of document recognition tech-

¹ The International Association for Pattern Recognition, <http://www.iapr.org>

niques applied to complex French telephonic network documents with the goal of separating the documents into information layers.

The part on *maps and geographic documents* begins with Watanabe's overview of the field. Den Hartog et al. describe a knowledge-based system for polygon classification in geographic vector data. Compared with a human operator, the system drastically cuts down on processing time while maintaining the same level of accuracy as a human. Interestingly, the types of errors made by the system differ from the types of errors a human operator makes. Adam and Dinstein propose compound-regulated morphological operations to better capture the geometrical structure in signals with application to maps and line drawings. The next two papers (by Kwon, Shimasaki and Watanabe) deal with the detection of houses and house blocks. The first attempts to find point houses in topographic maps. The next finds connective relationships among house blocks in house maps.

The third section focuses on *graphic document analysis*. It begins with Lopresti and Nagy's very interesting (tabular) discourse on tabular document recognition. Stückelberg and Doermann propose overcoming the limitations of sequential recognition and processing by using a model-based approach. Their probabilistic framework is motivated by the shortcomings of Kopec and Chou's document image decoding (DID) approach. Chhabra et al. present a client-server methodology for implementing graphics recognition systems in large organizations. This approach has several advantages over installation of stand-alone graphics recognition software and over X-windows-based LAN access to graphics recognition engines. Lahoti et al. propose a new and compact representation for block layouts in document images. Yamada and Watanabe present an application of graphics recognition to identify people in Japanese comic strips.

The topic of greatest interest at the workshop was *graphic symbol and shape recognition*. The overview by Cordella and Vento categorizes the techniques according to representation, description, and classification. Jiang et al. propose generalized median graphs for learning the representation of graphical symbols from examples. Velveny and Martí present a Bayesian framework for deformable matching of template representation of hand-drawn graphic symbols. Anquetil et al. propose a combination of radial basis function networks, fuzzy clustering, and genetic algorithms for a classifier with a built-in notion of rejection. Cordella et al. present a skeleton-based shape decomposition technique. Ramel et al. use a structural graph as the image representation for recognizing hand-drawn chemical formulas. Adam et al. use a combination of Fourier–Mellin transform and other invariants for recognition of text in technical drawings. The remaining papers in this part cover emerging areas in graphics recognition. Two papers by Müller and Rigoll focus on graphics-based retrieval of drawings and images from image databases. Both of these problems are addressed using hidden Markov models. Jorge and Fonseca attempt to recognize geometric shapes interactively. They use temporal adjacency and global geometric properties of a multi-stroke hand-drawn geometric shape. The method has been illustrated well

for a small vocabulary of geometric shapes. The technique is suitable for personal digital assistants.

Interpretation of *engineering drawings and schematics* has long motivated the field of graphics recognition. Dov Dori used the object process methodology (OPM), a graphics-based visual formalism, for designing the machine drawing understanding system (MDUS). Here he describes the OPM formalism in detail. The other papers in this part (by Mukerjee et al., Cao et al., and Ritchings et al.) focus on drawing interpretation in different domains – 3-D reconstruction from 2-D mechanical drawings, interpretation of construction structure drawings, and analysis of scanned cable and associated diagrams.

And finally, Bob Haralick introduces the section on *performance evaluation* listing the key ingredient of evaluation for document recognition applications; performance must be measured as a function of predefined categories of documents, noise perturbation parameters, internal algorithm tuning parameters, sampling variations, and the specification of the algorithm. Chhabra and Phillips briefly present the edit cost index as a goal-directed way to evaluate the performance of vectorization systems. Wenyin et al. evaluate the MDUS system to empirically determine the edit cost in terms of time taken to correct the mistakes in vectorization. In the last paper, Wenyin et al. study the impact of the algorithm parameters on the performance of line segmentation using their SPV method.

As at the past workshops, a graphics recognition contest was planned for GREC'99. However, the contest could not be completed at the workshop. It was held after the workshop. The results will be reported in the proceedings of ICPR 2000².

We owe special thanks to the contributing authors and the reviewers. Thanks are also due to the session chairs who helped stimulate useful discussions at the workshop. Most of the post-workshop refinements that you see in the papers here are due to ideas that were generated during these discussions and due to the suggestions of the reviewers. We are grateful to Eugenia Smith of CEDAR, State University of New York (SUNY) at Buffalo, for handling the payment processing work related to the workshop. Thanks to Prof. Sargur Srihari of SUNY Buffalo for providing the services of Eugenia Smith and for allowing us to use an account at the University at Buffalo Foundation.

The next Graphics Recognition Workshop, GREC 2001³, will be held in Kingston, Ontario, Canada, in September 2001.

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² The IAPR International Conference on Pattern Recognition, Barcelona, Spain, September 2000

³ <http://www.cs.queensu.ca/grec2001/>

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