2000 15th International Conference on
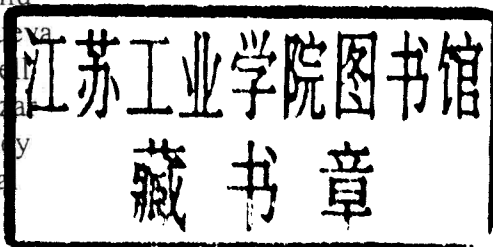Pattern Recognition
(V.4) (V.A)

Proceedings

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Volume 4
Applications, Robotics, Systems and Architectures

Editors

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Proceedings

15th International Conference on Pattern Recognition

ICPR-2000

Volume 4

Applications, Robotics, Systems and Architectures

Message from the ICPR2000 General Co-Chairs

Welcome to the 15th International Conference on Pattern Recognition and welcome to Barcelona!

Firstly, we would like to thank you all for participating in the ICPR2000. It has been an honour for us to have such a good reception. We never expected so many papers to be sent for submission. It has been a nice surprise.

We received 1438 papers and, we have finally accepted 973 (410 for Track 1; 251 for Track 2; 114 for Track 3; and, 198 for Track 4). From all those received we had to reject some very good papers for logistic reasons, and this large submission delayed the review process for different reasons. We therefore want to offer our apologies for all the changes we have made with the conference dates. We hope we have not caused too many inconveniences to the participants.

In this conference we have incorporated some new issues that we believe makes ICPR more attractive. As well as the combination of four parallel tracks of sessions with their respective Plenary Invited Speakers, we have included Invited Papers and Contests to increase the participation of the congress's people in this event. We have tried to put an Invited Paper for each oral session. We have specially invited 26 well known specialists in order for them to present the state of the art of a topic giving a personal review and outlook in a provocative, entertaining and meaningful way. We have also included several Contests to encourage the participation of research groups to solve specific issues.

We want to thank the help of many people. First of all the help of Edzard Gelsema Ex-president of IAPR, who's death surprised us during the organization of the Congress. We want to give special thanks to the Local Organization Co-Chairs, Maria Vanrell and René Alquézar for their dedication and devotion to ICPR2000, and to Mérida McCarthy for her administrative assistance. We would like to express our appreciation to all the referees for their excellent work and patience, specially considering the unexpected "avalanche" of papers. The work of the Track Chairs for their support at all times, and for maintaining the very high scientific quality of the conference, is also specially recognised. We also want to thank to members of the IAPR, the Centre de Visió per Computador, the Institut de Robòtica e Informàtica Industrial, the ESAII and the OTAC for their valuable help in the organization of the congress. Last but not least, we want to thank specially the collaboration in the organization of the Spanish Association for Pattern Recognition and Image Analysis (AERFAI), the Universitat Politècnica de Catalunya and the Universitat Autònoma de Barcelona.

We hope you all enjoy the conference and your stay in Barcelona!

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Alberto Sanfeliu
Juan José Villanueva
ICPR2000 General Co-Chairs

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Message from the Acting President of IAPR

It is my great pleasure to welcome you to the 15th International Conference on Pattern Recognition. This conference is the main event of the International Association for Pattern Recognition (IAPR). I hope you'll find it rewarding to attend the technical sessions, enjoy meeting colleagues and friends, and have some time for sightseeing in the beautiful city of Barcelona.

This ICPR is special for several reasons. First, it will be the last ICPR in this millenium. Secondly, it received the most papers ever submitted to an ICPR, and the organizers expect the largest number of people ever attending an ICPR. And thirdly, it marks 25 successful years of IAPR activities. Strictly speaking, IAPR was only founded at the 3rd International Conference on Pattern Recognition in Coronado, California, on November 8, 1976. But a sigificant portion of the work to set up the organization was actually done in the year 1975.

The large attendance to this conference is a clear indication of the growing importance of our field. But there are other indicators as well. Since the last ICPR held in Brisbane two years ago, the number of national member societies grew from 32 to 37, with New Zealand, Ireland, France, Turkey, and Cuba joining IAPR as new members. There seems to be even potential for a further increase in the number of member societies, particularly in South America and Africa. IAPR is a very active community. Looking at the previous issues of our Newsletter, I counted nearly 30 IAPR Workshops and Conferences held in 1999 and 2000, in addition to ICPR. All these developments and activities clearly show that our discipline is in very prosperous state.

The year 2000 brought us not only good news. It was with great sadness that we had to accept the deaths of IAPR President E. Gelsema and former IAPR President J.C. Simon. They are missed by all of us. We will remember them always as leading scientists, active promoters of IAPR, and fine individuals.

I would like to take this opportunity to express my appreciation to all our colleagues who were engaged in the organization of this conference, especially to the General Co-Chairs and the Track Co-Chairs. Furthermore, many thanks go to the organizers of various IAPR events and the chairs and members of various committees, particularly the Executive Committee.

It has been very enjoyable and rewarding for me to cooperate with them.

Horst Bunke
University of Bern
Bern, Switzerland
IAPR President

Message from the ICPR2000 Local Organizing Committee Co-Chairs

Welcome to Barcelona and thanks for participating in the 15th International Conference on Pattern Recognition. We thank all the participants and all the people who expressed their interest or will to participate but for any reasons have not finally come.

First of all, we want to thank the opportunity we have had of organizing this event. The organization of a conference like ICPR2000 has been a source of valuable experiences and has given the opportunity to collaborate with many people of our scientific community. Most of the organization has been done using a web-based software which has kept all the data updated and allowed all the people involved in the organization to share all the information at any time. Even though this has brought slight problems, it has been very useful, simplifying all the communications in general. From here, we want to encourage the future organizers to go further in digitalisation and electronic communication in all the stages of the conference organization including the final publication of all the papers.

Due to the large amount of submitted papers, the review process was especially difficult and we would like to thank all the referees for their kind contribution and for their patience, the non-digital shipping of papers introduced the most important delay in the organization. In this respect, we want to express our gratitude to all the track chairs, Yiannis Aloimonos, Jan-Olof Eklundh, Anil K. Jain, Josef Kittler, Tom Huang, Jean Serra, James Crowley and Yoshiaki Shirai, who have been ready to do at any moment all the tasks concerning the technical program. They are responsible of the high technical level of this conference. In this sense, we also want to specially thank to Joan Climent for preparing an excellent tutorial program.

We also appreciate the help of the IAPR Executive Committee, as well as Brian Lovell and Walter Kropatsch as main organizers of previous ICPR conferences, for their guidelines, comments and suggestions, and of Susan and Michael Duff in the dissemination of news regarding this event.

Obviously, this kind of events are not strictly organised by two people, we have always been supported by our colleagues from the Centre de Visió per Computadora of the UAB and the Institut de Robòtica i Informàtica Industrial of the UPC, from them we want to specially thank to Ernest Valveny, Josep Lladós, Albert Pujol, Ramon Baldrich and Xavier Roca.

Finally, we want to thank the help of many people who have taken responsibilities for different parts of the organization. In particular, to Mérida McCarthy for her excellent administrative support and willingness, Pere Quintana for the multiple organization tasks, Imma Valls and Joan Masoliver for their full time assistance on the computer programs and Ernest Estruga for his excellent designs. We also, want to thank to Tom Baldwin, Bob Werner and Lorretta Palagi of the IEEE CS Press for all the facilities in the publication process.

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Maria Vanrell
René Alquézar
ICPR2000 Local Organizing Co-Chairs

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Yiannis Aloimonos
Computer Vision Laboratory — Center for Automation Research
University of Maryland, USA

Jan-Olof Eklundh
Computer Science Department
KTH, Royal Institute of Technology, Sweden

Pattern Recognition and Neural Networks Chairs

Anil K. Jain
Computer Science & Engineering Department
Michigan State University, USA

Josef Kittler
Centre for Vision, Speech and Signal Processing
University of Surrey, United Kingdom

Image, Speech and Signal Processing Chairs

Thomas Huang
Beckman Institute
University of Illinois at Urbana-Champaign, USA

Jean Serra
Centre de Morphologie Mathématique
Ecole Supérieure des Mines de Paris, France

Applications, Robotics, Systems and Architectures Chairs

James Crowley
GRAVIR of the Institut IMAG
INRIA Rhône Alpes, France

Yoshiaki Shirai
Dept. of Computer-Controlled Mechanical Systems
Osaka University, Japan

Referees

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Ukraine: Ukrainian Association on Information Processing and Pattern Recognition — Professor T.K. Vintsiuk

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