

Sankar K. Pal
Sanghamitra Bandyopadhyay
Sambhunath Biswas (Eds.)

LNCS 3776

Pattern Recognition and Machine Intelligence

First International Conference, PReMI 2005
Kolkata, India, December 2005
Proceedings



Springer

TP18-53

P316
2005

Sankar K. Pal Sanghamitra Bandyopadhyay
Sambhunath Biswas (Eds.)

Pattern Recognition and Machine Intelligence

First International Conference, PReMI 2005
Kolkata, India, December 20-22, 2005
Proceedings



E200601366

 Springer

Volume Editors

Sankar K. Pal
Indian Statistical Institute
Kolkata 700 108, India
E-mail: sankar@isical.ac.in

Sanghamitra Bandyopadhyay
Sambhunath Biswas
Indian Statistical Institute, Machine Intelligence Unit
Kolkata 700 108, India
E-mail: {sanghami,sambhu}@isical.ac.in

Library of Congress Control Number: 2005937700

CR Subject Classification (1998): I.4, F.1, I.2, I.5, J.3, C.2.1, C.1.3

ISSN 0302-9743
ISBN-10 3-540-30506-8 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-30506-4 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media
springer.com

© Springer-Verlag Berlin Heidelberg 2005
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 11590316 06/3142 5 4 3 2 1 0

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Friedemann Mattern

ETH Zurich, Switzerland

John C. Mitchell

Stanford University, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

University of Dortmund, Germany

Madhu Sudan

Massachusetts Institute of Technology, MA, USA

Demetri Terzopoulos

New York University, NY, USA

Doug Tygar

University of California, Berkeley, CA, USA

Moshe Y. Vardi

Rice University, Houston, TX, USA

Gerhard Weikum

Max-Planck Institute of Computer Science, Saarbruecken, Germany

Lecture Notes in Computer Science

For information about Vols. 1–3737

please contact your bookseller or Springer

- Vol. 3837: K. Cho, P. Jacquet (Eds.), *Technologies for Advanced Heterogeneous Networks. IX*, 307 pages. 2005.
- Vol. 3835: G. Sutcliffe, A. Voronkov (Eds.), *Logic for Programming, Artificial Intelligence, and Reasoning. XIV*, 744 pages. 2005. (Subseries LNAI).
- Vol. 3833: K.-J. Li, C. Vangenot (Eds.), *Web and Wireless Geographical Information Systems. XI*, 309 pages. 2005.
- Vol. 3829: P. Pettersson, W. Yi (Eds.), *Formal Modeling and Analysis of Timed Systems. IX*, 305 pages. 2005.
- Vol. 3828: X. Deng, Y. Ye (Eds.), *Internet and Network Economics. XVII*, 1106 pages. 2005.
- Vol. 3826: B. Benatallah, F. Casati, P. Traverso (Eds.), *Service-Oriented Computing - ICSSOC 2005. XVIII*, 597 pages. 2005.
- Vol. 3824: L.T. Yang, M. Amamiya, Z. Liu, M. Guo, F.J. Rammig (Eds.), *Embedded and Ubiquitous Computing. XXIII*, 1204 pages. 2005.
- Vol. 3823: T. Enokido, L. Yan, B. Xiao, D. Kim, Y. Dai, L.T. Yang (Eds.), *Embedded and Ubiquitous Computing. XXXII*, 1317 pages. 2005.
- Vol. 3822: D. Feng, D. Lin, M. Yung (Eds.), *Information Security and Cryptology. XII*, 420 pages. 2005.
- Vol. 3821: R. Ramanujam, S. Sen (Eds.), *FSTTCS 2005: Foundations of Software Technology and Theoretical Computer Science. XIV*, 566 pages. 2005.
- Vol. 3820: L.T. Yang, X. Zhou, W. Zhao, Z. Wu, Y. Zhu, M. Lin (Eds.), *Embedded Software and Systems. XXVIII*, 779 pages. 2005.
- Vol. 3818: S. Grumbach, L. Sui, V. Vianu (Eds.), *Advances in Computer Science - ASIAN 2005. XIII*, 294 pages. 2005.
- Vol. 3815: E.A. Fox, E.J. Neuhold, P. Premssmit, V. Wu-wongse (Eds.), *Digital Libraries: Implementing Strategies and Sharing Experiences. XVII*, 529 pages. 2005.
- Vol. 3814: M. Maybury, O. Stock, W. Wahlster (Eds.), *Intelligent Technologies for Interactive Entertainment. XV*, 342 pages. 2005. (Subseries LNAI).
- Vol. 3810: Y.G. Desmedt, H. Wang, Y. Mu, Y. Li (Eds.), *Cryptography and Network Security. XI*, 349 pages. 2005.
- Vol. 3809: S. Zhang, R. Jarvis (Eds.), *AI 2005: Advances in Artificial Intelligence. XXVII*, 1344 pages. 2005. (Subseries LNAI).
- Vol. 3808: C. Bento, A. Cardoso, G. Dias (Eds.), *Progress in Artificial Intelligence. XVIII*, 704 pages. 2005. (Subseries LNAI).
- Vol. 3807: M. Dean, Y. Guo, W. Jun, R. Kaschek, S. Krishnaswamy, Z. Pan, Q.Z. Sheng (Eds.), *Web Information Systems Engineering - WISE 2005 Workshops. XV*, 275 pages. 2005.
- Vol. 3806: A.H. H. Ngu, M. Kitsuregawa, E.J. Neuhold, J.-Y. Chung, Q.Z. Sheng (Eds.), *Web Information Systems Engineering - WISE 2005. XXI*, 771 pages. 2005.
- Vol. 3805: G. Subsol (Ed.), *Virtual Storytelling. XII*, 289 pages. 2005.
- Vol. 3804: G. Bebis, R. Boyle, D. Koracin, B. Parvin (Eds.), *Advances in Visual Computing. XX*, 755 pages. 2005.
- Vol. 3803: S. Jajodia, C. Mazumdar (Eds.), *Information Systems Security. XI*, 342 pages. 2005.
- Vol. 3802: Y. Hao, J. Liu, Y. Wang, Y.-m. Cheung, H. Yin, L. Jiao, J. Ma, Y.-C. Jiao (Eds.), *Computational Intelligence and Security, Part II. XLII*, 1166 pages. 2005. (Subseries LNAI).
- Vol. 3801: Y. Hao, J. Liu, Y. Wang, Y.-m. Cheung, H. Yin, L. Jiao, J. Ma, Y.-C. Jiao (Eds.), *Computational Intelligence and Security, Part I. XLI*, 1122 pages. 2005. (Subseries LNAI).
- Vol. 3799: M. A. Rodríguez, I.F. Cruz, S. Levashkin, M.J. Egenhofer (Eds.), *GeoSpatial Semantics. X*, 259 pages. 2005.
- Vol. 3798: A. Dearle, S. Eisenbach (Eds.), *Component Deployment. X*, 197 pages. 2005.
- Vol. 3797: S. Maitra, C. E. V. Madhavan, R. Venkatesan (Eds.), *Progress in Cryptology - INDOCRYPT 2005. XIV*, 417 pages. 2005.
- Vol. 3796: N.P. Smart (Ed.), *Cryptography and Coding. XI*, 461 pages. 2005.
- Vol. 3795: H. Zhuge, G.C. Fox (Eds.), *Grid and Cooperative Computing - GCC 2005. XXI*, 1203 pages. 2005.
- Vol. 3794: X. Jia, J. Wu, Y. He (Eds.), *Mobile Ad-hoc and Sensor Networks. XX*, 1136 pages. 2005.
- Vol. 3793: T. Conte, N. Navarro, W.-m. W. Hwu, M. Valero, T. Ungerer (Eds.), *High Performance Embedded Architectures and Compilers. XIII*, 317 pages. 2005.
- Vol. 3792: I. Richardson, P. Abrahamsson, R. Messnarz (Eds.), *Software Process Improvement. VIII*, 215 pages. 2005.
- Vol. 3791: A. Adi, S. Stoutenburg, S. Tabet (Eds.), *Rules and Rule Markup Languages for the Semantic Web. X*, 225 pages. 2005.
- Vol. 3790: G. Alonso (Ed.), *Middleware 2005. XIII*, 443 pages. 2005.
- Vol. 3789: A. Gelbukh, Á. de Albornoz, H. Terashima-Marín (Eds.), *MICAI 2005: Advances in Artificial Intelligence. XXVI*, 1198 pages. 2005. (Subseries LNAI).
- Vol. 3788: B. Roy (Ed.), *Advances in Cryptology - ASIACRYPT 2005. XIV*, 703 pages. 2005.

- Vol. 3785: K.-K. Lau, R. Banach (Eds.), Formal Methods and Software Engineering. XIV, 496 pages. 2005.
- Vol. 3784: J. Tao, T. Tan, R.W. Picard (Eds.), Affective Computing and Intelligent Interaction. XIX, 1008 pages. 2005.
- Vol. 3783: S. Qing, W. Mao, J. Lopez, G. Wang (Eds.), Information and Communications Security. XIV, 492 pages. 2005.
- Vol. 3781: S.-Z. Li, Z. Sun, T. Tan, S. Pankanti, G. Chollet, D. Zhang (Eds.), Advances in Biometric Person Authentication. XI, 250 pages. 2005.
- Vol. 3780: K. Yi (Ed.), Programming Languages and Systems. XI, 435 pages. 2005.
- Vol. 3779: H. Jin, D. Reed, W. Jiang (Eds.), Network and Parallel Computing. XV, 513 pages. 2005.
- Vol. 3778: C. Atkinson, C. Bunse, H.-G. Gross, C. Peper (Eds.), Component-Based Software Development for Embedded Systems. VIII, 345 pages. 2005.
- Vol. 3777: O.B. Lupanov, O.M. Kasim-Zade, A.V. Chaskin, K. Steinhöfel (Eds.), Stochastic Algorithms: Foundations and Applications. VIII, 239 pages. 2005.
- Vol. 3776: S.K. Pal, S. Bandyopadhyay, S. Biswas (Eds.), Pattern Recognition and Machine Intelligence. XXIV, 808 pages. 2005.
- Vol. 3775: J. Schönwälder, J. Serrat (Eds.), Ambient Networks. XIII, 281 pages. 2005.
- Vol. 3774: G. Bierman, C. Koch (Eds.), Database Programming Languages. X, 295 pages. 2005.
- Vol. 3773: A. Sanfeliu, M.L. Cortés (Eds.), Progress in Pattern Recognition, Image Analysis and Applications. XX, 1094 pages. 2005.
- Vol. 3772: M. Consens, G. Navarro (Eds.), String Processing and Information Retrieval. XIV, 406 pages. 2005.
- Vol. 3771: J.M.T. Romijn, G.P. Smith, J. van de Pol (Eds.), Integrated Formal Methods. XI, 407 pages. 2005.
- Vol. 3770: J. Akoka, S.W. Liddle, I.-Y. Song, M. Bertolotto, I. Comyn-Wattiau, W.-J. van den Heuvel, M. Kolp, J. Trujillo, C. Kop, H.C. Mayr (Eds.), Perspectives in Conceptual Modeling. XXII, 476 pages. 2005.
- Vol. 3769: D.A. Bader, M. Parashar, V. Sridhar, V.K. Prasanna (Eds.), High Performance Computing – HiPC 2005. XXVIII, 550 pages. 2005.
- Vol. 3768: Y.-S. Ho, H.J. Kim (Eds.), Advances in Multimedia Information Processing - PCM 2005, Part II. XXVIII, 1088 pages. 2005.
- Vol. 3767: Y.-S. Ho, H.J. Kim (Eds.), Advances in Multimedia Information Processing - PCM 2005, Part I. XXVIII, 1022 pages. 2005.
- Vol. 3766: N. Sebe, M.S. Lew, T.S. Huang (Eds.), Computer Vision in Human-Computer Interaction. X, 231 pages. 2005.
- Vol. 3765: Y. Liu, T. Jiang, C. Zhang (Eds.), Computer Vision for Biomedical Image Applications. X, 563 pages. 2005.
- Vol. 3764: S. Tixeuil, T. Herman (Eds.), Self-Stabilizing Systems. VIII, 229 pages. 2005.
- Vol. 3762: R. Meersman, Z. Tari, P. Herrero (Eds.), On the Move to Meaningful Internet Systems 2005: OTM 2005 Workshops. XXXI, 1228 pages. 2005.
- Vol. 3761: R. Meersman, Z. Tari (Eds.), On the Move to Meaningful Internet Systems 2005: CoopIS, DOA, and ODBASE, Part II. XXVII, 653 pages. 2005.
- Vol. 3760: R. Meersman, Z. Tari (Eds.), On the Move to Meaningful Internet Systems 2005: CoopIS, DOA, and ODBASE, Part I. XXVII, 921 pages. 2005.
- Vol. 3759: G. Chen, Y. Pan, M. Guo, J. Lu (Eds.), Parallel and Distributed Processing and Applications - ISPA 2005 Workshops. XIII, 669 pages. 2005.
- Vol. 3758: Y. Pan, D.-x. Chen, M. Guo, J. Cao, J.J. Dongarra (Eds.), Parallel and Distributed Processing and Applications. XXIII, 1162 pages. 2005.
- Vol. 3757: A. Rangarajan, B. Vemuri, A.L. Yuille (Eds.), Energy Minimization Methods in Computer Vision and Pattern Recognition. XII, 666 pages. 2005.
- Vol. 3756: J. Cao, W. Nejdl, M. Xu (Eds.), Advanced Parallel Processing Technologies. XIV, 526 pages. 2005.
- Vol. 3754: J. Dalmau Royo, G. Hasegawa (Eds.), Management of Multimedia Networks and Services. XII, 384 pages. 2005.
- Vol. 3753: O.F. Olsen, L.M.J. Florack, A. Kuijper (Eds.), Deep Structure, Singularities, and Computer Vision. X, 259 pages. 2005.
- Vol. 3752: N. Paragios, O. Faugeras, T. Chan, C. Schnörr (Eds.), Variational, Geometric, and Level Set Methods in Computer Vision. XI, 369 pages. 2005.
- Vol. 3751: T. Magedanz, E.R. M. Madeira, P. Dini (Eds.), Operations and Management in IP-Based Networks. X, 213 pages. 2005.
- Vol. 3750: J.S. Duncan, G. Gerig (Eds.), Medical Image Computing and Computer-Assisted Intervention – MIC-CAI 2005, Part II. XL, 1018 pages. 2005.
- Vol. 3749: J.S. Duncan, G. Gerig (Eds.), Medical Image Computing and Computer-Assisted Intervention – MIC-CAI 2005, Part I. XXXIX, 942 pages. 2005.
- Vol. 3748: A. Hartman, D. Kreisiche (Eds.), Model Driven Architecture – Foundations and Applications. IX, 349 pages. 2005.
- Vol. 3747: C.A. Maziero, J.G. Silva, A.M.S. Andrade, F.M.d. Assis Silva (Eds.), Dependable Computing. XV, 267 pages. 2005.
- Vol. 3746: P. Bozanis, E.N. Houstis (Eds.), Advances in Informatics. XIX, 879 pages. 2005.
- Vol. 3745: J.L. Oliveira, V. Maojo, F. Martín-Sánchez, A.S. Pereira (Eds.), Biological and Medical Data Analysis. XII, 422 pages. 2005. (Subseries LNBI).
- Vol. 3744: T. Magedanz, A. Karmouch, S. Pierre, I. Venieris (Eds.), Mobility Aware Technologies and Applications. XIV, 418 pages. 2005.
- Vol. 3742: J. Akiyama, M. Kano, X. Tan (Eds.), Discrete and Computational Geometry. VIII, 213 pages. 2005.
- Vol. 3740: T. Srikanthan, J. Xue, C.-H. Chang (Eds.), Advances in Computer Systems Architecture. XVII, 833 pages. 2005.
- Vol. 3739: W. Fan, Z. Wu, J. Yang (Eds.), Advances in Web-Age Information Management. XXIV, 930 pages. 2005.
- Vol. 3738: V.R. Syrotiuk, E. Chávez (Eds.), Ad-Hoc, Mobile, and Wireless Networks. XI, 360 pages. 2005.

¥792.96元

Message from the General Chair

Pattern recognition and machine intelligence form a major area of research and developmental activity that encompasses the processing of multimedia information obtained from the interaction between science, technology and society. An important motivation for the spurt of activity in this field is the desire to design and make intelligent machines capable of performing certain tasks that we human beings do. Potential applications exist in forefront research areas like computational biology, data mining, Web mining, global positioning systems, medical imaging, forensic sciences, besides classical problems of optical character recognition, biometry, target recognition, face recognition, remotely sensed data analysis, and man-machine communication. There have been several conferences around the world in the past few decades individually in these two areas of pattern recognition and artificial intelligence, but hardly any combining the two, although both communities share similar objectives. Therefore holding this international conference covering these domains is very appropriate and timely, considering the recent needs of information technology, which is a key vehicle for the economic development of any country. The first integrated meeting of 2005, under this theme, was PReMI 2005.

The objective of this international meeting is to present state-of-the-art scientific results, encourage academic and industrial interaction, and to promote collaborative research and developmental activities, in pattern recognition, machine intelligence and related fields, involving scientists, engineers, professionals, researchers and students from India and abroad. The conference will be held every two years to make it an ideal platform for people to share their views and experiences in these areas. Particular emphasis in PReMI 2005 was placed on computational biology, data mining and knowledge discovery, soft computing, case-based reasoning, biometry, as well as various upcoming pattern recognition/image processing problems. There were tutorials, keynote talks and invited talks, delivered by speakers of international repute from both academia and industry. These were accompanied by interesting special sessions apart from the regular technical sessions.

It may be mentioned here that in India the activity on pattern recognition started in the 1960s, mainly in ISI, Calcutta, TIFR, Bombay and IISc, Bangalore. ISI, having a long tradition of conducting basic research in statistics/mathematics and related areas, has been able to develop profoundly activities in pattern recognition and machine learning in its different facets and dimensions with real-life applications. These activities have subsequently been consolidated under a few separate units in one division. As a mark of the significant achievements, special mention may be made of the DOE-sponsored KBCS Nodal Center of ISI founded in the 1980s and the Center for Soft Computing Research (CSCR) of ISI established in 2004 by the DST, Government of India.

CSCR, which is the first national center in the country in this domain, has many important objectives including distance learning, establishing linkage to premier institutes/industries, organizing specialized courses, as well as conducting fundamental research.

The conference proceedings of PReMI-05, containing rigorously reviewed papers, is published by Springer in its prestigious *Lecture Notes in Computer Science* (LNCS) series. Different professional sponsors and funding agencies (both national and international) came forward to support this event for its success. These include, International Association of Pattern Recognition (IAPR); Web Intelligence Consortium (WIC); Institute of Electrical and Electronics Engineering (IEEE); International Center for Pure and Applied Mathematics (CIMPA), France; Webel, Government of West Bengal IT Company; Department of Science & Technology (DST), India; Council of Scientific & Industrial Research (CSIR), India. To encourage participation of bright students and young researchers, some fellowships were provided.

I believe the participants found PReMI-05 an academically memorable and intellectually stimulating event. It enabled young researchers to interact and establish contacts with well-known experts in the field

I hope that you have all enjoyed staying in Calcutta (now Kolkata), the city of Joy.

September 2005

Sankar K. Pal, Kolkata
General Chair, PReMI-05
Director, Indian Statistical Institute

Preface

This volume contains the papers selected for the 1st International Conference on Pattern Recognition and Machine Intelligence (PReMI 2005), held in the Indian Statistical Institute Kolkata, India during December 18–22, 2005. The primary goal of the conference was to present the state-of-the-art scientific results, encourage academic and industrial interaction, and promote collaborative research and developmental activities in pattern recognition, machine intelligence and related fields, involving scientists, engineers, professionals, researchers and students from India and abroad. The conference will be held every two years to make it an ideal platform for people to share their views and experiences in these areas.

The conference had five keynote lectures, 16 invited talks and an evening talk, all by very eminent and distinguished researchers from around the world. The conference received around 250 submissions from 24 countries spanning six continents. Each paper was critically reviewed by two experts in the field, after which about 90 papers were accepted for oral and poster presentations. In addition, there were four special sessions organized by eminent researchers. Accepted papers were divided into 11 groups, although there could be some overlap.

We take this opportunity to express our gratitude to Professors A. K. Jain, R. Chellappa, D. W. Aha, A. Skowron and M. Zhang for accepting our invitation to be the keynote speakers in this conference. We thank Professors B. Bhattacharya, L. Bruzzone, A. Buller, S. K. Das, U. B. Desai, V. D. Gesu, M. Gokmen, J. Hendler, J. Liu, B. Lovell, J. K. Udupa, M. Zaki, D. Zhang and N. Zhong for accepting our invitation to present invited papers in this conference. Our special thanks are due to Professor J. K. Aggarwal for the acceptance of our invitation to deliver a special evening lecture. We also express our deep appreciation to Professors Dominik Ślęzak, Carlos Augusto Paiva da Silva Martins, P. Nagabhushan and Kalyanmoy Gupta for organizing interesting special sessions during the conference. We gratefully acknowledge Mr. Alfred Hofmann, Executive Editor, Computer Science Editorial, Springer, Heidelberg, Germany, for extending his co-operation for publication of the PReMI-05 proceedings. Finally, we would like to thank all the contributors for their enthusiastic response.

We hope that the conference was an enjoyable and academically fruitful meeting for all the participants.

September 2005

Sankar K. Pal
Sanghamitra Bandyopdhyay
Sambhunath Biswas
Editors

Organization

PReMI 2005 was organized by the Machine Intelligence Unit, Indian Statistical Institute (ISI) in Kolkata during December 18–22, 2005.

PReMI 2005 Conference Committee

General Chair:	Sankar K. Pal (ISI, Kolkata, India)
Program Chairs:	S. Mitra (ISI, Kolkata, India) S. Bandyopadhyay (ISI, Kolkata, India) W. Pedrycz (University of Alberta, Edmonton, Canada)
Organizing Chairs:	C. A. Murthy (ISI, Kolkata, India) R. K. De (ISI, Kolkata, India)
Tutorial Chair:	A. Ghosh (ISI, Kolkata, India)
Publication Chair:	S. Biswas (ISI, Kolkata, India)
Industrial Liaison:	M. K. Kundu (ISI, Kolkata, India) R. Roy (PWC, India)
International Liaison:	G. Chakraborty (Iwate Prefectural University, Takizawamura, Japan) J. Ghosh (University of Texas at Austin, USA)

Advisory Committee

A. K. Jain, USA
A. Kandel, USA
A. P. Mitra, India
A. Skowron, Poland
B. L. Deekshatulu, India
C. Y. Suen, Canada
D. Dutta Majumder, India
H. Bunke, Switzerland
H.-J. Zimmermann, Germany
J. Keller, USA
J. K. Ghosh, India
J. M. Zurada, USA
K. Kasturirangan, India
L. Kanal, USA
L. A. Zadeh, USA
M. G. K. Menon, India
M. Jambu, France
M. Vidyasagar, India

N. Balakrishnan, India
R. Chellappa, USA
R. A. Mashelkar, India
S. Prasad, India
S. I. Amari, Japan
T. S. Dillon, Australia
T. Yamakawa, Japan
V. S. Ramamurthy, India
Z. Pawlak, Poland

Program Committee

A. Pal, India
A. K. Majumdar, India
A. M. Alimi, Tunisia
B. B. Bhattacharyya, India
B. Chanda, India
B. Lovell, Australia
B. Yegnanarayana, India
D. Mukhopadhyay, India
D. Ślęzak, Canada
D. Zhang, Hong Kong, China
D. P. Mukherjee, India
D. W. Aha, USA
E. Diday, France
G. S. di Baja, Italy
H. Frigui, USA
H. Kargupta, USA
H. L. Larsen, Denmark
J. Basak, India
J. K. Udupa, USA
L. Bruzzone, Italy
L. Hall, USA
L. I. Kuncheva, UK
M. Banerjee, India
M. Nikraves, USA
M. N. Murty, India
N. Nasrabadi, USA
N. Zhong, Japan
O. Nasraoui, USA
O. Vikas, India
P. Chaudhuri, India
P. Mitra, India
R. Kothari, India
R. Setiono, Singapore

R. Krishnapuram, India
 R. Weber, Chile
 S. Bose, India
 S. B. Cho, Korea
 Santanu Chaudhuri, India
 Subhasis Chaudhuri, India
 S. Mukhopadhyay, India
 S. Sarawagi, India
 S. Ray, Australia
 S. Sinha, India
 S. K. Parui, India
 T. Heskes, Netherlands
 T. K. Ho, USA
 U. B. Desai, India
 V. D. Gesù, Italy
 Y. Hayashi, Japan
 Y. V. Venkatesh, Singapore
 Y. Y. Tang, Hong Kong, China

Reviewers

A. M. Alimi	D. Mukhopadhyay	K. Mali
A. Bagchi	D. P. Mukherjee	K. Polthier
A. Bhaduri	D. Ślęzak	K. S. Venkatesh
A. Bishnu	D. Zhang	L. Bruzzone
A. Biswas	E. Diday	L. Dey
A. Ghosh	F. R. B. Cruz	L. Hall
A. Konar	F. A. C. Gomide	L. I. Kuncheva
A. Laha	G. S. di Baja	L. V. Subramaniam
A. Lahiri	G. Chakraborty	L. E. Zarate
A. Liu	G. Gupta	M. Acharyya
A. K. Majumdar	G. Pedersen	Mahua Banerjee
A. Mukhopadhyay	G. Siegmon	Minakshi Banerjee
A. Negi	H. Frigui	M. Deodhar
A. Pal	H. Kargupta	M. Gehrke
B. B. Bhattacharyya	H. L. Larsen	M. K. Kundu
B. Chanda	J. Basak	M. Mandal
B. Lovell	J. Ghosh	M. Mitra
B. Raju	J. Mukhopadhyay	M. N. Murty
C. A. Murthy	J. K. Sing	M. Nasipuri
C. V. Jawahar	J. Sil	M. K. Pakhira
D. W. Aha	J. K. Udupa	M. P. Sriram
D. Chakraborty	Jayadeva	N. Das
D. M. Akbar Hussain	K. Kummamuru	N. Zhong

O. Nasraoui	S. Bandyopadhyay	S. K. Pal
P. Bhowmick	S. Biswas	S. K. Parui
P. Biswas	S. Bose	T. Acharya
P. Chaudhuri	Santanu Chaudhuri	T. A. Faruque
P. Dasgupta	Subhasis Chaudhuri	T. Heskes
P. Dutta	S. Datta	T. K. Ho
P. Guha	S. Ghosh	T. Pal
P. Mitra	S. Maitra	U. Bhattacharyya
P. P. Mohanta	S. Mitra	U. B. Desai
P. Nagabhushan	S. Mukhopadhyay	U. Garain
P. A. Vijaya	S. Mukherjee	U. Pal
Rajasekhar	S. Palit	V. S. Devi
R. Krishnapunam	S. Ray	V. D. Gesù
R. Setiono	S. Roychowdhury	V. A. Popov
R. Kothari	S. Sarawagi	V. V. Saradhi
R. Weber	S. Sandhya	W. Pedrycz
R. K. De	S. Sen	Y. Y. Tang
R. U. Udupa	S. Sinha	Y. Hayashi
R. M. Lotlikar	S. Sur-Kolay	Y. V. Venkatesh
R. H. C. Takashi	S. B. Cho	Y. Zhang
Sameena	S. K. Das	
S. Asharaf	S. K. Mitra	

Sponsoring Organizations

- Indian Statistical Institute (ISI), Kolkata
- Center for Soft Computing Research-A National Facility, ISI, Kolkata
- Department of Science and Technology, Government of India
- International Center for Pure and Applied Mathematics (CIMPA), France
- International Association for Pattern Recognition (IAPR)
- Web Intelligence Consortium (WIC), Japan
- Webel, Government of West Bengal IT Company, India
- Council of Scientific & Industrial Research (CSIR), Government of India
- Institute of Electrical and Electronics Engineers (IEEE), USA
- And others

Table of Contents

Keynote Papers

Data Clustering: A User's Dilemma <i>Anil K. Jain, Martin H.C. Law</i>	1
Pattern Recognition in Video <i>Rama Chellappa, Ashok Veeraraghavan, Gaurav Aggarwal</i>	11
Rough Sets in Perception-Based Computing <i>Andrzej Skowron</i>	21
Conversational Case-Based Reasoning <i>David W. Aha</i>	30
Computational Molecular Biology of Genome Expression and Regulation <i>Michael Q. Zhang</i>	31
Human Activity Recognition <i>J.K. Aggarwal</i>	39

Invited Papers

A Novel T ² -SVM for Partially Supervised Classification <i>Lorenzo Bruzzone, Mattia Marconcini</i>	40
S-Kernel: A New Symmetry Measure <i>Vito Di Gesù, Bertrand Zavidovique</i>	50
Geometric Decision Rules for Instance-Based Learning Problems <i>Binay Bhattacharya, Kaustav Mukherjee, Godfried Toussaint</i>	60
Building Brains for Robots: A Psychodynamic Approach <i>Andrzej Buller</i>	70
Designing Smart Environments: A Paradigm Based on Learning and Prediction <i>Sajal K. Das, Diane J. Cook</i>	80

Towards Generic Pattern Mining <i>Mohammed J. Zaki, Nilanjana De, Feng Gao, Nagender Parimi, Benjarath Phoophakdee, Joe Urban Vineet Chaoji, Mohammad Al Hasan, Saeed Salem</i>	91
Multi-aspect Data Analysis in Brain Informatics <i>Ning Zhong</i>	98
Small Object Detection and Tracking: Algorithm, Analysis and Application <i>U.B. Desai, S.N. Merchant, Mukesh Zaveri, G. Ajishna, Manoj Purohit, H.S. Phanish</i>	108
Illumination Invariant Face Alignment Using Multi-band Active Appearance Model <i>Fatih Kahraman, Muhittin Gökmen</i>	118
Globally Optimal 3D Image Reconstruction and Segmentation Via Energy Minimisation Techniques <i>Brian C. Lovell</i>	128
Go Digital, Go Fuzzy <i>Jayaram K. Udupa, George J. Grevera</i>	137
A Novel Personal Authentication System Using Palmprint Technology <i>David Zhang, Guangming Lu, Adams Wai-Kin Kong, Michael Wong</i>	147
World Wide Wisdom Web (W4) and Autonomy Oriented Computing (AOC): What, When, and How? <i>Jiming Liu</i>	157
Semantic Web Research Trends and Directions <i>Jennifer Golbeck, Bernardo Cuenca Grau, Christian Halaschek-Wiener, Aditya Kalyanpur, Bijan Parsia, Andrew Schain, Evren Sirin, James Hendler</i>	160

Contributory Papers

Clustering, Feature Selection and Learning

Feature Extraction for Nonlinear Classification <i>Anil Kumar Ghosh, Smarajit Bose</i>	170
--	-----

Anomaly Detection in a Multi-engine Aircraft <i>Dinkar Mylaraswamy</i>	176
Clustering Within Quantum Mechanical Framework <i>Güleser K. Demir</i>	182
Linear Penalization Support Vector Machines for Feature Selection <i>Jaime Miranda, Ricardo Montoya, Richard Weber</i>	188
Linear Regression for Dimensionality Reduction and Classification of Multi Dimensional Data <i>Lalitha Rangarajan, P. Nagabhushan</i>	193
A New Approach for High-Dimensional Unsupervised Learning: Applications to Image Restoration <i>Nizar Bouguila, Djemel Ziou</i>	200
Unsupervised Classification of Remote Sensing Data Using Graph Cut-Based Initialization <i>Mayank Tyagi, Ankit K Mehra, Subhasis Chaudhuri, Lorenzo Bruzzone</i>	206
Hybrid Hierarchical Learning from Dynamic Scenes <i>Prithwijit Guha, Pradeep Vaghela, Pabitra Mitra, K.S. Venkatesh, Amitabha Mukerjee</i>	212
Reference Extraction and Resolution for Legal Texts <i>Mercedes Martínez-González, Pablo de la Fuente, Dámaso-Javier Vicente</i>	218

Classification

Effective Intrusion Type Identification with Edit Distance for HMM-Based Anomaly Detection System <i>Ja-Min Koo, Sung-Bae Cho</i>	222
A Combined fBm and PPCA Based Signal Model for On-Line Recognition of PD Signal <i>Pradeep Kumar Shetty</i>	229
Handwritten Bangla Digit Recognition Using Classifier Combination Through DS Technique <i>Subhadip Basu, Ram Sarkar, Nibaran Das, Mahantapas Kundu, Mita Nasipuri, Dipak Kumar Basu</i>	236

Arrhythmia Classification Using Local Hölder Exponents and Support Vector Machine <i>Aniruddha Joshi, Rajshekhar, Sharat Chandran, Sanjay Phadke, V.K. Jayaraman, B.D. Kulkarni</i>	242
A Voltage Sag Pattern Classification Technique <i>Délio E.B. Fernandes, Mário Fabiano Alvaes, Pyramo Pires da Costa Jr.</i>	248
Face Recognition Using Topological Manifolds Learning <i>Cao Wenming, Lu Fei</i>	254
A Context-Sensitive Technique Based on Support Vector Machines for Image Classification <i>Francesca Bovolo, Lorenzo Bruzzone</i>	260
Face Recognition Technique Using Symbolic PCA Method <i>P.S. Hiremath, C.J. Prabhakar</i>	266
A Hybrid Approach to Speaker Recognition in Multi-speaker Environment <i>Jigish Trivedi, Anutosh Maitra, Suman K. Mitra</i>	272
Design of Hierarchical Classifier with Hybrid Architectures <i>M.N.S.S.K. Pavan Kumar, C.V. Jawahar</i>	276
Neural Networks and Applications	
Human-Computer Interaction System with Artificial Neural Network Using Motion Tracker and Data Glove <i>Cemil Oz, Ming C. Leu</i>	280
Recurrent Neural Approaches for Power Transformers Thermal Modeling <i>Michel Hell, Luiz Secco, Pyramo Costa Jr., Fernando Gomide</i>	287
Artificial Neural Network Engine: Parallel and Parameterized Architecture Implemented in FPGA <i>Milene Barbosa Carvalho, Alexandre Marques Amaral, Luiz Eduardo da Silva Ramos, Carlos Augusto Paiva da Silva Martins, Petr Ekel</i>	294
Neuronal Clustering of Brain fMRI Images <i>Nicolas Lachiche, Jean Hommet, Jerzy Korczak, Agnès Braud</i>	300