

## Preface

It is our great pleasure to welcome you to the *11th International Conference on Neural Information Processing* (ICONIP 2004) to be held in Calcutta. ICONIP 2004 is organized jointly by the Indian Statistical Institute (ISI) and Jadavpur University (JU). We are confident that ICONIP 2004, like the previous conferences in this series, will provide a forum for fruitful interaction and the exchange of ideas between the participants coming from all parts of the globe. ICONIP 2004 covers all major facets of computational intelligence, but, of course, with a primary emphasis on neural networks. We are sure that this meeting will be enjoyable academically and otherwise.

We are thankful to the track chairs and the reviewers for extending their support in various forms to make a sound technical program. Except for a few cases, where we could get only two review reports, each submitted paper was reviewed by at least three referees, and in some cases the revised versions were again checked by the referees. We had 470 submissions and it was not an easy task for us to select papers for a four-day conference. Because of the limited duration of the conference, based on the review reports we selected only about 40% of the contributed papers. Consequently, it is possible that some good papers are left out. We again express our sincere thanks to all referees for accomplishing a great job. In addition to 186 contributed papers, the proceedings includes two plenary presentations, four invited talks and 18 papers in four special sessions. The proceedings is organized into 26 coherent topical groups. We are proud to have a list of distinguished speakers including Profs. S. Amari, W.J. Freeman, N. Saitou, L. Chua, R. Eckmiller, E. Oja, and T. Yamakawa. We are happy to note that 27 different countries from all over the globe are represented by the authors, thereby making it a truly international event.

We are grateful to Prof. A.N. Basu, Vice-Chancellor, JU and Prof. K.B. Sinha, Director, ISI, who have taken special interest on many occasions to help the organizers in many ways and have supported us in making this conference a reality. Thanks are due to the Finance Chair, Prof. R. Bandyopadhyay, and the Tutorial Chair, Prof. B.B. Chaudhuri.

We want to express our sincere thanks to the members of the Advisory Committee for their timely suggestions and guidance. We sincerely acknowledge the wholehearted support provided by the members of the Organizing Committee. Special mention must be made of the organizing Co-chairs, Prof. D. Patranabis and Prof. J. Das for their initiative, cooperation, and leading roles in organizing the conference. The staff members of the Electronics and Communication Sciences Unit of ISI have done a great job and we express our thanks to them. We are also grateful to Mr. Subhasis Pal of the Computer and Statistical Services Center, ISI, for his continuous support. Things will remain incomplete unless we mention Mr. P.P. Mohanta, Mr. D. Chakraborty, Mr. D.K. Gayen and Mr. S.K. Shaw without whose help it would have been impossible for us to

make this conference a success. We must have missed many other colleagues and friends who have helped us in many ways; we express our sincere thanks to them also.

We gratefully acknowledge the financial support provided by different organizations, as listed below. Their support helped us greatly to hold this conference on this scale.

Last, but surely not the least, we express our sincere thanks to Mr. Alfred Hofmann and Ms. Ursula Barth of Springer for their excellent support in bringing out the proceedings on time.

November 2004

Nikhil R. Pal  
Nikola Kasabov  
Rajani K. Mudi  
Srimanta Pal  
Swapan K. Parui

## Funding Agencies

- Infosys Technologies Limited, India
- IBM India Research Lab, India
- Department of Science and Technology, Govt. of India
- Council of Scientific and Industrial Research, Govt. of India
- Reserve Bank of India
- Department of Biotechnology, Govt. of India
- Defence Research and Development Organization, Govt. of India
- Department of Higher Education, Govt. of West Bengal, India
- Jadavpur University, Calcutta, India
- Indian Statistical Institute, Calcutta, India

# **Organization**

## **Organizers**

Indian Statistical Institute, Calcutta, India  
Jadavpur University, Calcutta, India  
Computational Intelligence Society of India (CISI), India

## **Chief Patrons**

K.B. Sinha, Indian Statistical Institute, India  
A.N. Basu, Jadavpur University, India

## **Honorary Co-chairs**

S. Amari, Riken Brain Science Institute, Japan  
T. Kohonen, Neural Networks Research Centre, Finland

## **General Chair**

N.R. Pal, Indian Statistical Institute, India

## **Vice Co-chairs**

E. Oja, Helsinki University of Technology, Finland  
R. Krishnapuram, IBM India Research Lab, India

## **Program Chair**

N. Kasabov, University of Otago, New Zealand

## **Organizing Co-chairs**

D. Patranabis, Jadavpur University, India  
J. Das, Indian Statistical Institute, India

## **Joint Secretaries**

S.K. Parui, Indian Statistical Institute, India  
R.K. Mudi, Jadavpur University, India  
S. Pal, Indian Statistical Institute, India

## **Tutorials Chair**

B.B. Chaudhuri, Indian Statistical Institute, India

## **Finance Chair**

R. Bandyopadhyay, Jadavpur University, India

## **Technical Sponsors**

Asia Pasific Neural Network Assembly (APNNA)  
World Federation on Soft Computing (WFSC)

## Advisory Committee

- A. Atiya, Cairo University, Egypt  
Md.S. Bouhlel, National Engineering School of Sfax, Tunisia  
S. Chakraborty, Institute of Engineering and Management, India  
G. Coghill, University of Auckland, New Zealand  
A. Engelbrecht, University of Pretoria, South Africa  
D. Fogel, Natural Selection Inc., USA  
K. Fukushima, Tokyo University of Technology, Japan  
T. Gedeon, Australian National University, Australia  
L. Giles, NEC Research Institute, USA  
M. Gori, Università di Siena, Italy  
R. Hecht-Nielsen, University of California, USA  
W. Kanarkard, Ubonratchathani University, Thailand  
O. Kaynak, Bogazici University, Turkey  
S.V. Korobkova, Scientific Centre of Neurocomputers, Russia  
S.Y. Lee, Korea Advanced Institute of Science and Technology, Korea  
C.T. Lin, National Chiao-Tung University, Taiwan  
D.D. Majumder, Indian Statistical Institute, India  
M. Mitra, Jadavpur University, India  
D. Moitra, Infosys Technologies Limited, India  
L.M. Patnaik, Indian Institute of Science, India  
W. Pedrycz, University of Alberta, Canada  
S.B. Rao, Indian Statistical Institute, India  
V. Ravindranath, National Brain Research Centre, India  
J. Suykens, Katholieke Universiteit Leuven, Belgium  
A.R. Thakur, Jadavpur University, India  
S. Usui, Neuroinformatics Lab., RIKEN BSI, Japan  
L. Wang, Nanyang Technological University, Singapore  
L. Xu, Chinese University of Hong Kong, Hong Kong  
T. Yamakawa, Kyushu Institute of Technology, Japan  
Y.X. Zhong, University of Posts and Telecommunications, China  
J. Zurada, University of Louisville, USA

## Track Chairs

Quantum Computing	E. Behrman (USA)
Bayesian Computing	Z. Chan (New Zealand)
Bio-informatics	J.Y. Chang (Taiwan)
Support Vector Machines and Kernel Methods	V.S. Cherkassky (USA)
Biometrics	S.B. Cho (Korea)
Fuzzy, Neuro-fuzzy and Other Hybrid Systems	F.K. Chung (Hong Kong)
Time Series Prediction and Data Analysis	W. Duch (Poland)
Evolutionary Computation	T. Furuhashi (Japan)
Neuroinformatics	I. Hayashi (Japan)
Pattern Recognition	R. Kothari (India)
Control Systems	T.T. Lee (Taiwan)
Image Processing and Vision Robotics	M.T. Manry (USA)
Novel Neural Network Architectures	J.K. Mukherjee (India)
Brain Study Models	M. Palaniswami (Australia)
Brain-like Computing	V. Ravindranath (India)
Learning Algorithms	A. Roy (USA)
Cognitive Science	P.N. Suganthan (Singapore)
Speech and Signal Processing	R. Sun (USA)
Computational Neuro-science	H. Szu (USA)
Neural Network Hardware	S. Usui (Japan)
	T. Yamakawa (Japan)

## Organizing Committee

K. Banerjee	U. Garai	P. Pal
J. Basak	Karmeshu	S. Raha
U. Bhattacharya	R. Kothari	Baldev Raj
B.B. Bhattacharya	S. Kumar	K. Ray
B. Chanda	K. Madhanmohan	K.S. Ray
N. Chatterjee	K. Majumdar	B.K. Roy
B.N. Chatterji	A.K. Mandal	K.K. Shukla
B. Dam	M. Mitra	B.P. Sinha
A.K. De	D.P. Mukherjee	B. Yegnanarayana
K. Deb	K. Mukhopadhyay	
U.B. Desai	P.K. Nandi	
B.K. Dutta	U. Pal	

## Reviewers

S. Abe	V. Cherkassky	T.V. Geetha
A. Abraham	W. Cheung	A. Ghosh
M. Alcy	E. Cho	S. Ghosh
A.S. Al-Hegami	S. Cho	B.G. Gibson
N.M. Allinson	S.B. Cho	K. Gopalsamy
E. Alpaydin	K. Chokshi	K.D. Gopichand
L. Andrej	N. Chowdhury	R. Gore
A. Arsenio	A.A. Cohen	M. Grana
A. Atiya	R.F. Correa	L. Guan
M. Atsumi	S. Daming	C. Guang
M. Azim	J. Das	H. Guangbin
T. Balachander	N. Das	A. Hafez
J. Basak	C.A. David	M. Hagiwara
Y. Becerikli	A.K. Dey	M. Hattori
R. Begg	R. De	I. Hayashi
L. Behera	K. Deb	G. Heidemann
Y. Bengio	W.H. Delashmit	G.Z. Chi
U. Bhattacharya	G. Deng	S. Himavathi
C. Bhattacharyya	B. Dhara	P.S. Hiremath
A.K. Bhaumik	G. Dimitris	A. Hirose
A. Biem	M. Dong	L. Hongtao
Z. Bingul	Y. Dong	C.-H. Hsieh
S. Biswas	T. Downs	W.-Hsu
S.N. Biswas	K. Doya	B. Huang
M. Blumenstein	W. Duch	H.-D. Huang
S. Buchala	A. Dutta	Y.K. Hui
A. Canuto	D.P.W. Ellis	M.F. Hussin
A.C. Carcamo	M. Er	S. Ikeda
F.A.T. Carvaho	P. E'rdi	T. Inoue
K.-M. Cha	M. Ertunc	H. Ishibuchi
D. Chakraborty	A. Esposito	P. Jaganathan
Debrup Chakraborty	E.C. Eugene	M. Jalilian
S. Chakraborty	X. Fan	M. Jalili-Kharajoo
U. Chakraborty	Z.-G. Fan	G. Ji
C.-H. Chan	O. Farooq	X. Jiang
B. Chanda	S. Franklin	L. Jinyan
H. Chandrasekaran	M. Fukui	T. Kalyani
K. Chang	T. Furuhashi	T. Kambara
B.N. Chatterjee	M. Gabrea	C.-Y. Kao
B.B. Chaudhuri	M. Gallagher	K. Karim
H.-H. Chen	U. Garain	N. Kasabov
J. Chen	A. Garcez	U. Kaymak
K. Chen	S.S. Ge	O. Kaynak
T.K. Chen	T. Gedeon	S.S. Khan

J.Y. Ki	C.K. Luk	G.A.V. Pai
J. Kim	P.-C. Lyu	N.R. Pal
J.-H. Kim	Y. Maeda	S. Pal
K. Kim	S. Maitra	U. Pal
K.B. Kim	S.P. Maity	S. Palit
H. Kita	K. Majumdar	R. Panchal
A. Koenig	M. Mak	J.-A. Park
M. Koppen	F.J. Maldonado	K.R. Park
K. Kotani	A.K. Mandal	S.K. Parui
R. Kothari	J. Mandziuk	M.S. Patel
R. Kozma	N. Mani	S.K. Patra
K. Krishna	D.H. Manjaiah	M. Perus
R. Krishnapuram	M. Matsugu	T.D. Pham
S.N. Kudoh	Y. Matsuyama	A.T.L. Phuan
C. Kuiyu	B. McKay	H. Pilevar
A. Kumar	O. Min	M. Premaratne
A.P. Kumar	M. Mitra	S. Puthusserypady
S. Kumar	S. Mitra	S. Qing
M.K. Kundu	B.M. Mohan	M. Rajeswari
Y. Kuroe	P.P. Mohanta	K.S. Rao
S. Kurogi	R.K. Mudi	F. Rashidi
J. Kwok	S. Mukherjea	M. Rashidi
H.Y. Kwon	A. Mukherjee	V. Ravindranath
J. Laaksonen	D.P. Mukherjee	B.K. Rout
S. LaConte	J.K. Mukherjee	A. Roy
A. Laha	K. Mukhopadhyaya	P.K. Roy
D. Lai	A.K. Musla	R. Roy
S. Laine	W. Naeem	J. Ruiz-del-Solar
R. Langari	P. Nagabhushan	S. Saha
J.-H. Lee	H. Najafi	S. Saharia
K.J. Lee	T. Nakashima	A.D. Sahasrabudhe
V.C.S. Lee	P.K. Nanda	S. Sahin
J. Li	P. Narasimha	J.S. Sahmbi
P. Li	M. Nasipura	M. Sakalli
S. Lian	V.S. Nathan	A.R. Saravanan
C. Lihui	G.S. Ng	S.N. Sarbadhikari
C.-J. Lin	A. Nijholt	P. Sarkar
C.T. Lin	G.S. Nim	P.S. Sastry
C. Liu	D. Noelle	A. Savran
J. Liu	A. Ogawa	H. Sawai
P. Lokuge	E. Oja	A. Saxena
R. Lotlikar	H. Okamoto	C.C. Sekhar
M. Louwerse	P.R. Oliveira	A. Sharma
C.L. Lu	T. Omori	C. Shaw
T. Ludermir	Y. Oysal	B.H. Shekar

## XII Organization

P.K. Shetty	R. Tadeusiewicz	R.H.S. Wong
Z. Shi	P.K.S. Tam	K.-W. Wong (Kevin)
C.N. Shivaji	H. Tamaki	B. Xia
P. Shivakumara	C.Y. Tang	C. Yamaguchi
K.K. Shukla	E.K. Tang	Y. Yamaguchi
A.P. Silva Lins	P. Thompson	T. Yamakawa
M.J. Silva Valenca	K.-A. Toh	L. Yao
J.K. Sing	A. Torda	S. Yasui
R. Singh	V. Torra	Z. Yeh
S. Singh	D. Tran	D.C.S. Yeung
S. Sinha	J. Uchida	H. Yigit
M. Sirola	S. Usui	C.-G. Yoo
G. Sita	P. Vadakkepat	N.M. Young
K.R. Sivaramakrishnan	B. Valsa	C. Yu
J. Sjoberg	D. Ventura	M. Yunqian
K. Smith	A. Verma	C. Zanchettin
X. Song	B. Verma	Z. Zenn Bien
M.C.P. de Souto	J. Vesanto	B.-T. Zhang
A. Sowmya	E. Vijayakumar	D. Zhang
R. Srikanth	D. Wang	L. Zhang
B. Srinivasan	J. Wang	Q. Zhang
P.N. Suganthan	L. Wang	Y. Zhang
C. Sun	S. Wang	L. Zhiying
R. Sun	J. Watada	S. Zhong
E. Sung	O. Watanabe	D. Zhou
V. Suresh	J. Wei	H. Zujun
J. Suykens	A. Wichert	