The Ninth International Conference on Advances in Pattern Recognition

In celebration of the 125th Birth Anniversary of Professor Prasanta Chandra Mahalanobis

ICAPR 2017
December 27-30, 2017

Organized by

Electronics and Communication Sciences Unit
Indian Statistical Institute, Kolkata

R. C. Bose Centre for Cryptology and Security
Indian Statistical Institute, Kolkata

Systems Science and Informatics Unit
Indian Statistical Institute, Bangalore

Venue: Indian Statistical Institute, Bangalore
8th Mile, Mysore Road, RVCE Post, Bengaluru 560 059.

Email: icapr17@isical.ac.in
http://www.isical.ac.in/~icapr17
Welcome to the ninth International Conference on Advances in Pattern Recognition (ICAPR 2017) at the Indian Statistical Institute, Bangalore.

Indian Statistical Institute (ISI), the brain child of Late Professor Prasanta Chandra Mahalanobis, integrates a large number of disciplines in natural and mathematical sciences, social sciences, biological sciences, physical and earth sciences as well as computer and communication sciences so that active interaction between statistics as the key technology and all other sciences can take place under one umbrella. Since its inception, ISI has been playing a pioneering role in the development of computer science in India.

The institute developed the first indigenous electronic computer as early as in 1953, when the need for massive computational aids for research in Statistics was keenly felt. The first electronic digital computer in Asia, HEC 2M was installed here in ISI, Kolkata in 1956 followed by the installation of URAL 2 in 1958-59. The need for in-house maintenance of these computers led to the establishment of infra-structural facilities for research in digital circuits and computer hardware in the Institute. The first Indian Second Generation Digital Computer ISIJU-1 was built jointly by ISI and the Jadavpur University (JU) in 1966.

In 70s, the need to hold a conference in application areas of computer science was felt to promote interaction at the national level. The first conference in the series was held in 1976. Considering the growth of research activities in India in the area of pattern recognition, image analysis and digital techniques, it was felt in 1981 (the Golden Jubilee Year of the Institute) that an international conference might be held to provide a forum for exchange of thoughts between Indian scientists and those outside India. A series of this international conference was subsequently held in 1981, 1986, 1993, 1999, 2003, 2007, 2009, and 2015, and those conferences were extremely successful in this sense.

Over the years the scientists engaged in the field of Pattern Recognition, Machine Learning, Computer Vision, Image and Video Processing, Remote Sensing, Natural Language Processing and related topics have been attending this series of conferences. This year, the ninth edition of ICAPR celebrates the same spirit of innovation in these fields. In addition, the conference also commemorates the 125-th Birth Anniversary of Professor Mahalanobis, the founding father of ISI and includes a special session on his life and works.

We are thankful for the overwhelming response from the participants from different parts of the world. We also thank the program committee members and the reviewers for their help in reviewing the manuscripts in time. Finally, we are grateful to ISI for providing continuous encouragement and partial financial support to hold the event.

Bhabatosh Chanda
General Chair, ICAPR 2017
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<thead>
<tr>
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<tr>
<td>Abhirup Banerjee</td>
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VENUE OF ICAPR 2017

ISI Bangalore Campus

The Bangalore Centre of the Indian Statistical Institute was conceived by Prof. P. C. Mahalanobis during 1960s, even when the city was emerging as a centre of science. It is a tribute to his foresight that the Institute is now well-established in one of the most vibrant scientific communities in Asia.

With the Statistical Quality Control unit functioning in Bangalore from 1956, and Documentation Research and Training Centre from 1962, Professor Mahalanobis thought of starting a centre of ISI around the mid-sixties. The presence of several national institutes of higher learning, the salubrious climate and the growing metropolitan culture must have prompted him to consider this possibility. In 1966, Government of Karnataka granted ISI 30 acres of forest land full of eucalyptus trees, next to the upcoming Bangalore University on Mysore Road, at a token price.

However, Professor Mahalanobis did not live long enough to see the realization of his dream. It was left to Professor Kallianpur, the Director of ISI during 1976-78, to revive the idea, make concrete proposals to the Government of India and get grants for the development of the land already in possession of the Institute and the construction of an Academic Block with space for a library and offices. In the meantime, a building was rented on Church Street, in the heart of the city, and started the activities of the Bangalore Centre in September 1978. The Statistics and Mathematics Unit (SMU) was established. The Statistical Quality Control (SQC) Unit and Documentation Research and Training Centre (DRTC), which were functioning from other rented buildings at that time came to constitute the new Centre. The Economic Analysis Unit (EAU) was established.

With the completion of the construction of the Administrative Block, the various units moved to the new campus in May 1985. However, it was only in September 1996, the Bangalore Centre was formally declared as a Centre of ISI. With the increasing faculty strength, and computer and library facilities, the Bangalore Centre has by now become an institution well-known for its academic activities in Mathematics and Statistics, Statistical Quality Control and Operations Research, Library and Information Sciences, and Quantitative Economics. Systems Science and Informatics Unit (SSIU) was added in August 2009.

How to Get There

ISI is located about 50 km south west of the Kempegowda International airport and 12 km south-west of the Bangalore (officially known as Bengaluru) city railway station (also known as Krantivira Sangolli Rayanna railway station). It takes 1-2 hrs from the airport (depending on the time of the day) and about 30-45 minutes from the city railway station.

Popular Landmarks close to ISI

1. Bangalore University
2. RV College
3. There is a bus stop adjacent to the institute, which is popularly known as Jayram Das bus stop
Reaching the Institute:

If you are arriving by car/taxi then (going west) on Mysore road after crossing Bangalore University gate (about 300 meters onward), you will see a break in the middle median of the road. Turn right and pass the railway crossing. As soon as you pass the crossing you can follow the signs to the Institute main gate.

From Airport: As you come out of the baggage claim area, just outside the terminal you will find taxis run by Meru Cabs and Easy Cabs. You can specify your destination as near R.V. College/Bangalore University on Mysore Road. Then follow the above instruction to reach the Institute. The cabs are metered and the driver will give you a receipt for the fare paid.

App based taxis: OLA and UBER, among others have service in Bangalore and at airport as well. You may follow signs to their pick up points at the airport. There are air-conditioned buses as well. You should take the one to Vijayanagar Bus stand and then take a taxi/auto-rickshaw from there to the Institute.

From Bengaluru City station (Krantiwira Sangolli Rayanna railway station): As you come out of the station to your left are the Prepaid Auto and Taxi Stand. Across the station is the Majestic Bus stand and you can take bus no. 222A and it will drop you at Jayaram Das Bus stand (close to the institute).

Alternatively, you can also avail the Namma Metro, which has stops at Kempegowda busstop and also at Bengaluru City railway station. The fare is Rs.22/- (from Kempegowda/Majestic) and Rs.19/- from the city railway station to Mysore Road/Nayandahalli stop, which is the last stop in this direction. One should be careful to cross the Mysore Road and use the foot over bridge provided at the Metro station. From the Metro stop, one can easily take a bus/auto to ISI. Metro is operational from 6.00 AM to 10.00 PM.
**Venue of the Events**

**Registration Desk**  
Reception lobby, Platinum Jubilee Auditorium (PJA)

**Conference Inauguration**  
Platinum Jubilee Auditorium (PJA) (Hall A)

**Conference Venue**  
Hall A, Hall B, and Hall C

**Tutorial Venue**  
Hall A and Hall B

**Lunch**  
Reception lobby, Platinum Jubilee Auditorium (PJA)

**Welcome Dinner and Conference Dinner**  
Lawn, Hotel The Club,  
Mysore Road, Nayandahalli  
Bangalore - 560039, Karnataka, India
**Paper Presentation Details**

Audio Visual Equipment available includes Laptop (with USB port, HDMI) equipped with Windows OS, MS Power Point, VLC media player, PDF Viewer, and LCD Projector. All presentation sessions are oral.

**Instructions for Speakers**
Time allotted for each keynote talk is 60 minutes. The speaker is requested to finish the presentation within 55 minutes leaving 5 minutes for open discussion.
Time allotted for each contributed talk is 20 minutes. The speaker is requested to finish the presentation within 17 minutes leaving 3 minutes for open discussion.

**Instructions for Chairpersons**
Time allotted for each keynote talk is 60 minutes. The speaker should be requested to finish the presentation within 55 minutes leaving 5 minutes for open discussion.
Time allotted for each contributed talk is 20 minutes. The speaker should be requested to finish the presentation within 17 minutes leaving 3 minutes for open discussion.
Please note that there is no specific time slot for pre and post session moderation, which is certainly very important. Please apply your judgment to adjust/monitor this so that overall time limit for the session could be maintained.
Representative of the organizing committee will try to inform you about any change of schedule/non-availability of speakers for any particular session. In case of any difficulty the chairperson should communicate with any of the following persons:

Dilip Kumar Gayen: 94331 55474
Partha Pratim Mohanta: 9038000129

The chairperson may seek assistance of registration desk for contacting these persons.
# Program at a Glance

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<th><strong>December 27, 2017</strong></th>
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<td>08:30 - 9:30</td>
<td>Registration</td>
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<tr>
<td>09:30 - 11:00</td>
<td>Tutorial - I (By S. Srihari)</td>
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<tr>
<td>11:00 - 11:15</td>
<td>Tea Break</td>
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<tr>
<td>11:15 - 12:45</td>
<td>Tutorial - I (By S. Srihari)</td>
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<tr>
<td>12:45 - 14:00</td>
<td>Lunch</td>
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<tr>
<td>14:00 - 15:30</td>
<td>Tutorial - II (By S. Anand)</td>
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<td>15:30 - 15:45</td>
<td>Tea Break</td>
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<tr>
<td>15:45 - 17:15</td>
<td>Tutorial - II (By S. Anand)</td>
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<td>Tutorial - IV (By G. Chatterjee)</td>
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<td><strong>December 28, 2017</strong></td>
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<tr>
<td>08:00 - 09:00</td>
<td>Registration</td>
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<td>09:00 - 09:30</td>
<td>Inauguration</td>
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<td>09:30 - 10:30</td>
<td>Keynote - I (By R. M. Haralick)</td>
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<td>10:30 - 10:45</td>
<td>Tea Break</td>
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<tr>
<td>10:45 - 13:00</td>
<td>Image Processing – I</td>
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<td>Paper Ids: 17, 30, 44, 46, 47, 107</td>
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<td>Real World Applications – I</td>
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<td>Paper Ids: 128, 89, 96, 105, 110</td>
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<td>13:00 - 14:00</td>
<td>Lunch</td>
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<tr>
<td>14:00 - 15:00</td>
<td>Keynote - II (by S. Srihari)</td>
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<td>15:00 - 15:15</td>
<td>Tea Break</td>
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<td>15:15 - 17:30</td>
<td>Special Session on Big data</td>
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<td>Hand Writing Recognition</td>
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<td>Paper Ids: 74, 39, 133, 33, 19, 68</td>
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<td>Machine Learning – I</td>
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<td>Paper Ids: 132, 163, 160, 146, 135, 121</td>
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<td><strong>December 29, 2017</strong></td>
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<td>09:30 - 10:30</td>
<td>Keynote - III (by E. R. Hancock)</td>
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<td>10:30 - 10:45</td>
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<td>10:45 - 13:00</td>
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<td>13:00 - 14:00</td>
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<td>14:00 - 15:00</td>
<td>Keynote - IV (by L. Najman)</td>
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<td>15:15 - 17:30</td>
<td>Biometrics</td>
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<td>Video Analysis - I</td>
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<td>Paper Ids: 92, 27, 174, 106, 54, 180</td>
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<td>18:00 – 19:00</td>
<td>Cultural Programme</td>
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<td>19:00 – 22:00</td>
<td>Banquet Dinner</td>
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**December 30, 2017**

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>09:30 - 10:30</td>
<td>Special Session on the life and works of Prof. P. C. Mahalanobis</td>
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<td>10:30 - 10:45</td>
<td>Tea Break</td>
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<td>10:45 - 13:00</td>
<td>Voice and Speech Recognition</td>
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<td>Image Processing – III</td>
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<td>Paper Ids: 156, 61, 93, 50, 5, 57</td>
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<td>13:00 - 14:00</td>
<td>Lunch</td>
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<td>14:00 - 15:00</td>
<td>Machine Learning – III</td>
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<td>Paper Ids: 24, 15, 9, 81</td>
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<td>Robotics and Video Analysis</td>
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<td>Paper Ids: 25, 48, 120, 65, 143</td>
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<td>Social Network Analysis</td>
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<td>Paper Ids: 41, 75, 134</td>
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<td>15:15 - 15:30</td>
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<td>15:30 - 16:00</td>
<td>Valedictory</td>
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Subspace Classifiers

Schedule: 9.30 - 10.30, December 28, 2017, Hall A

Speaker: Robert M. Haralick

Speaker’s Affiliation: Graduate Center, City University of New York, USA.

Abstract: Subspace Classifiers were introduced by Bledsoe and Browning in their famous paper in 1959 on the N-tuple classifier. The technique was designed for specialized fast table lookup hardware. It involved projecting the feature vector to multiple randomly chosen subspaces each with a small enough dimension that the class conditional probabilities could be stored in a table. The class conditional subspace probabilities for a given measurement vector were combined, often by addition or multiplication to produce an assigned class for the measurement vector. Through the 1990’s many of the IBM products that had classifiers used N-tuple classifiers. Watanabe introduced the idea of associated a subspace for each class. It has come to be called the nearest subspace method. There have been many papers and variations since his 1969 paper. There are subspace classifier papers discussing methodology and some discussing application. We will make a brief survey of some of the more recent subspace classifiers such as random forest classifiers and ensemble classifiers. We discuss the relationship between them and classifiers based on graphical models. We will conclude with a conjecture that subspace classifiers constitute a group of universal approximators.

Speaker’s Biography: Haralick received a B.A. degree in mathematics from the University of Kansas in 1964, a B.S. degree in electrical engineering in 1966, and a M.S. degree in electrical engineering in 1967. In 1969, after completing his Ph.D. at the University of Kansas, he joined the faculty of the electrical engineering department, serving as professor from 1975 to 1978. In 1979 Haralick joined the electrical engineering department at Virginia Polytechnic Institute and State University, where he was a professor and director of the spatial data analysis laboratory. From 1984 to 1986 Haralick served as vice president of research at Machine Vision International, Ann Arbor, MI. Haralick occupied the Boeing Clairmont Egtvedt Professorship in the department of electrical engineering at the University of Washington from 1986 through 2000. At UW, Haralick was an adjunct professor in the computer science department and the bioengineering department. In 2000 Haralick accepted a Distinguished Professorship position at the computer science department of the Graduate Center, City University of New York. He is the recipient of K. S. Fu Prize of the IAPR in 2016 for contributions in image analysis including remote sensing, texture analysis, mathematical morphology, consistent labeling, and system performance evaluation.
Keynote - II

Generative Models in Deep Learning

Schedule: 14:00 - 15:00, December 28, 2017, Hall A

Speaker: Sargur Srihari

Speaker’s Affiliation: University at Buffalo, The State University of New York, USA.

Abstract: Although early approaches to statistical pattern recognition emphasized generative models (the “Bayes Classifier”, Naive Bayes Classifier, Hidden Markov Models) they proved to be less useful than discriminative models (logistic regression, nearest-neighbor, conditional random fields, neural networks). Probabilistic graphical models made a comeback for generative models by overcoming some computational issues (fewer parameters), but others remained (inference is #P complete). Deep Learning has created a resurgence of interest in generative models. Starting with the Restricted Boltzmann machine, spectacular results have been obtained with Variational Autoencoders and Generative Adversarial Networks. The talk will outline this progression of models and indicate some of our results with deep generative models.

Speaker’s Biography: Srihari received a B.Sc. in Physics and Mathematics from the Bangalore University (National College) in 1967, a B.E. in Electrical Communication Engineering from the Indian Institute of Science, Bangalore in 1970, and a Ph.D. in Computer and Information Science from the Ohio State University, Columbus in 1976.

With support from the United States Postal Service for over 20 years, he founded CEDAR, the Center of Excellence for Document Analysis and Recognition, in 1991, which had a major impact. His research led to: (i) the first large-scale handwritten address interpretation systems in the world (deployed by the IRS and USPS), (ii) post-Daubert court acceptance of handwriting testimony based on handwriting individuality assessment, (iii) a software system in use by forensic document examiners worldwide (iv) statistical characterization of uncertainty in impression evidence, and (v) first characterization of document image analysis as a sub-field of pattern recognition.

He has chaired committees of the International Association for Pattern Recognition. He is presently chairman of CedarTech, a corporation for university technology transfer. Srihari’s honors include: Outstanding Achievements Award of IAPR/ICDAR in Beijing China in 2011, Distinguished alumnus of the Ohio State University College of Engineering in 1999, Fellow of the International Association for Pattern Recognition in 1996, Life Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in 1995, and Fellow of the Institute of Electronics and Telecommunications Engineers (IETE, India) in 1992.

Srihari is an author of over 330 research papers and seven United States patents with over 15,000 citations. He has edited five books, and served as principal advisor to 37 doctoral students. He also played a leading role in establishing the International Conference on Document Analysis and Recognition, the International Conference on Frontiers in Handwriting Recognition, and the International Workshop on Computational Forensic.
Keynote - III

Recent Advances in Polarisation Vision

Schedule: 9:30 - 10:30, December 29, 2017, Hall A

Speaker: Edwin R Hancock

Speaker’s Affiliation: Department of Computer Science, University of York, UK.

Abstract: When unpolarised light is reflected from a diffusely reflecting dielectric surface, it acquires a spontaneous degree of polarisation. According to the Fresnel theory, the degree of diffuse polarisation is determined by the angle of incidence of the light and the refractive index of the dielectric. Thus, by measuring the polarisation for different angles of incidence at different locations on a surface, the estimation of shape and refractive index can be leveraged. The aim in this talk is to review the basic physics of polarisation vision, in natural and man-made vision systems, and to report recent results on the direct estimation of surface shape from multiple polarisation images.

Speaker’s Biography: Edwin R. Hancock holds a BSc degree in physics (1977), a PhD degree in high-energy physics (1981) and a D.Sc. degree (2008) from the University of Durham, and a doctorate Honoris Causa from the University of Alicante in 2015. In 1991, he joined the University of York as a lecturer in the Department of Computer Science, where he has held a chair in Computer Vision since 1998. His main research interests are in the use of optimization and probabilistic methods for high and intermediate level vision. He has published about 170 journal papers and 610 refereed conference publications. He was awarded the Pattern Recognition Society medal in 1991 and an outstanding paper award in 1997 by the journal Pattern Recognition. He has also received best paper prizes at CAIP 2001, ACCV 2002, ICPR 2006, BMVC 2007 and ICIAP in 2009 and 2015. In 2009 he was awarded a Royal Society Wolfson Research Merit Award. In 1998, he became a fellow of the International Association for Pattern Recognition. He is also a fellow of the Institute of Physics, the Institute of Engineering and Technology, and the British Computer Society. In 2016 he became a fellow of the IEEE and was named Distinguished Fellow by the British Machine Vision Association. He is currently Editor-in-Chief of the journal Pattern Recognition, and was founding Editor-in-Chief of IET Computer Vision from 2006 until 2012. He has also been a member of the editorial boards of the journals IEEE Transactions on Pattern Analysis and Machine Intelligence, Pattern Recognition, Computer Vision and Image Understanding, Image and Vision Computing, and the International Journal of Complex Networks. He has been Conference Chair for BMVC in 1994 and Programme Chair in 2016, Track Chair for ICPR in 2004 and 2016 and Area Chair at ECCV 2006 and CVPR in 2008 and 2014, and in 1997 established the EMMCVPR workshop series. He has been a Governing Board Member of the IAPR since 2006, and is currently Vice President of the Association.
KEYNOTE - IV

Recent Advances in Graph-based Mathematical Morphology

Schedule: 14:00 - 15:00, December 29, 2017, Hall A

Speaker: Laurent Najman

Speaker’s Affiliation: Laboratoire d’Informatique Gaspard Monge, ESIEE Universite Paris-Est, France.

Abstract: In this talk, we will present some recent advances of mathematical morphology on graphs. Graphs are generic data structures that have a long history in mathematics and have been applied in almost every scientific and engineering field, notably image analysis and computer vision. Because of their many interesting properties, a current trend is to develop the classical continuous tools from signal processing onto this kind of structures. The usefulness of graphs for mathematical morphology has long been recognized, and the same trend as in the signal processing community can be observed here. This talk will provide an overview of the advantages of graphs for mathematical morphology. In particular, we will present connective filtering, together with its close cousin, the watershed. Combining the two will lead us to hierarchical segmentation and filtering. We end up with some recent advances linking optimization and morphology, namely the power-watershed framework, with applications to segmentation and to spectral clustering.

Speaker’s Biography: Laurent Najman received the Habilitation à Diriger les Recherches in 2006 from the University of Marne-la-Vallée, a Ph.D. of applied mathematics from Paris-Dauphine University in 1994 with the highest honour (Félicitations du Jury) and an “Ingénieur” degree from the Ecole des Mines de Paris in 1991. After earning his engineering degree, he worked in the Central Research Laboratories of Thomson-CSF for three years, working on some problems of infrared image segmentation using mathematical morphology. He then joined a start-up company named Animation Science in 1995, as director of research and development. The technology of particle systems for computer graphics and scientific visualisation, developed by the company under his technical leadership received several awards, including the “European Information Technology Prize 1997” awarded by the European Commission (Esprit programme) and by the European Council for Applied Science and Engineering and the “Hottest Products of the Year 1996” awarded by the Computer Graphics World journal. In 1998, he joined OCÉ Print Logic Technologies, as senior scientist. He worked there on various problem of image analysis dedicated to scanning and printing. In 2002, he joined the Informatics Department of ESIEE, Paris, where he is professor and a member of the Laboratoire d’Informatique Gaspard Monge, Université Paris-Est Marne-la-Vallée. His current research interest is discrete mathematical morphology and discrete optimization.
TUTORIALS

Tutorial - I: Deep Learning

Schedule: 9:30 - 11:00 and 11.15 – 12.45, December 27, 2017, Hall A

Speaker: Sargur Srihari

Speaker’s Affiliation: University at Buffalo, The State University of New York

Abstract: The tutorial will be in two parts. The first part will be an overview of methods for achieving Artificial Intelligence today (known as deep learning), how they differ from methods of an earlier era, and principles of deep learning. The second part will describe methods of deep learning covering deep feed forward networks, regularization, optimization and performance-evaluation.

Speaker’s Biography: Please see under Keynote IV.

Tutorial - II: Visualizing Machine Learning

Schedule: 14:30 - 15:30 and 15.45 – 17.15, December 27, 2017, Hall A

Speaker: S. Anand

Speaker’s Affiliation: Gramener, Bangalore

Abstract: Machine learning algorithms are increasingly black-box models. However, their outputs are business data that humans need to understand and act upon. For example, if a clustering model suggests 4 customer clusters, how do we identify and characterize these? If a random forest model suggests a pattern of classification, how do we understand the dominant factors and the irrelevant ones? These topics fall under the umbrella of model visualisation -- where the inputs, process and output of machine learning models are the topic of understanding. This talk explores some of the prevalent ways of visualising machine learning models.

Speaker’s Biography: Anand is a co-founder of Gramener, a data science company. He leads a team of data enthusiasts with skills in analysis, design, programming and statistics. He studied at IIT Madras, IIM Bangalore and LBS, and worked at IBM, Infosys, Lehman Brothers and BCG. He and his team explore insights from data and communicate these as visual stories. These visual analyses and dashboards are built on the Gramener Visualisation Server.
**Tutorial - III: Non-iterative Methods for Time Series Forecasting**

**Schedule:** 14:30 - 15:30, December 27, 2017, Hall B

**Speaker:** Ponnuthurai Nagaratnam Suganthan

**Speaker’s Affiliation:** School of Electronics and Electrical Engineering, Nanyang Technological University, Singapore.

**Abstract:** In this talk, non-iterative learning methods such as kernel ridge regression, random vector functional link, random forest, their recent variants, ensemble variants, and related methods will be presented in detail. The non-iterative methods with closed form solutions have the potential to operate at high speed. Comparative studies with deep learning methods will also be included. Further, this presentation will also touch on classification problems too.

**Speaker’s Biography:** Ponnuthurai Nagaratnam Suganthan received the B.A degree, Postgraduate Certificate and M.A degree in Electrical and Information Engineering from the University of Cambridge, UK in 1990, 1992 and 1994, respectively. After completing his PhD research in 1995, he served as a pre-doctoral Research Assistant in the Dept of Electrical Engineering, University of Sydney in 1995-96 and a lecturer in the Dept of Computer Science and Electrical Engineering, University of Queensland in 1996-99. He moved to NTU in 1999. He is an Editorial Board Member of the Evolutionary Computation Journal, MIT Press. He is an associate editor of the IEEE Trans on Cybernetics (2012 - ), IEEE Trans on Evolutionary Computation (2005 -), Information Sciences (Elsevier) (2009 - ), Pattern Recognition (Elsevier) (2001 - ) and Int. J. of Swarm Intelligence Research (2009 - ) Journals. He is a founding co-editor-in-chief of Swarm and Evolutionary Computation (2010 - ), an SCI Indexed Elsevier Journal. His co-authored SaDE paper (published in April 2009) won the "IEEE Trans. on Evolutionary Computation outstanding paper award" in 2012. IEEE CIS Singapore Chapter won the best chapter award in Singapore in 2014 for its achievements in 2013 under his leadership. His research interests include swarm and evolutionary algorithms, pattern recognition, big data, deep learning and applications of swarm, evolutionary & machine learning algorithms. His publications have been well cited (Google Scholar Citations: ~26k). His SCI indexed publications attracted over 1000 SCI citations in each calendar years 2013, 2014, 2015, 2016 and 2017. He was selected as one of the highly cited researchers by Thomson Reuters in 2015, 2016, and 2017 in computer science, also known as the World’s Most Influential Scientists-2015. He served as the General Chair of the IEEE SSCI 2013. He has been a member of the IEEE (S’90, M’92, SM’00, F’15) since 1990 and an elected AdCom member of the IEEE Computational Intelligence Society (CIS) in 2014-2016.
**Tutorial - IV: Real world challenges in face recognition, ethical issues and lessons from Cognitive Science**

**Schedule:** 15:45 - 17:10, December 27, 2017, Hall B

**Speaker:** Garga Chatterjee

**Speaker’s Affiliation:** Indian Statistical Institute, Kolkata.

**Abstract:** In this two-part talk and tutorial, the issue of face recognition will be discussed, both from real world technology perspective as well as from the perspective of Cognitive Biology. The real world technology aspects will be discussed in the context of the specific problems which make face recognition just a difficult affair, especially with dynamic real-world faces. Thereafter, certain ethical issues that arise out of artificial face recognition technologies will be discussed. Finally, given the challenges of developing a robust face-recognition system artificially, a series of takeaways from empirical cognitive science research will be presented which would set the context for how the brain system accomplishes the task. Those lessons, hopefully, will have relevance to face recognition artificial system creators.

**Speaker’s Biography:** Dr. Garga Chatterjee graduated in Medicine (MBBS) from Medical College, University of Calcutta (1999-2005). He received his PhD from Harvard University (2006-2011) in the Cognition, Brain and Behavior track at the Vision Sciences Lab headed by Prof. Ken Nakayama. Thereafter, he did his post-doctoral training at the Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology at the lab of Prof. Pawan Sinha (2011-2014).
# Tutorial Sessions

**December 27, 2017**

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# Conference Sessions

**December 28, 2017**

## Keynote – I

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## Image Processing – I

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<td>Image Hash Minimization for Tamper Detection Subhajit Maity and Ram Kumar Karsh</td>
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## Real World Application – I

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Collaborative Filtering with Label Consistent Restricted Boltzmann Machine
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Generative Models in Deep Learning
S. Srihari

Special Session on Big Data
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Hand Writing Recognition
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Segmentation-free Word Spotting in Historical Bangla Handwritten Binarized Document
Sugata Das and Sekhar Mandal
ISIHWD: A Database for Off-line Handwritten Word Recognition and Writer Identification
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A Style Preserving Shape Representation Scheme for Handwritten Gesture Recognition
Chandra Sekhar and Viswanath Pulabaigari
Document Structure Analysis for Online Handwriting Recognition in Mobile Applications
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### Machine Learning - I  
**15:15 - 17:30, December 28, 2017**

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*Recent Advances in Polarisation Vision*  
E. Hancock
### Machine Learning – II  
**10:45 - 13:00, December 29, 2017**

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**Brain Computing**  
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**Venue**  Hall C  
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**Keynote – IV**  
14.00 - 15:00, December 29, 2017

**Venue**  Hall A  
**Chair**  B. S. Daya Sagar, ISI

*Recent Advances in Graph-based Mathematical Morphology*

L. Najman

**Biometrics**  
15:15 - 17:30, December 29, 2017

**Venue**  Hall A  
**Chair**  B. Yogameena, TCE

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<td>Srija Chowdhury and Jaya Sil</td>
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Muzzle Analysis for Biometric Identification of Pigs
Kannan Karthik, Shoubhik Chakraborty and Santanu Banik

Face recognition across pose for PTZ camera video surveillance applications
Komagal E, Yogameena B, Saravana Perumaal S, Menaka K and Nivethitha G

Face Spoofing Detection using Binary Gradient Orientation Pattern with Deep Neural Network
M Parisa Beham, S Md. Mansoor Roomi, H Jebina and M Kavitha

A Modular Approach For Facial Expression Recognition using HSOG
Sujata and Suman K Mitra

2.5D Palmprint Recognition using Signal level Fusion and Graph based Matching
Vijay Gangapure, Rahul Sarkar and Ananda S. Chowdhury

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Video Analysis – I  
15:15 - 17:30, December 29, 2017

Venue  Hall B  
Chair  Laurent Najman, UParis-Est

Violent/Non-Violent Video Classification based on Deep Neural Network
Sounak Mondal, Soumyajit Pal, Sanjoy Kumar Saha and Bhabatosh Chanda

An Ellipse Fitted Training-less Model for Pedestrian Detection
Arindam Sikdar and Ananda S. Chowdhury

Video Summarization using Hierarchical Shot Boundary Detection Approach
Sasithradevi Anbalagan, Mohamed Mansoor Roomi S, Maragatham G and Kousika G

Event Recognition in Unconstrained Video using Multi-Scale Deep Spatial Features
Saiyed Umer, Mrinmoy Ghorai and Partha Mohanta

Object Tracking based on Quantum Particle Swarm Optimization
Rajesh Misra and Kumar Sankar Ray

Training on region specific tagged images using traversing CNN embedded with morphological filters
Abhishek Biswas, Samudranil Saha and Pinaki Ghosh

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Cultural programme  
18:00 - 19:00, December 29, 2017

Banquet Dinner  
19:00 - 22:00, December 29, 2017
December 30, 2017

PCM Special Session  9:30 - 10:30, December 30, 2017
Venue  Hall A
Chair  Mohan Delampady, ISI

Speakers:
Anil K. Bera, University of Illinois at Urbana-Champaign, USA.
Probal Chaudhuri, ISI.
T. J. Rao, C. R. Rao, Advanced Institute of Mathematics, Statistics and
Computer Science (AIMSCS) University of Hyderabad Campus, India.

Voice and Speech Processing  10:45 - 13:00, December 30, 2017
Venue  Hall A
Chair  P. P. Mohanta, ISI

45  Novel Quality Metric for Duration Variability Compensation in Speaker Verification using
    i-Vectors
    Arnab Poddar, Md. Sahidullah and Goutam Saha

155  Vocal and Non-vocal Segmentation based on the Analysis of Formant Structure
    Srinivasa Murthy Y V, Shashidhar Koolagudi and Vishnu Swaroop

100  Subband Autoencoder features for Automatic Speech Recognition
    Meet Soni, Manisha Sharma, Hardik Sailor and Hemant Patil

1  Two Stage Zero-resource Approaches for QbE-STD
    Maulik Madhavi Maulik and Hemant Patil

14  Robust representation and efficient matching of spoken word templates
    Anupam Mandal, K. R. Prasanna Kumar and Pabitra Mitra

38  Novel Energy Separation Based Frequency Modulation Features for Spoofed Speech
    Classification
    Madhu Kamble and Hemant Patil

Image Processing – III  10:45 - 13:00, December 30, 2017
Venue  Hall B
Chair  Suvadip Mukherjee, GE

156  A Fuzzy C-Means based Approach towards Efficient Document Image Binarization
    Prithwish Jana, Soulib Ghosh, Ram Sarkar and Mita Nasipuri
Semi-supervised Classification of Land Cover in Multi-spectral Images Using Spectral Slopes
Shashaank M. Aswatha, Jayanta Mukhopadhyay and Prabir K. Biswas

Underwater Fish Species Classification using Convolutional Neural Network and Deep Learning
Dhruv Rathi, Dr. S. Indu and Sushant Jain

Performance Analysis of Image Segmentation for Oral Tissue
Archana A. Nawandhar, Lakshmi Yamujala and Navin Kumar

A Novel Method for Image Compression Using Spectrum
Himanshu Kumar, Sumana Gupta and K. S. Venkatesh

Novel Theory and Algorithms of Path-Gradient and Their Application to Image Segmentation
Syed Ahmed Nadeem, Eric Hoffman and Punam Saha

**Machine Learning – III** 14:00-15:20, December 30, 2017

**Venue**  Hall A
**Chair**  Snehanshu Saha, PESSE

24  A Hybrid Deep Neural Network for Online Learning
Trupti Chavan and Abhijeet Nandedkar

15  Multi-ellipse Fitting with PEARL and a Multi-Objective Genetic Algorithm
Heriberto Cruz Hernández and Luis Gerardo de La Fraga

9  Trust Region Levenberg-Marquardt Method for Linear SVM
Vinod Kumar Chauhan, Kalpana Dahiya and Anuj Sharma

81  On the Unification of $k$-Harmonic Means and Fuzzy $c$-Means Clustering Problems under Kernelization
Avisek Gupta and Swagatam Das

**Robotics and Video Analysis** 14:00-15:20, December 30, 2017

**Venue**  Hall B
**Chair**  Rituparna Sarkar, Samsung

25  Fast Path planning on planar occupancy grid exploiting geometry of obstacles
Soumabha Bhowmick, J. Mukhopadhyay and Alok Kanti Deb

48  A heuristics based approach for optimizing delivery schedule of an Unmanned Aerial Vehicle (Drone) based delivery system
Vivek Yadav and Anand M. Narasimhamurthy

120  A Novel Hybrid Brain-Computer Interface for Robot Arm manipulation using Visual Evoked Potential
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**Social Network Analysis**  
14:00 - 15:20, December 30, 2017

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**Valedictory**  
15:30 - 16:00, December 30, 2017

| Venue | Hall A  |
ABOUT BENGALURU

Bangalore, now officially known as Bengaluru, is the capital of the Indian state of Karnataka. It has a population of about 8.42 million and a metropolitan population of about 8.52 million, making it the third most populous city and fifth most populous urban agglomeration in India. It is located in southern India on the Deccan Plateau. Its elevation is over 900 m (3,000 ft) above sea level, the highest of India's major cities. A succession of South Indian dynasties, the Western Gangas, the Cholas and the Hoysalas, ruled the present region of Bangalore until in 1537 CE, Kempé Gowdā – a feudal ruler under the Vijayanagara Empire – established a mud fort considered to be the foundation of modern Bangalore. Bangalore is sometimes referred to as the "Silicon Valley of India" (or "IT capital of India") because of its role as the nation's leading information technology (IT) exporter. Indian technological organisations ISRO, Infosys, Wipro and HAL are headquartered in the city. A demographically diverse city, Bangalore is the second fastest-growing major metropolis in India. It is home to many educational and research institutions in India, such as Indian Institute of Science (IISc), Indian Statistical Institute (ISI), Indian Institute of Management (Bangalore), National Institute of Fashion Technology, National Institute of Design, National Law School of India University and National Institute of Mental Health and Neurosciences (NIMHANS). Numerous state-owned aerospace and defence organisations, such as Bharat Electronics, Hindustan Aeronautics and National Aerospace Laboratories are located in the city.

Air Connections

Bangalore is served by Kempegowda International Airport, located at Devanahalli, about 40 kilometres (25 miles) from the city centre. Bangalore is internationally connected by air directly to Paris, Hong Kong, Kuala Lumpur, Frankfurt, Singapore and others. Within India it is linked with Kolkata, Delhi, Mumbai, Chennai, Guwahati, Dibrugarh, Nagpur, Bhubaneswar, Hyderabad and other important cities.

Places to Visit

Bangalore Fort: It was originally built by Kempegowda in 1537 A.D. It is located next to the Victoria Hospital Gate in the K.R Market area.

Tipu Sultan’s Summer Palace: It was built in 1791, is a two-storied ornate wooden structure with exquisitely carved pillars, arches and balconies. It houses a museum that contains artifacts relating to the Hyder-Tipu regime.

Bangalore Palace: A scenic palace which bears striking resemblance to England’s Windsor Castle, Bangalore Palace is a scenic tourist hotspot with a majestic castle-like structure set amidst lush green environs. The huge palace grounds are used for organizing various types of events and musical shows, most of which include rock concerts. While you are here, don’t miss the immaculately designed interiors of the palace filled with magnificent paintings and stained glass windows. Photography is allowed within the premises so capture some of the greatness in your lens!
**Lal Bagh:** Lal Bagh is the most famous tourist attraction in Bangalore and is spread out over 240 acres. The botanical garden was built in the 18th century during the reign of Hyder Ali and his son Tipu Sultan. This enchanting garden has preserved some of the rarest species of flora and fauna and also houses a lake and a glasshouse. Flower shows held at Lal Bagh is something you wouldn’t want to miss out on!

**Vidhan Soudha:** This is one of the most important structures in Bangalore. The 46-metre tall imposing building comprises 300 rooms, each of which reflects the impressive Dravidian style of architecture. Housing 22 departments of the Government of Karnataka, Vidhan Soudha also happens to be one of the one of the largest legislative buildings and is a must-see tourist attraction in Bangalore.

**Bannerghatta National Park:** Bannerghatta National Park, covering nearly 25000 acres, is located at a distance of about 22 km from Bangalore city and is home to one of the richest natural zoological reserves. Many wild animals like the tiger, lion, panthers, deer, elephant and a variety of reptiles and birds roam around freely in this park.

**Cubbon Park:** This wonderful green island situated in the middle of the city was created in late 19th century by Major General Richard Sankey, the then British Chief Engineer of Mysore State. Initially it covered an area of 100 acres but it spreads over 300 acres now. Thick bamboo gardens add a special beauty to this park.

**Vidhana Soudha:** Vidhana Soudha is the seat of the state legislature of Karnataka. It is an imposing granite building, built in 1956 in the 'Neo-Dravidian' style, incorporates elements of Indo-Saracenic, Rajasthani Jharokha and Dravidian styles. Vidhana Soudha is the brainchild of Kengal Hanumanthaiah and built by chief engineer B.R. Manickam.

**Indira Gandhi Musical Fountain:** The dancing and musical fountain was commissioned in 1996 in the heart of the city on the Raj Bhavan Road on a 17-acre land beautifully landscaped by the Department of Horticulture, Government of Karnataka. The fountain is designed using latest multimedia technology and varieties of Indian and Western musical themes. A number of beautiful patterns are formed in three distinct levels and the formation gives an illusion of a folk or group dance. It is located opposite to the Jawaharlal Nehru Planetarium and close to the Vidhana Soudha and Cubbon Park.

**Innovative Film City:** This is an entertainment theme park with something for everybody. Located about 40 km from Bangalore, we can somewhat equate this to Disneyland of the United States of America. Located on a 50-acre land, the city offers many entertainment facilities to suit all age groups such as Teddy Museum, Louis Tussaud’s Wax Museum, Mini Golf field, Ripley’s Believe It or Not, Haunted Mansion, Bungee Jumping and so much more.
Nandi Hills: Nandi Hills or Nandidurg is an ancient hill fortress about 60 km from Bangalore, which is a favourite picnic spot for the young and old of Bangalore because of its pristine evergreen forests and rich flora and fauna. It is situated just 20 km away from NH 7, just after Devanahalli, where the Kempegowda International Airport is located.

National Gallery of Modern Art (NGMA): NGMA is located in the prestigious heritage premises of Manikyavelu Mansion, which was originally owned by the royal family of Mysore and then by the leading miner Raja Manikyavelu Mudaliar, from whom it was taken over by the State Government in the late sixties. In July, 1989, it was handed over to the Ministry of Culture for setting up a modern art museum by NGMA. Being located in a central locality just off Cunningham Road, this serene place is worth visiting, to view the modern art works displayed in the galleries and also attend events, if any, taking place in this ever vibrant cultural space.

Sankey Tank: Sankey Tank was constructed by Col. Richard Hieram Sankey of the Madras Sappers Regiment in 1882 to meet the water supply needs of the growing Bangalore city. It was also called the Gandhadhakotikere. It is situated right in the central zone of the city surrounded by residential localities such as Sadhashivanagar, a very posh locality, Malleshwaram and Vyalikaval.

Ulsoor or Halsuru Lake: Bangalore once had 300 plus lakes. But many of the lakes have vanished. Ulsoor Lake is one of the oldest lakes spread over 123.6 acres and is the only surviving lake gifted to Bangalore by the Gowda dynasty. It was built by Kempegowda II in the later part of the sixteenth century. The lake has boating facilities, a small park on its bank, and number of beautiful islands in the middle.

Wonderla Amusement Park: This amusement park, supposedly the largest of its kind in India, is located at Bidadi, about 28 km into the Bangalore-Mysore road. Spread over 82 acres, Wonderla has 56 thrill-packed rides for people of all ages. There are kids’ rides, water rides, dry rides and high thrill rides. This Park is an attraction to the children and all those who want to get away from the busy city life and soak in some fun-filled activities.
ESSENTIAL PHONE NUMBERS

Local Volunteers from Conference Committee

B. S. Daya Sagar, 9880893291
H. M. Rajasekhara, 9448068622
T. S. Sruthy, 9663685577
D. Sravan, 9663599288
C. Aditya, 7259260318
Sampriti Soor, 8697733631

Ambulance and Other Medical Services

Bangalore Children's Hospital & Research Centre, 2860252 / 28600552
Bangalore Hospital, 26562753 / 26565494
Indian Red Cross Society, 2264205 / 22268435

Trains / Flights

Train Phone Number (+91 - 80)
Bangalore City Railway Station Enquiry - General / Reservations: 131 / 132
Public Relations Officer (Railway): 22874670
Malleswaram Railway Station: 23347651
Yeshwanthpur Railway Station: 23371444

Air Services: Phone Numbers (+91 - 80)
Air India - City Office 22277747 / 22277748
Air India - Reservation Manager 2243153
Air India - Lost Baggage Services / Baggage Services 25221531
Enquiries / Customer Services (Airport) 140
General Enquiries / Booking 22211914
Baggage Services Unit 25227074

Police

Police 100
Traffic / Accidents 103
DG's Office 22411777 / 22942111 / 22942777
Help Line (DG's Office) 22942595
RGP - Home Guards & Civil Defence 25570733

Fire

Fire: 101
Central Fire Control Room & Ambulance, 2942999 / 2251780
Banashankari Fire Station, 26715088
Yeshwanthpur Fire Station, 22251780 / extn -215