EECS@IISc

Division of Electrical, Electronics, and Computer Sciences

Indian Institute of Science, Bangalore

EECS : Departments and Chairs

Director: Anurag Kumar (ECE)

Networks
FIEEE, FTWAS,
FNA, FNAE, FASc
JC Bose Fellow

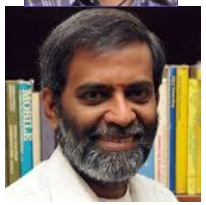
Divisional Chair: Y. Narahari (CSA)

Game Theory
FIEEE, FNA,
FASc, FNAE
JC Bose Fellow

Electrical Engineering (1911)
(UGC-Centre for Advanced Study)
Chair : G. Narayanan

Power Electronics
Satish Dhawan Awardee

Electrical Communication Engineering (1947)
(UGC-Centre for Advanced Study)
Chair : A. Chockalingam



Wireless networks & communications
FNA, FNAE, FASc
JC Bose Fellow

Computer Science and Automation (1969)
(UGC Centre for Advanced Study)
Chair : Shalabh Bhatnagar

Stochastic control &optimization
Fellow, INSA, IASc, INAE

Electronic Systems Engineering (1974)
Chair : Joy Kuri

Networks
Co-author of
Scholarly books on
networks

EECS Faculty

80 **Academic Faculty**

16 **Scientific Staff**

8 **Associate Faculty**

7 **Adjunct Faculty**

Ravi Kannan, Microsoft Research
Ramesh Hariharan, Strand Life Sciences
Kumar Sivarajan, Tejas Networks
Shihab Shamma, University of Maryland
Venkat Padmanabhan, Microsoft Research
Vikram Srinivasan, Target Research

14 **Fellowships from IEEE, ACM, TWAS**

38 **Fellowships from INSA, IASc, INAE, NASI**

18 **Recognitions: Infosys Prize, Bhatnagar Prize, JC Bose Fellowships, ACCS-CDAC Prize, Vikram Sarabhai Research Award**

42 **Swarnajayanti/ Young Scientist/ Young Engineer Awardees**

22 **Editors/Associate Editors of IEEE/ACM/SIAM Journals**

EECS Alumni

More than 10000 Alumni …

N. Seshagiri – Architect of National Informatics Centre (NIC)

V. Rajaraman – Father of Computer Science in India

S. Ramadorai – Chief of TCS during its exponential growth

V.K. Aatre – Scientific Advisor to Defence Minister and DRDO Chief

Bishnu S. Atal – Inventor of linear predictive coding (Bell Labs)

Nikil Jayant – pioneer of digital coding and waveform quantization

Umeshwar Dayal – fundamental contributions to industry level database design

Raj Jain - Pioneering researcher in optic fiber networking

Sunil Kumar – Provost, Johns Hopkins Univ. (formerly Dean, Booth School)

Sudha Murty – Prolific writer and inspirational social worker

EECS: Research Areas and Thematic Clusters

Core Research Areas

Information Theory, Signal Processing, Communications, Networks,
Electromagnetics, Devices & Microelectronics,
Theoretical Computer Science, Computer Systems, Machine Learning,
Control & Optimization, Image Processing, Computer Vision,
Power Systems, High Voltage Engineering, Power Electronics

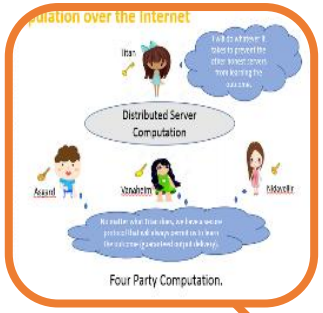
Thematic Clusters (Division-wide and Institute-wide)

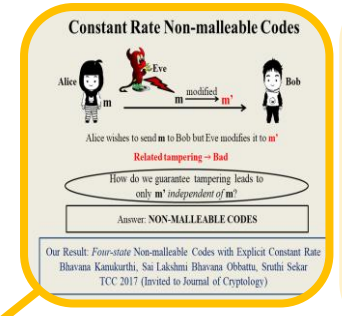
Artificial Intelligence, Autonomous Systems, Brain and Computation,
Cyber-physical Systems, High Performance Devices, Photonics,
Programming Languages & Software Engineering, Security, Smart Energy Systems,
Speech and Language Processing, Storage Systems, Visual Analytics, 5G Systems

Thematic Cluster: Cyber Security

*IISc designated as **Anchor Institution for Karnataka State CoE in Cyber Security**: Interactions with Bangalore startups, capacity building, outreach and raising awareness on cyber security-related issues*

Breakthrough work on secure multiparty computation. Published in tier-1 venues: NDSS, CRYPTO, ACM CCS.
Arpita Patra (CSA)





Important advances in non-malleable codes: Preventing tampering of encoded messages.
Bhavana Kanukurthi (CSA)
TCC (2017), EuroCrypt (2018)

Cloud platform security

Security for IoT & CPS

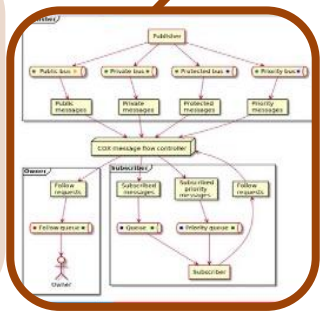
Classical & post-quantum cryptography

Automated program analysis & repair

Information theoritic security

Statistical inference & privacy

Security for Smart Cities: secure data collection & analysis, access control & app development
Bharadwaj Amrutur (ECE)
Ongoing research

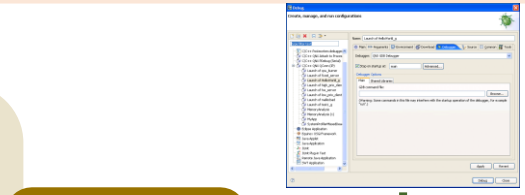


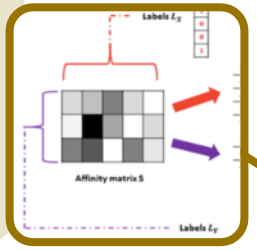
New techniques using trusted hardware for regulating smart devices in restricted spaces.
Vinod Ganapathy (CSA)
ACM MobiSys (2016)

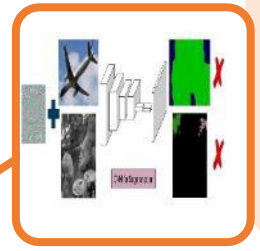
Thematic Cluster: Artificial Intelligence

DEEPFIX: Program debugging and programming language correction using deep learning. **Rahul Gupta (CSA), Aditya Kanade (CSA), Shirish Shevade (CSA),** *AAAI (2018); AAAI (2019)*

Novel algorithms for cross-modal retrieval. Applications in surveillance, forensic analysis.
Soma Biswas (EE) **+ Kunal Chaudhury** (EE), *IEEE Transactions on Image Processing (2019)*

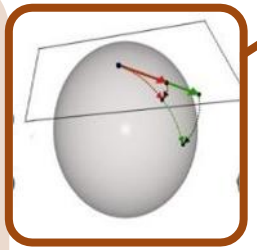






Novel tool to 'fool' Deep Neural Networks. Testing vulnerability for decision-making applications.
Venkatesh Babu (CDS), *IEEE Tran. Patt. Anal. & Machine Intelligence (2018)*

Novel motion-averaging 3D vision framework. Used in commercial products & open source packages.
Venu Madhav Govindu (EE), *IEEE Tran. Patt. Anal. & Machine Intelligence (2018)*



AI

Deep results in consistency of spectral hypergraph partitioning
D. Ambedkar (CSA),
Annals of Statistics, 2016

Industry support from MSR, Amazon, Wipro, Mindtree, Volvo, BT, TCS

Design of optimal auctions.
Thirumulanathan(ECE), R. Sundaresan(ECE), Y. Narahari, (CSA)
Journal of Mathematical Economics (2 papers)

New Division-wide M.Tech. Program In Artificial Intelligence

Thematic Cluster: Brain, Computation & Data Science

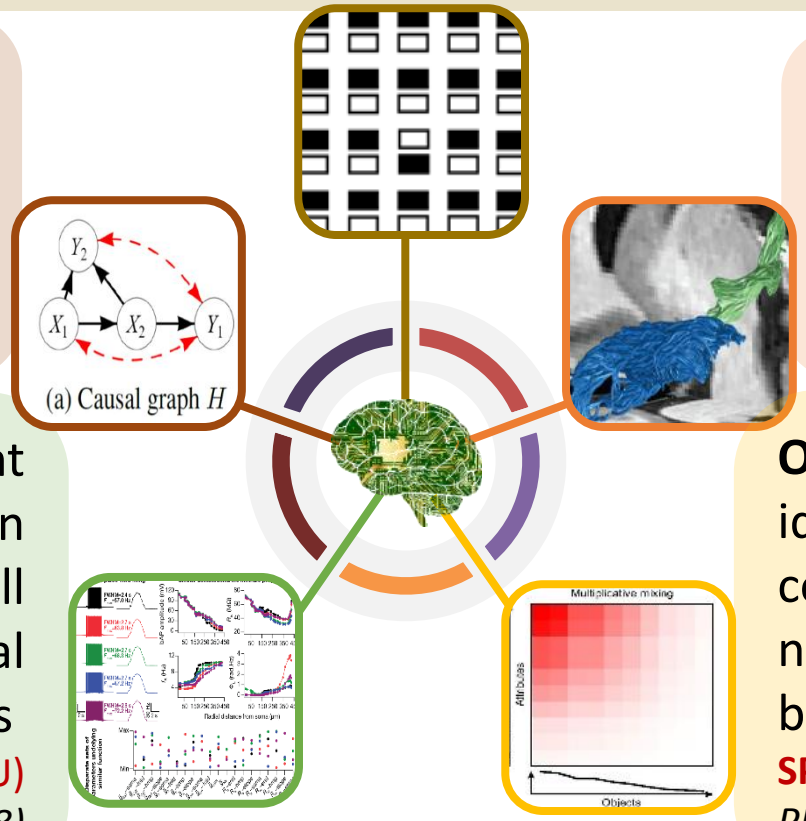
Searching for oddball target: Optimal strategy to employ scarce attention resources using Markov decision process

Rajesh Sundaresan (ECE) + **SP Arun** (CNS)

IEEE Transactions on Information Theory (2017)

Algorithm with polynomial time-complexity for computing minimal set of interventions for some familiesof causal graphs *AAAI (2019)*

Arnab Bhattacharya (CSA) **and V. Honavar**



ReAl-LiFE: Rapid evaluation of brain connectomes on GPUs. 100x speedups (Alzheimer's).

Sridharan Devarajan (CNS) + **Partha Talukdar** (CDS/CSA), *AAAI (2019)*

Degeneracy (structurally different elements performing same function) in concomitant emergence of place cell responses & intrinsic neuronal properties

Rishikesh Narayanan (MBU)

PNAS (2014), J. Physiology (2018)

Object recognition: Signals related to identity & other attributes are combined multiplicatively in single neurons in higher visual areas for better decoding.

SP Arun (CNS)

PNAS (2018)

Special support for this area from ***Pratiksha Trust (Mr. Kris Gopalakrishnan & Mrs. Sudha Gopalakrishnan)***

Distinguished Visiting Chairs in Brain and Computation

Promoted by a generous endowment to support three visiting chair positions and research activities

Pratiksha Trust

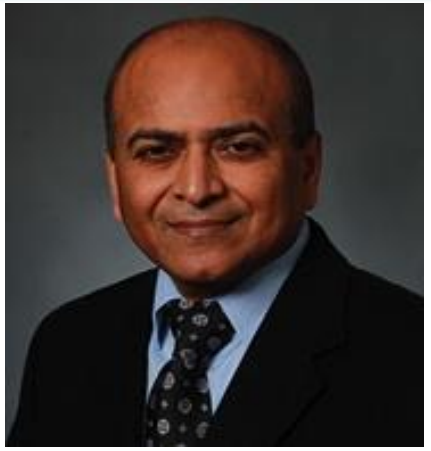
Kris Gopalakrishnan

Sudha Gopalakrishnan

Shri K. Vaidyanathan Chair

Professor Shihab Shamma,

University of Maryland



Smt. Sudha Murty Chair

Prof. Vasant Honavar

Pennsylvania State University

Pratiksha Chair

Christos Papadimitriou

Columbia University

Recent Highlights

Best Paper and Dissertation Awards

Uday Kumar Reddy Bondugula (CSA). PLDI Most Influential Paper Award

Prathamesh Mayekar, Parimal Parag, Himanshu Tyagi (ECE). ISIT 2018 Best Student Paper Award

Lekshmi Ramesh and Chandra Murthy (ECE). IEEE ICASSP 2018 Best Student Paper Award

Chandan Saha (CSA) and Co-authors. ICALP 2017 Best paper Award

Suvam Mukherjee & Deepak D'Souza (CSA) and Co-authors. SAS 2017 Best Student Paper Award

Palash Dey (CSA). ACM India Doctoral Dissertation Award 2017

Young Faculty Awards

Vijay Natarajan (CSA). Swarnajayanti Fellowship 2017, Mindtree Chair Professorship

Mayank Srivastava (ESE). INAE YE 2017, INSA YS 2018, IASc YA 2017, NASI YS 2018, IEEE EDS 2017

Arpita Patra (CSA). INAE YE 2017, IASc YA 2017, NASI YS 2018, TWAS YA 2017

Sriram Ganapati (EE). DAE Young Scientist Award

Uday Kumar Reddy Bondugula (CSA). INAE YE 2017, INSA YS 2017, IASc YE 2017

Chandan Saha (CSA). INAE YE 2016, INSA YS 2016

Siddharth Barman, INAE YE 2018

Connect to the Industry

Research grant leading to multiple collaborative projects seeking fundamental advances In machine learning, optimization, algorithms, and cryptography

wipro

WIRIN (Wipro-IISc Research Innovation Network)

Multi-faculty collaborative initiative in autonomous systems and artificial intelligence

amazon

Amazon – CSA Collaborative Initiative

Amazon Post-Doctoral Fellowship

Multi-faculty collaborative project on AI

Mindtree

Welcome to possible

Mindtree – IISc Collaborative Initiative

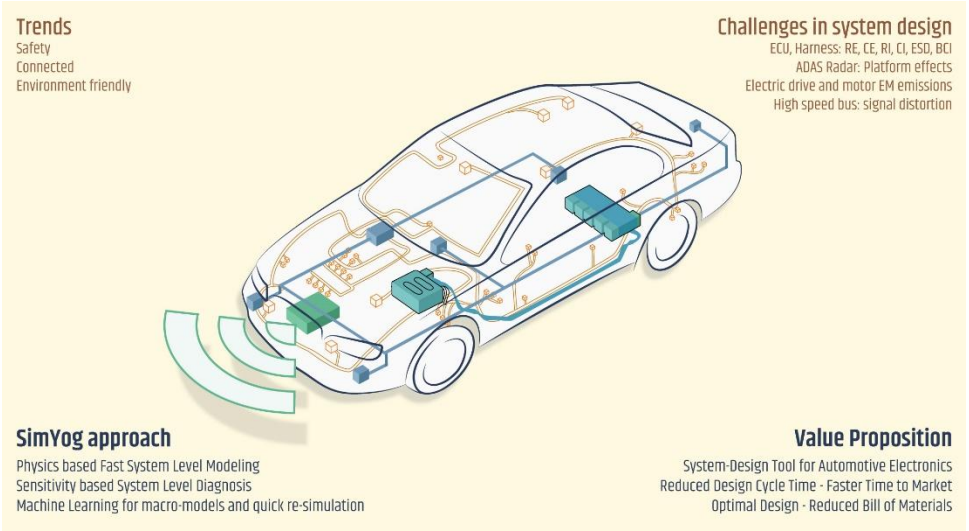
Mindtree Associate Professor Chair in AI

Collaborative research projects

Deep Technology Start-Ups

Endoscopy training device, with haptics and visualisation

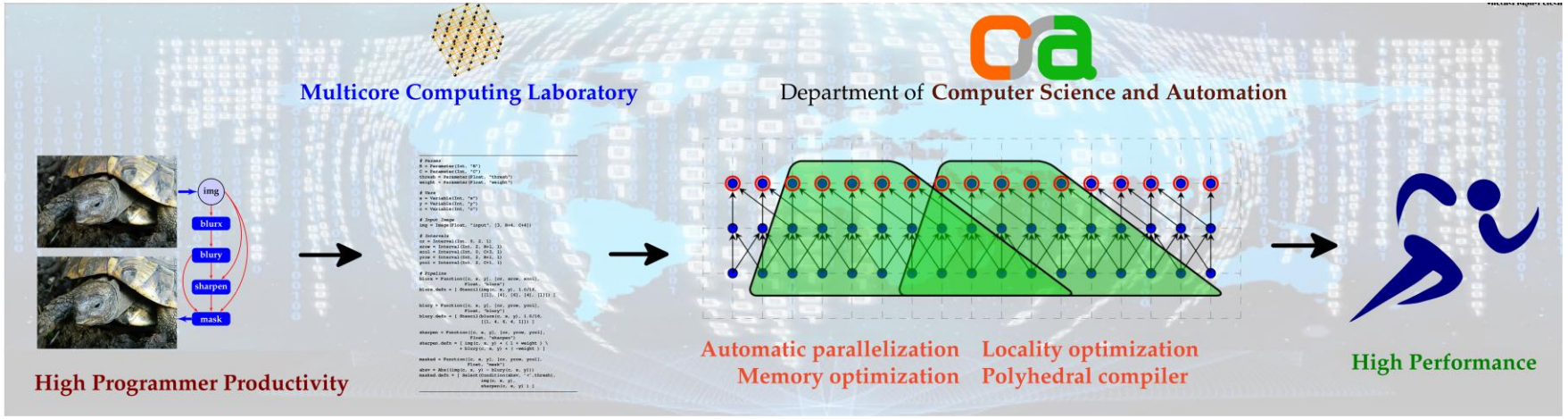
Vijay Natarajan (CSA)



Symyog

Design and Sign-off Tools for Automotive Electronics

Dipanjan Gope (ECE)

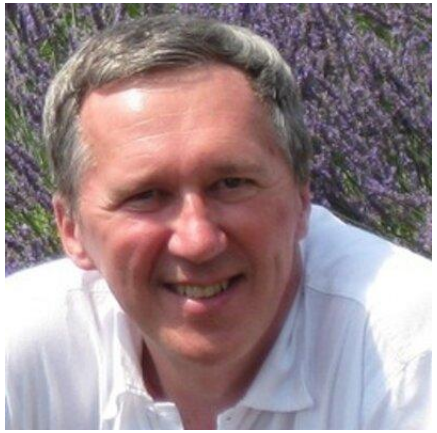


Polymage Computing

Software and services For high-performance domain-specific computations (based on PLDI Most Influential Paper)

Uday Kumar Bondugula (CSA)

Engagement with Distinguished Visiting Chairs



Tom Mitchell
University Professor, CMU
Pratiksha Visiting Professor

Mike Norman
UCSD Supercomputing Centre
Rukmini Gopalakrishnachar Chair

Rakesh Agrawal
CEO, Data Insigt Labs, USA
Rukmini Gopalakrishnachar Chair

Sargur Srihari
SUNY, Buffalo
RG Chair

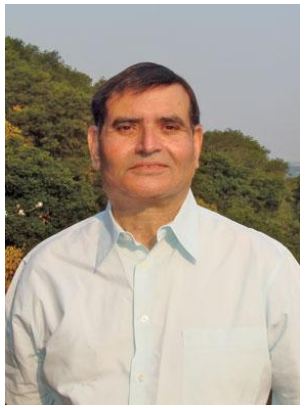
Babak Falsafi
EPFL
RG Chair

Goutam Chattopadhyay
Jet Propulsion Lab and CalTech
BEL Chair for Radar Systems

Tangali S. Sudarshan
University of South Carolina
CPRI Visiting Chair Professor

Vijay Vittal
Arizona State University
CPRI Visiting Chair Professor

V. Chandrasekar
Colorado State University
BEL Chair for Radar Systems



D.V. Giri
CEO, Pro-Tech
BEL Chair for Radar Systems

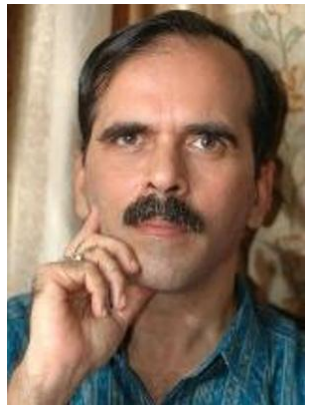
International Review (2017)

Munther Dahleh
MIT

P.R. Kumar
Texas A & M

Jitendra Malik
UC-Berkeley

Umesh Mishra
UC-San Diego



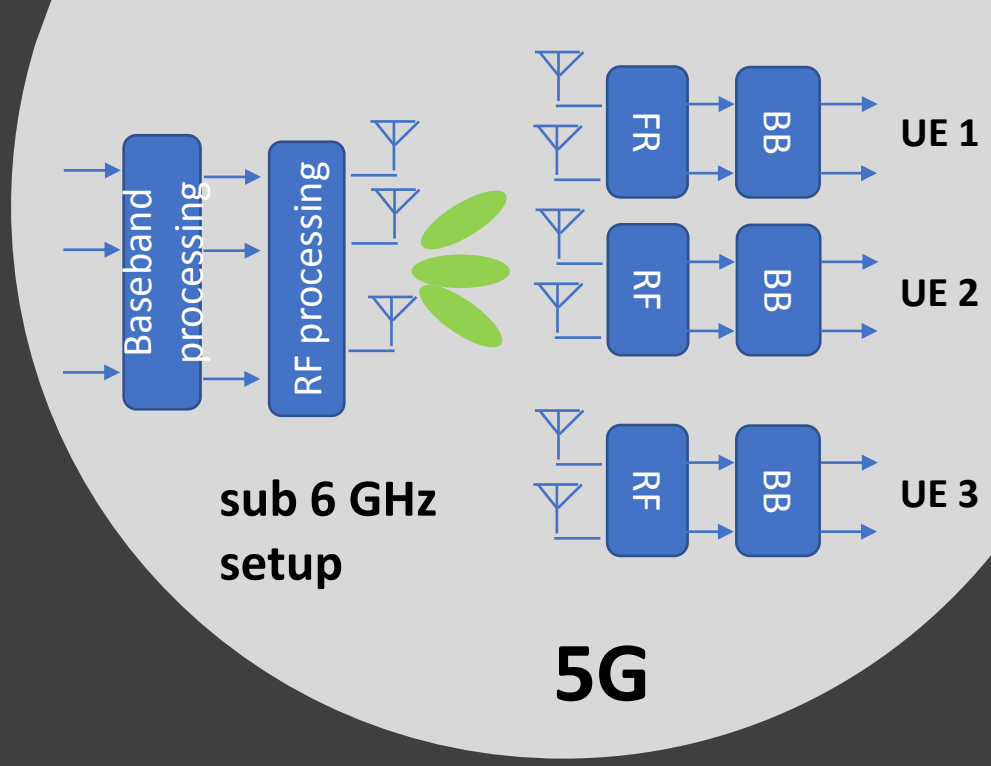
Krithi Ramamritham
IIT-Bombay

Kaushik Roy
Purdue

Four Day Review of the Division During September 17-20, 2017
The review has brought out our strengths and weaknesses
We are engaged with them for continuous improvement

EECS Vision

Strive to be among the world's foremost clusters of electrical, electronics, and computer science researchers, through pursuit of research excellence and promotion of innovation, by offering world class education to train future leaders in EECS, and by contributing to societal needs.



We are hiring in core areas as well as in thematic clusters. Please apply!

Thank you for
your interest
and
participation

EECS and IISc: Strengths & Uniqueness

- Equal emphasis on fundamental science, rigorous engineering, and technology innovation
- Culture of fundamental investigations
  - IISc has nurtured curiosity driven research in all areas
  - Independence to pursue individual research goals while being a part of exciting collaborative initiatives
- Best doctoral and masters students in India (and from abroad, soon)
- Optimal teaching loads
- Located in Bangalore which has best of the breed industrial research labs and startup ecosystem
- Availability of high value startup grants

EECS Alumni

More than **10000** Alumni

Many Distinguished Alumni …

N. Seshagiri – Architect of National Informatics Centre (NIC)

V. Rajaraman – Father of Computer Science in India

S. Ramadorai – Chief of TCS during its exponential growth

V.K. Aatre – Scientific Advisor to Defence Minister and DRDO Chief

Bishnu S. Atal – Inventor of linear predictive coding (Bell Labs)

Nikil Jayant – pioneer of digital coding and waveform quantization

Umeshwar Dayal – fundamental contributions to industry level database design

Raj Jain - Pioneering researcher in optic fiber networking

Sunil Kumar – Provost, Johns Hopkins Univ. (formerly Dean, Booth School)

Sudha Murty – Prolific writer and inspirational social worker

EECS Teaching Programs

- M.Tech. (Communication & Networks)
- M.Tech. (Microelectronic Systems)
- M.Tech. (Signal Processing)
- M.Tech. (Electronic Systems Engineering)
- M.Tech. (Electrical Engineering)
- M.Tech. (Computer Science & Engineering)
- M.Tech. (Systems Engineering)

EECS Students (August 1, 2017)

Ph.D. (on roll)	344
M.Tech. (Research) (on roll)	99
M.Tech. (Course)(on roll)	302
Ph.D. graduates during 2012-16	199
Ph.D. graduates during 2016	48
M.Tech. (Research) graduates during 2016	20
M.Tech. (Course) graduates during 2016	149

EECS Publications

	2013-2017	2017
Books	12	2
Journal Publications	712	172
Conference Publications	1118	235
Book Chapters	31	8

Journals: All flagship IEEE Transactions and ACM Transactions; SIAM journals; Leading Elsevier Journals; Annals of Statistics, ML, JMLR, AI, Stochastics, Math of OR, JCT, etc.

Conferences: FOCS, STOC, SODA, NIPS, ICML, COLT, AISTATS, ICDM, UAI, CVPR, ICCV, SIGIR, SIGKDD, WWW, AAAI, IJCAI, INFOCOM, ISIT, ICASSP, Globecom, PLDI, ISCA, SIGMETRICS, ICSE, FSE, OOPSLA, SC, MICRO, etc.

EECS Interactions

Collaborative Projects

Google, IBM, Amazon, Flipkart, Microsoft, Intel, AMD, TI, Qualcomm, NetApp, Mozilla, Shakti Foundation, Bosch, Nucleus Software, Volvo, TCS, Wipro

Consulting Projects

Shell, AOL, NetApp, SAP, MindTree, Wipro, EMC, Evivo Software, Intel, LGSoft, DRDO,Altium, Nimbic, Tetcos, CDOT, CDAC, L&T, Toshiba, etc.

Unrestricted Research Grants

Google, Yahoo!, IBM, Microsoft Research , Amazon, Flipkart, Adobe Labs, Intel, Accenture, NIDIA, HP Labs, National Instruments, Qualcomm

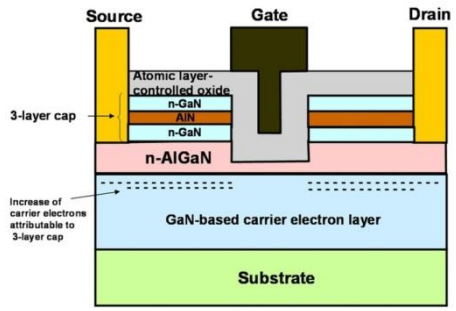
Bilateral Programs: Indo-US, Indo-UK, Indo-French, Indo-Israel, Indo-Swedish, Indo-Brazil, Indo-Dutch

Universities: Technion, Gavle, Glasgow, Southampton, CNRS, INRIA, KTH, TU-Delft, EPFL, MIT, Harvard, CMU, Ohio State, Cornell, USC, UCSD

Some Ongoing National Initiatives

IISc-DRDO Program on Frontiers in Communications, Signal Processing, Control, and Computing

R&D program on high performance devices and algorithms for satellite applications



Technology development for 600 V normally OFF Gallium Nitride transistor for reliable power electronic systems

सत्यमेव जयते
Department of Science and Technology
Ministry of Science and Technology
Government of India

Enabling Industrial Research

SID@ IISc

Society for Innovation and Development
Long-term collaborative projects, Tech Park, incubation
https://sid.iisc.ac.in/

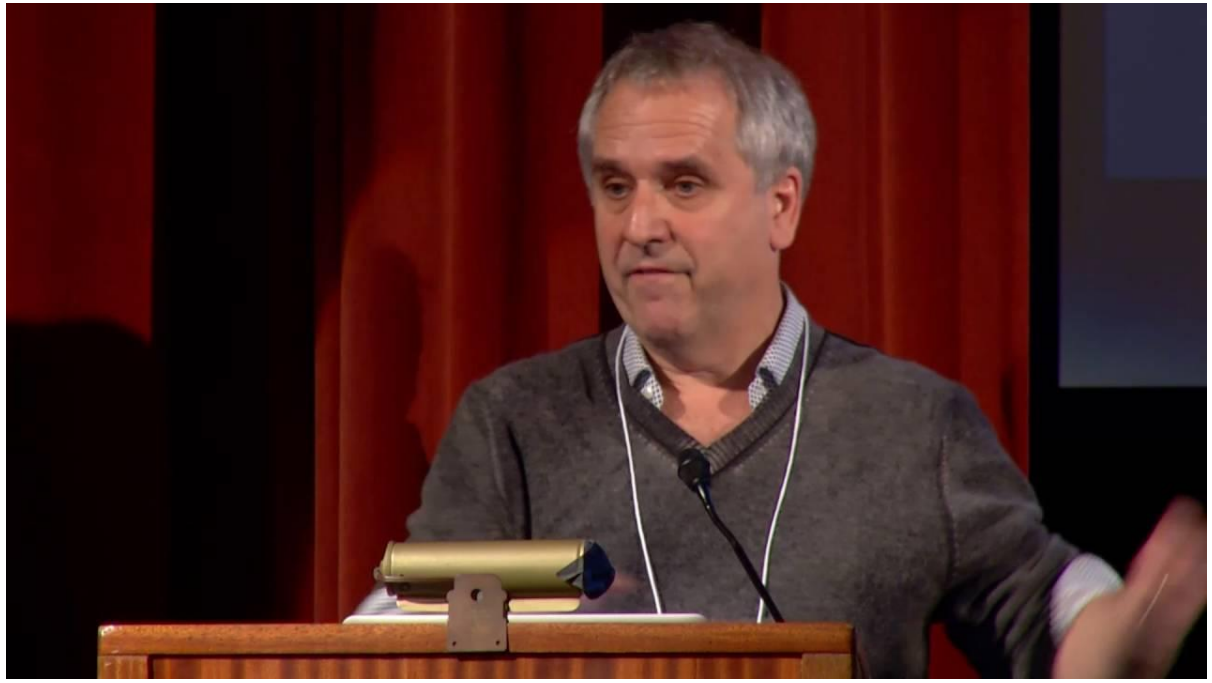
CSIC@ IISc

Centre for Scientific Industrial Consultancy
Technical and scientific advisory, consulting engagements
http://www.csic.iisc.ernet.in/

IPTeL@ IISc

Intellectual Property and Technology Licensing
IP, Patents, Technology Licensing, MOUs
http://iptel.iisc.ac.in/

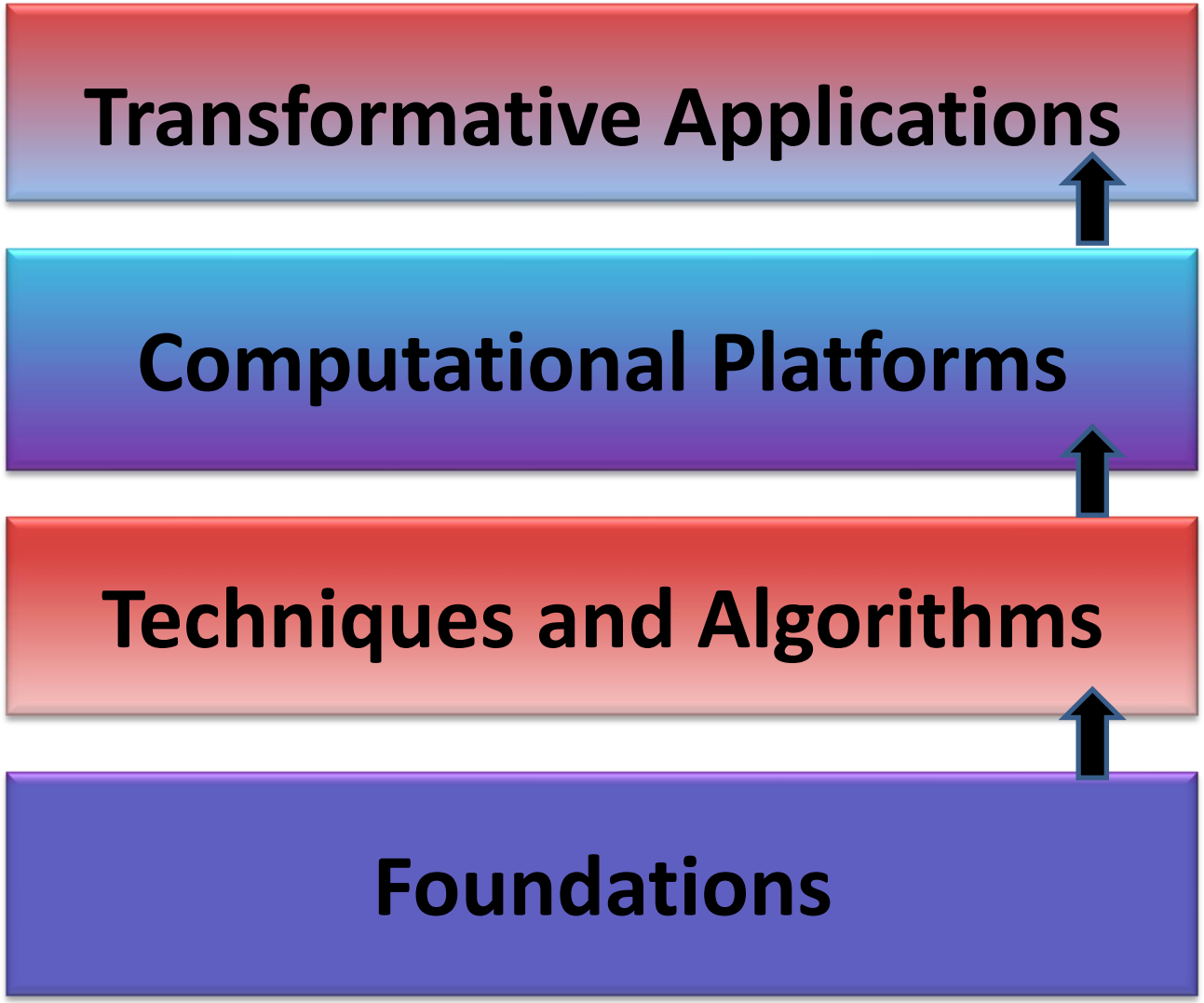
New Age AI



Prof. Michael Jordan
UC-Berkeley

"Blends ideas from statistics, CS, OR, and other disciplines to design algorithms to process massive data, make inferences and predictions, and help in decision making"

Courtesy: Google Images


Transformative Applications
Computational Platforms
Techniques and Algorithms
Foundations

Structure of the Curriculum

Pool A – 19 Credits

- E0 251 3:1 Data Structures and Algorithms
- E1 222 3:0 Stochastic Models and Applications [OR]
  E2 202 3:0 Random Processes
- E1 2XX 3:1 Computational Linear Algebra (New)
- E0 230 3:1 Computational Methods of Optimization
- E1 213 3:1 Pattern Recognition and Neural Networks [OR]
  E0 270 3:1 Machine Learning

Pool B – Minimum 12 Credits

- E1 277 3:1 Reinforcement Learning
- E1 216 3:1 Computer Vision
- E9 241 2:1 Digital Image Processing
- E9 261 3:1 Speech Information Processing
- E1 254 3:1 Game Theory
- E1 241 3:0 Dynamics of Linear Systems
- E0 259 3:1 Data Analytics
- E2 231 3:0 Topics in Statistical Methods
- E9 206 3:0 Digital Video: Perception and Algorithms

Project – 21 Credits

Recommended Electives (Up to 12 Credits)

- E0 265 3:1 Convex Optimization and Applications
- E0 334 3:1 Deep Learning for Natural Language Processing
- E0 268 3:1 Practical Data Science
- DS 256 3:1 Scalable Systems for Data Science
- E9 205 3:1 Machine Learning for Signal Processing
- DS 222 3:1 Machine Learning with Large Data Sets
- DS 265 3:1 Deep Learning for Computer Vision
- E0 306 3:1 Deep Learning: Theory and Practice
- E0 249 3:1 Approximation Algorithms
- E0 235 3:1 Cryptography
- E0 238 3:1 Intelligent Agents
- E2 201 3:0 Information Theory
- E1 245 3:0 Online Prediction and Learning
- E2 336 3:0 Foundations of Machine Learning
- E2 207 3:0 Concentration Inequalities
- E1 244 3:0 Detection and Estimation Theory
- E1 396 3:0 Topics in Stochastic Approximation Algorithms
- E2 230 3:0 Network Science and Modeling
- E1 246 3:1 Natural Language Understanding
- E9 253 3:0 Neural Networks and Learning Systems

M.Tech. (AI) : A Division-wide Program

Division of EECS
Electrical, Electronics, and Computer Sciences

We have received 1600+ applications
CS, EC, EE GATE disciplines
We will be producing 45 to 50 graduates per year

Vibrant research cluster with 30+ faculty members and 50+ Ph.D. students spread over multiple departments (CSA, ECE, EE, ESE, CDS)

Areas: Machine Learning, Deep Learning, Reinforcement Learning, Convex and Non-convex Optimization, Visual Analytics, Speech and Language Processing, Foundations of AI, High Performance Computing for AI

Interdisciplinary Centres (RBCCPS, ICWaR, CISTUP, CBR, DCCC) are working on applications (smart cities, autonomous systems, water, brain, climate)

Papers in NIPS, ICML, SIGKDD, AAAI, AAMAS, IJCAI, CVPR, WWW, COLT, ICLR
12 papers in AAAI – 2019; 8 Books in the area

Helping the Karnataka Government in Data Science Education initiatives;
Engaging with NITI AAYOG on strategic national initiatives in AI

Industry Connect: Wipro, Mindtree, Google, Amazon, MSR, Volvo, Shell, BT,…

Transformative Applications of AI

National need for AI capacity building; Industry in need of rigorously trained Masters and PhD graduates

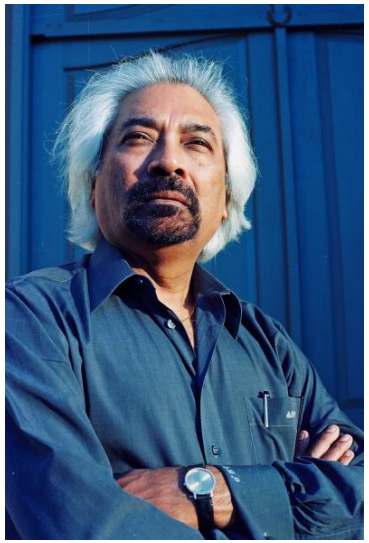
IISc has a vibrant group in AI, cutting across Departments (40+ faculty)

Vision: Impart rigorous training in the foundations and deep technology of AI to produce graduates who can become world leaders in AI and lead India's march towards leadership in AI

Courtesy: Google Images

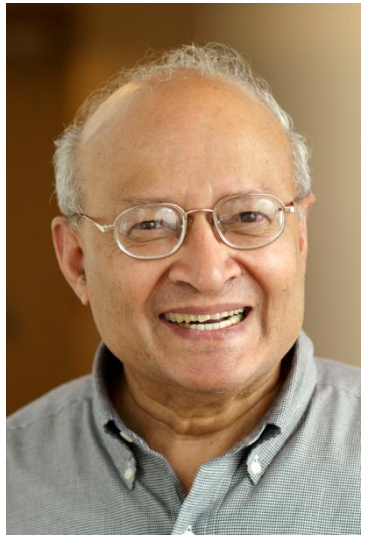
Silvio Micali
Prof. I.G. Sarma Memorial Lecture

The quest for Resilient Mechanism Design



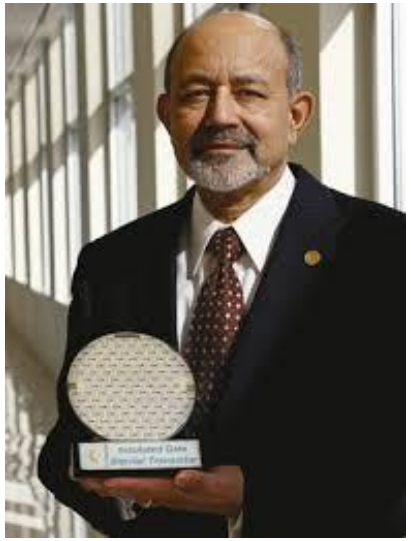
Sam Pitroda
M. Ct. M. Chidambaram Chettyar Lecture

Dreaming Big – My Journey to Connect India



Thomas Kailath
IISc Centenary Lecture

The Process of Making Breakthroughs in Engineering



B. Jayant Baliga
IISc Golden Jubilee Lecture

The IGBT Device: Challenges and Triumphs

Eric Maskin
IISc Golden Jubilee Lecture

Financial Crises: Why they occur and What to do about them