2019 Sixth Indian Control Conference (ICC)

Proceedings

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Welcome by the General Co-Chairs

We take great pleasure in welcoming all participants to the Sixth Indian Control Conference, being held at the Indian Institute of Technology Hyderabad. The first five ICCs were held during the first or second week of January. This year we decided to shift the time to the week after the IEEE Conference on Decision and Control. The change seems to have been well-received by all concerned. Going forward, ICC-7 will be held at IIT Bombay during December 16-18, 2020, again during the week after the CDC in Korea.

As in previous years, the IEEE Control Systems Society (CSS) provided technical co-sponsorship to ICC-6 and acquired the Proceedings for inclusion in IEEE Xplore. In addition, the Outreach Fund of the IEEE Control Systems Society has awarded $7,080 ($6,000 + 18% Goods and Services Tax) to ICC-6. The Outreach Fund is being used to promote student participation in the ICC. The organizers are very grateful to the CSS for all this assistance.

We would like to thank the IIT Hyderabad for being a Gold Sponsor of ICC-6 by providing the meeting rooms absolutely free of charge. In addition, we would also like to thank our Sponsors GE, ABB, and Quanser.

We are grateful to the members of the Organizing Committee for making our task relatively easy, especially the Local Organizing Committee and the many student volunteers. We would like to take this opportunity to thank all of them for their invaluable contributions.

M. Vidyasagar, General Chair	Ramkrishna Pasumarthy, General Co-Chair
Indian Institute of Technology Hyderabad	Indian Institute of Technology Madras

Report from the 2019 Sixth ICC Program Co-chairs

Welcome to the Sixth Indian Control Conference, being held from December 18-20, 2019, at the Indian Institute of Technology Hyderabad campus. The first edition of the conference was at held in January 2015 at IIT Madras. It has been an annual event since then with subsequent editions held at Mahindra Ecole Centrale-Hyderabad, IIT Guhawati, IIT Kanpur and IIT Delhi. First, we would like to thank the International Program Committee for their excellent support in selecting high quality papers. We also would like to thank the members of various committees for their contributions in organizing this event. We also thank our sponsors for their continuing support.

The conference received 143 contributed paper submissions representing 12 countries. The final program includes three plenaries, one tutorial session, three invited sessions consisting of 18 papers and 75 contributed papers. The plenary speakers are Professors Yonina Eldar (Weizmann Institute), Rajeeva L. Karandikar (Chennai Mathematical Institute) and Kristin Petterson (Norwegian Institute of Technology). The tutorial sessions will be delivered by Professors Harish Pillai, Madhu Belur and Debasattam Pal from IIT Bombay.

The conference is for three days with the first day (December 18) reserved for tutorial sessions. The second day's program will start with a plenary lecture followed by five parallel tracks of regular sessions in the morning and the second plenary and four parallel tracks in the afternoon. The evening will consist of a cultural event followed by a short award ceremony and ending with a banquet dinner. The third and last day of the conference will start with a plenary lecture followed by four parallel tracks of regular paper sessions, and finally four afternoon parallel tracks of regular papers sessions.

Arun Mahindrakar, Program Chair
Indian Institute of Technology Madras

Shaunak Sen, Program Co-Chair
Indian Institute of Technology Delhi

Plenary Sessions

Snake Robot Control

Kristin Pettersen

Auditorium, Thursday, December 19, 2019, 09:30-10:30

Abstract: Snake robots are motivated by the long, slender and flexible body of biological snakes, which allows them to move in virtually any environment on land and in water. Since the snake robot is essentially a manipulator arm that can move by itself, it has a number of interesting applications including firefighting applications, and search and rescue operations. In water, the robot is a highly flexible and dexterous manipulator arm that can swim by itself like a snake. This highly flexible snake-like mechanism has excellent accessibility properties; it can for instance access virtually any location on a subsea oil and gas installation, move into the confined areas of shipwrecks, or be used for observation of biological systems. Furthermore, not only can the swimming manipulator access narrow openings and confined areas, but it can also carry out highly complex manipulation tasks at this location since manipulation is an inherent capability of the system. In this talk, I will present recent research results on modelling and control of snake robots, including both theoretical and experimental results. Finally, I will present ongoing efforts for bringing the results from university research towards industrial use.

Biography: Kristin Y. Pettersen is a Professor in the Department of Engineering Cybernetics, NTNU where she has been a faculty member since 1996. She was Head of Department 2011-2013, Vice-Head of Department 2009-2011, and Director of the NTNU ICT Program of Robotics 2010-2013. She is Adjunct Professor at the Norwegian Defence Research Establishment (FFI). She is also Key Scientist at the CoE Centre for Autonomous Marine Operations and Systems (NTNU AMOS) for the period 2013-- 2022. She is a co-founder of the NTNU spin-off company Eelume AS, where she was CEO during 2015-2016.
She received the MSc and PhD degrees in Engineering Cybernetics at NTNU, Trondheim, Norway, in 1992 and 1996, respectively. She has published four books and more than 250 papers in international journals and refereed conferences. Her research interests focus on nonlinear control of mechanical systems with applications to robotics, with a special emphasis on marine robotics and snake robotics. She was awarded the IEEE Transactions on Control Systems Technology Outstanding Paper Award in 2006 and in 2017. She was a nominated and elected member of the Board of Governors of IEEE Control Systems Society 2012 – 2014 and is currently a member of the IFAC Council. She is an IEEE CSS Distinguished Lecturer for the period 2019-2021. She is an IEEE Fellow, member of the Norwegian Academy of Technological Sciences, and member of the Academy of the Royal Norwegian Society of Sciences and Letters.

Recovering Lost Information in Analog-to-Digital Conversion

Yonina Eldar

Auditorium, Thursday, December 19, 2019, 14:00-15:00

Abstract: The famous Shannon-Nyquist theorem has become a landmark in analog-to-digital conversion and the development of digital signal processing algorithms. However, in many modern applications, the signal bandwidths have increased tremendously, while the acquisition capabilities have not scaled sufficiently fast. Furthermore, the resulting high rate digital data requires storage, communication and processing at very high rates which is computationally expensive and requires large amounts of power. In the context of medical imaging sampling at high rates often translates to high radiation dosages, increased scanning times, bulky medical devices, and limited resolution. In this talk we consider a general framework for sub-Nyquist sampling and processing in space, time and frequency which allows to dramatically reduce the number of antennas, sampling rates and band occupancy in a variety of applications. We consider applications of these ideas to a variety of problems in communications, radar, and ultrasound imaging and show several demos of real-time sub-Nyquist prototypes including a wireless ultrasound probe, sub-Nyquist MIMO radar, cognitive radio, shared spectrum radar, and an analog combiner prototype.

Biography: Yonina Eldar is a Professor in the Department of Mathematics and Computer Science, Weizmann Institute of Science, Rechovot, Israel where she heads the center for Biomedical Engineering and Signal Processing. She was previously a Professor in the Department of Electrical Engineering at the Technion. She is also a Visiting Professor at MIT, a Visiting Scientist at the Broad Institute, and an Adjunct Professor at Duke University and was a Visiting Professor at Stanford. She received the B.Sc. degree in physics and the B.Sc. degree in electrical engineering both from Tel-Aviv University (TAU), Tel-Aviv, Israel, in 1995 and 1996, respectively, and the Ph.D. degree in electrical engineering and computer science from the Massachusetts Institute of Technology (MIT), Cambridge, in 2002. She is a member of the Israel Academy of Sciences and Humanities, an IEEE Fellow and a EURASIP Fellow. She has received many awards for excellence in research and teaching, including the IEEE Signal Processing Society Technical Achievement Award (2013), the IEEE/AESS Fred Nathanson Memorial Radar Award (2014) and the IEEE Kiyo Tomiyasu Award (2016). She was a Horev Fellow of the Leaders in Science and Technology program at the Technion and an Alon Fellow. She received the Michael Bruno Memorial Award from the Rothschild Foundation, the Weizmann Prize for Exact Sciences, the Wolf Foundation Krill Prize for Excellence in Scientific Research, the Henry Taub Prize for Excellence in Research (twice), the Hershel Rich Innovation Award (three times), the Award for Women with Distinguished Contributions, the Muriel & David Jacknow Award for Excellence in Teaching, and the Technion's Award for Excellence in Teaching (two times). She received several best paper awards and best demo awards together with her research students and colleagues, was selected as one of the 50 most influential women in Israel. She is the Editor-in-Chief of Foundations and Trends in Signal Processing, and a member of several IEEE Technical Committees and Award Committees.

Stochastic Calculus without Tears

Rajeeva Karandikar

Auditorium, Friday, December 20, 2019, 09:30-10:30

Abstract: Stochastic integration, invented by Kiyosi Ito in the 1940s, is a key methodology in stochastic control and filtering, and in mathematical finance. Until now it has been considered to be very technical and difficult to understand. Now, after several decades have elapsed, one can present a simple and intuitive treatment of the theory. We will present such an approach to stochastic calculus, which mimics the standard techniques used in Lebesgue integration.

Biography: Professor Rajeeva L Karandikar obtained his Ph. D. at the Indian Statistical Institute, Kolkata in 1981. He spent some years as a visiting professor in USA and returned to the Indian Statistical Institute, Delhi in 1984. He became a full professor in 1989 and served as Head of Department of Mathematics and Statistics at the Institute, and also as Head of the Delhi Centre of the Institute. He has been a visiting professor at several universities in USA and Europe. In 2006, he moved to Cranes Software International Limited as Executive Vice President – Analytics. In 2010, he returned to Academics and became Distinguished Professor at the Chennai Mathematical Institute. Since 2011, he is the Director of Chennai Mathematical Institute, Chennai, India. Karandikar has made significant contributions to various areas including Stochastic Calculus, Filtering theory, Markov processes and martingale problems, limit theorems, Monte Carlo techniques, queuing theory, game theory, and theory of option pricing. He has authored three books: one on filtering theory, one on option pricing with Professor G Kallianpur and one with Professor B V Rao on Stochastic Calculus. He is a fellow of Indian National Science Academy and Indian Academy of sciences and has been awarded the young scientist medal by Indian National Science Academy (1985), S S Bhatnagar prize by Council of Industrial and scientific research (1999), C R Rao National award in statistics by Government of India (2000) and P C Mahalanobis Memorial Medal awarded by Indian National Science Congress.

Dr Karandikar has been an Editor of Sankhya and on the editorial boards of Annals of Probability and Journal of Statistical Planning and Inference. Dr Karandikar has been involved in numerous consultancy projects over the years. He has worked on development of proprietary blockcipher algorithms for Indian defense services. Dr Karandikar has been involved with opinion polls and exit polls in India since 1998. He has worked with India Today, Doordarshan, T V Today (Aaj Tak), CNN-IBN, ABP news.

Tutorials

Passivity Theory for SISO and MIMO Systems: Part 1

Harish Pillai, Madhu Belur and Debasattam Pal

Wednesday, December 18, 2019, 09:30-13:00

Abstract: Passivity is a well-established area in Control theory. Research on passivity has developed in various strands over the years. Despite passivity being well known, the connections between various strands of research in passivity, are often not fully clear to researchers who work in this area. The aim of this tutorial is to introduce and bring out the inter-connections between these various topics associated with passivity. In particular, Part 1 of the tutorial will focus on:

- What are passive systems?
- Characterization of passivity: Positive real lemma, KYP lemma
- Passivity theorem: interconnection of two passive systems (one strictly passive)
- Quadratic differential forms
- Aizermann/Kalman's conjectures, sector nonlinearities, circle criteria, link with Nyquist criterion (all being variations of the same theme, a change in the quadratic differential form)

Passivity Theory for SISO and MIMO Systems: Part 2

Harish Pillai, Madhu Belur and Debasattam Pal

Wednesday, December 18, 2019, 14:00-17:30

Abstract: Part 2 of the tutorial will focus on applications in control where passivity plays a central role.

- Nyquist plot of positive real systems – variation giving negative-imaginary systems etc
- Algebraic Riccati Equation
- Dissipativity as a generalization of passivity and link with small gain theorem, H-infinity control and robustness
- Examples from electrical and mechanical systems
- Computational aspects involving topics covered in Parts 1 and 2.

Conference Information

Awards Ceremony, Conference Dinner, and Reception

Awards Ceremony and Cultural Event	Thursday, December 19	18:00-19:00
Conference Dinner	Thursday, December 19	19:30-21:30

Conference Registration

Registration is mandatory for all conference participants. Registration kits for all advance registrations may be picked up at the 2019 Sixth ICC Registration Desk. The Registration Desk will be open from 08:00 to 17:00 hours on all three days, except during the plenary sessions.

All registration categories include one copy of the conference proceedings on a USB flash-drive, admission to the tutorial sessions, technical sessions, and lunch on all three days, and one ticket for the conference dinner.

| Registration Category	Conference Registration Fee (in INR, including 18% GST)	
	Till October 15, 2019	After October 15, 2019
Students in India	6000	7000
Academic	14000	15000
Others	19000	20000

Best Student Paper Award Finalists and Winners

Fourteen nominations were received for the 2019 Sixth ICC Best Student Paper Award. The nominated papers were screened based on originality, clarity, technical correctness, potential impact, and strength of the nomination letter, and the following two nominees were selected as the finalists.

Paper Title	**Student Finalist** and co-author(s)	Presentation Slot
Estimating Scalar Fields with Mobile Sensor Networks	**Rihab Abdul Razak,** Srikant Sukumar, and Hoam Chung	ThAT3.2 Dec. 19 11:20-11:40
On the Watermark-Securable Subspace of a Linear Stochastic System	**Bharadwaj Satchidanandan,** and P. R. Kumar	ThAT2.5 Dec. 19 12:20-12:40

One of the finalists could not attend the conference to present his paper in person. In accordance with the rules of the award, the other finalist Rihab Abdul Razzak was selected as the winner of the 2019 Sixth ICC Best Student Paper Award.

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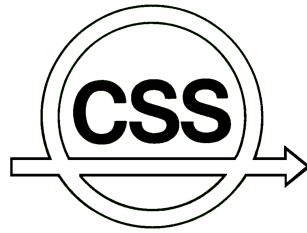
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