

# IEEE CIC Pre-Conference Tutorials Day:

## Wednesday, Oct 17, 2018

8:00am- 5:30pm	Conference Registration (Conference Registration Desk outside <i>Conference Lobby</i> )
8:30- 10:30am	<b>Tutorial 1: Dr. Mudhakar Srivatsa</b> <i>Distinguished Research Staff Member and Manager at the Distributed AI department,  IBM T. J. Watson Research Center, USA</i> <b>AI @ Edge</b> <i>(University 11 + 12)</i>
10:30 – 12:30 PM	<b>Tutorial 2: Dr. Nathalie Baracaldo</b> <i>Research Staff Member, Ph.D., AI Platforms,  IBM Almaden Research Center, USA</i> <b>Adversarial Machine Learning: Making AI Safer</b> <i>(University 11 + 12)</i>
12:30 -1:00 PM	<b>Lunch (on your own)</b>
1:30- 3:30PM	<b>Tutorial 3: Dr. Massimo Villari</b> <i>Professor, Computer Science Department, University of Messina, Italy</i> <b>Harmonising Cloud, Edge and IoT: The Osmotic Computing Paradigm</b> <i>Looking at simplified bio-techniques and models for managing complex analogous systems.</i> <i>(University 11 + 12)</i>
3:30 – 5:30PM	<b>Tutorial 4: Dr. Ashish Kundu</b> <i>Master Inventor, Research Staff Member, ACM Distinguished Member, ACM  Distinguished Speaker</i> <i>IBM T. J. Watson Research Center, USA</i> <b>Blockchain</b> <i>(University 11 + 12)</i>

# IEEE CIC Conference Day 1: Thursday, Oct 18, 2018

8am-5:30pm	Conference Registration (Conference Registration Desk outside <i>Conference Lobby</i> )		
7:30-8:30am	Informal Meet & Greet – Breakfast ( <i>Benjamin Franklin Combined</i> )		
8:30-8:45am	Welcome, Conference Opening Remarks ( <i>Benjamin Franklin Combined</i> )		
8:45-9:45am	<b>Keynote 1: Susan B. Davidson</b> <b>Weiss Professor</b> <b>University of Pennsylvania, USA</b> <b>Publication in The Era of Big Data and Open Source Software</b> ( <i>Benjamin Franklin Combined</i> )		
9:45-10am	Coffee Break ( <i>Benjamin Franklin Combined</i> )		
10am-12noon	Session 1 <b>Security &amp; Privacy 1</b> ( <i>University 11</i> ) <b>Chair:</b> Nathalie Baracaldo, IBM Almaden	Session 2 <b>Social Networks / Recommender Systems</b> ( <i>University 12</i> ) <b>Chair:</b> Latifur Khan, University of Texas, Dallas	<b>TeC4C Workshop I</b> ( <i>Benjamin Franklin 3</i> ) <b>Chair:</b> Massimo Villari, Università degli Studi di Messina
12:00am-1:00pm	<b>Lunch</b> ( <i>Benjamin Franklin Combined</i> )		
1:00pm – 2:00pm	<b>Keynote 2: Arjmand Samuel</b> <b>Principal Program Manager, Microsfost Azure IoT,Microsoft, USA</b> <b>Edge Computing – Bringing The Cloud Closer To The Edge</b> ( <i>Benjamin Franklin Combined</i> )		
2:00-3:30pm	Session 3 <b>Cloud / Networking</b> ( <i>University 11</i> ) <b>Chair:</b> Ashish Kundu, IBM TJ Watson	Session 4 <b>Application I</b> ( <i>University 12</i> ) <b>Chair:</b> Mudhakar Srivasta, IBM TJ Watson	<b>TeC4C Workshop II</b> ( <i>Benjamin Franklin 3</i> ) <b>Chair:</b> Michela Paolucci, Università degli Studi di Firenze
3:30pm – 3:45pm	Coffee Break ( <i>Benjamin Franklin Combined</i> )		
3:45-5:15pm	Session 5 <b>Vision I</b> ( <i>Benjamin Franklin Combined</i> ) <b>Chair:</b> James Joshi, University of Pittsburgh		
6:30 pm Onwards	Reception		

## IEEE CIC Conference Day 2: Friday, Oct 19, 2018

8am-5:30pm	Conference Registration (Conference Registration Desk at <i>Conference Lobby</i> )		
7:30-8:30am	Informal Meet & Greet – Breakfast ( <i>Benjamin Franklin Combined</i> )		
8:45-9:45am	<b>Keynote 3: Lixia Zhang</b> <i>Jonathan B. Postel Professor,</i> <i>University of California, Los Angeles, CA, USA</i> <b>Enabling Pervasive Collaboration from the Ground Up</b> ( <i>Benjamin Franklin Combined</i> )		
9:45–10am	Coffee Break ( <i>Benjamin Franklin Combined</i> )		
10am-12noon	Session 6 <b>Security / Privacy II</b> ( <i>University 11</i> ) <b>Chair:</b> Barbara Carminati, University of Insubria	Session 7 <b>Invited Papers</b> ( <i>University 12</i> ) <b>Chair:</b> Jaideep Vaidya, Rutgers University	<b>ECiSeH Workshop I</b> ( <i>Benjamin Franklin 3</i> ) <b>Chair:</b> Massimo Villari, Università degli Studi di Messina
12noon - 1:00pm	<b>Lunch</b> ( <i>Benjamin Franklin Combined</i> )		
1:00 – 2:00	<b>Keynote 4: Anupam Joshi</b> <i>Director, UMBC Center for Cybersecurity, Oros Family Professor and Chair,</i> <i>University of Maryland, Baltimore County, MD, USA</i> <b>CyberAllIntel: Extracting cybersecurity information from text</b> ( <i>Benjamin Franklin Combined</i> )		
2:00 – 3:30	Session 8 <b>Collaboration</b> ( <i>University 11</i> ) <b>Chair:</b> Christopher Yang, Drexel University	Session 9 <b>Application II</b> ( <i>University 12</i> ) <b>Chair:</b> Taieb Znati, University of Pittsburgh	<b>ECiSeH Workshop II</b> ( <i>Benjamin Franklin 3</i> ) <b>Chair:</b> Massimo Villari, Università degli Studi di Messina
3:30-3:45	Coffee Break ( <i>Benjamin Franklin Combined</i> )		<b>Tutorial:</b> <b>Big Data Stream Analytics for Cyber Security</b> <b>by</b> <b>Latifur Khan, UT Dallas</b> ( <i>Benjamin Franklin 3</i> )
3:45-5:15pm	Session 10 <b>Vision II</b> ( <i>Benjamin Franklin Combined</i> ) <b>Chair:</b> Valerie Issarny, Inria		
6:30-9:30pm	<b>Banquet/Social Dinner &amp; Awards Ceremony</b> <b>(Ben Franklin Combined)</b>		

## IEEE CIC Conference Day 3: Saturday, Oct 20, 2018

8am-5pm	Conference Registration (Conference Registration Desk at <i>Conference Lobby</i> )		
7:30-8:30am	Informal Meet & Greet – Breakfast ( <i>Benjamin Franklin Combined</i> )		
8:45-9:45am	<b>Keynote 5: Aameek Singh</b> <b>Vice President of Engineering,</b> <b>IBM T. J. Watson, US</b> <b>Reinventing Businesses with AI</b> ( <i>Benjamin Franklin Combined</i> )		
9:45 – 10:45am	Session 11 <b>Vision III</b> ( <i>Benjamin Franklin Combined</i> ) <b>Chair:</b> Elisa Bertino, Purdue University		
10:45–11am	Coffee Break ( <i>Benjamin Franklin Combined</i> )		
11am-1:00pm	Session 12 <b>Application III</b> ( <i>University 11</i> ) <b>Chair:</b> Jia Zhang, Carnegie Mellon University	Session 13 <b>Industry/Government</b> ( <i>University 12</i> ) <b>Chair:</b> Bharat Rawal, Penn State University, Abington	<b>ISCBD + I-CAPCHA Workshop</b>  <b>Chair:</b> Karuna P Joshi, University of Maryland, Baltimore County ( <i>Benjamin Franklin 3</i> )
1:00pm–2:00pm	<b>Lunch &amp; Closing: TBC</b> ( <i>Benjamin Franklin Combined</i> )		

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## Session 1: Security and Privacy - I

Chair: Nathalie Baracaldo

10:00 A.M. – Noon, *University11*

- **AutoBotCatcher: Blockchain-based P2P Botnet Detection for the Internet of Things**  
Gokhan Sagirlar, Barbara Carminati and Elena Ferrari (*University of Insubria*)
- **Blockchain-based PKI solutions for IoT**  
Ankush Singla and Elisa Bertino (*Purdue University*)
- **Monitor: An Abnormality Detection Approach in Buildings Energy Consumption**  
Haroon Rashid and Pushpendra Singh (*IIIT Delhi*)
- **Securing Mobile Data Collectors by Integrating Software Attestation and Encrypted Data Repositories**  
Jongho Won and Elisa Bertino (*Purdue University*)

## Session 2: Social Networks & Recommender Systems

Chair: Latifur Khan

10:00 A.M. – Noon, *University12*

- **Link-Sign Prediction in Dynamic Signed Directed Social Networks**  
Quang-Vinh Dang and Claudia-Lavinia Ignat (*Universite' de Lorraine*)
- **Mining the Best Observational Window to Model Social Phenomena**  
Chao Yan (*Vanderbilt University*), Zhijun Yin (*Vanderbilt University*), Stanley Xiang (*Vanderbilt University*), You Chen (*Vanderbilt University*), Yevgeniy Vorobeychik (*Washington University in St. Louis*), Daniel Fabbri (*Vanderbilt University*), Abel Kho (*Northwestern University*), David Liebovitz (*University of Chicago*) and Bradley Malin (*Vanderbilt University*)
- **Investigating Aspects of Platform Growth on Crowdsourced Recommendation Services**  
Julian Jarrett and M Brian Blake (*Drexel University*)

## Session 3: Cloud/Networking

Chair: Ashish Kundu

2:00 P.M. – 3:30 P.M., *University11*

- **Parallel Schedule of Live Migrations for Virtual Machine Placements**  
M P Giles (*Government Engineering College Wayanad*), Sanjay Satheesh (*National Institute of Technology Calicut*), Athul Chandran (*National Institute of Technology Calicut*), S D Madhu Kumar (*National Institute of Technology Calicut*) and Lillykutty Jacob (*National Institute of Technology Calicut*)
- **Link-Quality and Traffic-Load Aware Routing for UAV Ad Hoc Networks**  
Cong Pu (*Marshall University*)
- **Automatic Feedback Control for Graceful Degradation of Real-Time Services in the Face of an Attack**  
Jagannadh Vempati and Ram Dantu (*University of North Texas*)

## Session 4: Application - I

Chair: Mudhakar Srivasta

2:00 P.M. – 3:30 P.M., *University12*

- **A Decentralized Marketplace Application on The Ethereum Blockchain**  
Ranganthan Vishnu Prasad, Ram Dantu, Aditya Paul, Paula Mears and Kirill Morozov (*University of North Texas*)
- **A QoS framework for SDN-based Networks**  
Haitham Ghalwash and Chun-Hsi Huang (*University of Connecticut*)
- **Lightweight Web Services Migration Framework in Hybrid Clouds**  
Saadaoui Alaeddine and Stephen L. Scott (*Tennessee Technological University*)

## Session 5: Vision-I

Chair: James Joshi

3:45 P.M. – 5:15 P.M., *Benjamin Franklin Combined*

- **Towards modernizing the Future of American Voting**  
LeRoy Carr III, Anthony Newton, James Joshi (*University of Pittsburgh*) Invited
- **Collaborative and Accountable Hardware Governance using Blockchain**  
Ashish Kundu, Zehra Sura and Upendra Sharma (*IBM T J Watson Research Center*)
- **Blockchain as a Platform for Secure Inter-Organizational Business Processes**  
Barbara Carminati, Elena Ferrari and Christian Rondanini (*University of Insubria*)

## Session 6: Security and Privacy-II

Chair: Barbara Carminati

10:00 A.M. – 12:00 P.M., *University 11*

- **RIPA: Real-time Image Privacy Alert System**  
Dakshak Keerthi Chandra (*Missouri University of Science and Technology*), Weerdhawal Chowgule (*Missouri University of Science and Technology*), Yanjie Fu (*Missouri University of Science and Technology*) and Dan Lin (*University of Missouri*)
- **Detection of Temporal Data Ex-filtration Threats to Relational Databases**  
Asmaa Sallam and Elisa Bertino (*Purdue University*)
- **Prunable Authenticated Log and Authenticable Snapshot in Distributed Collaborative Systems**  
Victorien Elvinger, Gerald Oster and Francois Charoy (*Universite' de Lorraine*)
- **Context-Aware Deep Learning-Driven Framework for Mitigation of Security Risks in BYOD-Enabled Environments**  
Daniel Petrov and Taieb Znati (*University of Pittsburgh*)

## Session 7: Invited Papers

Chair: Jaideep Vaidya

10:00 A.M. – 12 P.M., *University 12*

- **Alcatraz: Data Exfiltration-Resilient Corporate Network Architecture**  
Daniele E. Asoni (*ETH Zürich*), Takayuki Sasaki (*NEC Corporation*), Adrian Perrig (*ETH Zürich*)
- **Supporting Virtual Organizations Using Attribute-Based Encryption in Named Data Networking**  
Craig A. Lee (*Aerospace Corporation*), Zhiyi Zhang (*University of California, Los Angeles*), Yukai Tu (*University of California, Los Angeles*), Alex Afanasyev (*Florida International University*), Lixia Zhang (*University of California, Los Angeles*)
- **The Impact of Malicious Accounts on Political Tweet Sentiment**

Brian Heredia, Joseph D. Prusa, and Taghi M. Khoshgoftaar (*Florida Atlantic University*)

➤ **Policy and Resource Orchestration in Software-Defined Networks**

Anduo Wang and Jie Wu (*Temple University*)

## Session 8: Collaboration

**Chair:** Christopher Yang

**2:00 P.M. – 3:30 P.M., *University 11***

➤ **Facilitating Data-Centric Recommendation in Knowledge Graph**

Jia Zhang (*Carnegie Mellon University*), Maryam Pourreza (*Carnegie Mellon University*), Rahul Ramachandran (*NASA/MSFC*), Tsengdar J. Lee (*NASA Headquarters*), Patrick Gatlin (*NASA/MSFC*), Manil Maskey (*NASA/MSFC*), Amanda Marie Weigel (*University of Alabama Huntsville*)

➤ **New Algorithms and Methods for Collaborative Co-Editing Using HTML DOM Synchronization**

Cristian Gadea, Bogdan Ionescu and Dan Ionescu (*University of Ottawa*)

➤ **A Teacher Dashboard for Real-time Intervention**

Sebastián Hernández (*Universidad de Chile*), Nelson Baloian (*Universidad de Chile*), José Pino (*Universidad de Chile*), Xiaojun (Jenny) Yuan (*University at Albany*)

## Session 9: Application – II

**Chair:** Taieb Znati

**2:00 P.M. – 3:30 P.M., *University 12***

➤ **Automated Threat Report Classification Over Multi-Source Data**

Gbadebo Ayoade, Swarup Chandra, Latifur Khan, Kevin Hamlen and Bhavani Thuraisingham (*University of Texas Dallas*)

➤ **Transfer Learning of Deep Neural Networks for Visual Collaborative Maritime Asset Identification**

Nicholas Warren (*Texas State University*), Benjamin Garrard (*Texas State University*), Elliot Staudt (Mayachitra) and Jelena Tesic (*Texas State University*)

➤ **Smart Surveillance as an Edge Network Service: from Harr-Cascade, SVM to a Lightweight CNN**

Seyed Yahya Nikouei (*Binghamton University*), Yu Chen (*Binghamton University*), Sejun Song (*University of Missouri*), Ronghua Xu (*Binghamton University*), Baek-Young Choi (*University of Missouri*), and Timothy R. Faughnan (*Binghamton University*),

## Session 10: Vision-II

**Chair:** Valerie Issarny

**3:45 P.M. – 5:15 P.M., *Benjamin Franklin Combined***

➤ **Envisioning an Information Assurance and Performance Infrastructure for the Internet of Things.**

Jamie Payton, Xiaojiang Du, Xubin He and Jie Wu (*Temple University*) **Invited**

➤ **MEDUSA: Malware Detection Using Statistical Analysis of System's Behavior**

Muhammad Ejaz Ahmed (*Data61 CSIRO*), Surya Nepal (*Data61 CSIRO*) and Hyounghick Kim (*Sungkyunkwan University*)

➤ **Next Generation Trustworthy Fraud Detection**

Sihong Xie (*Lehigh University*) and Philip S. Yu (*University of Illinois at Chicago*)

## Session 11: Vision – III

**Chair:** Elisa Bertino

**9:45 A.M. – 10:45 A.M., Benjamin Franklin Combined**

➤ **Storage Service Orchestration with Container Elasticity**

Amit Warke (*Almaden Research Center, IBM Research & Georgia Institute of Technology*), Mohamed Mohamed (*Almaden Research Center, IBM Research*), Robert Engel (*Almaden Research Center, IBM Research*), Heiko Ludwig (*Almaden Research Center, IBM Research*), Wayne Sawdon (*Almaden Research Center, IBM Research*) and Ling Liu (*Georgia Institute of Technology*)

➤ **Predictive Modeling with Vehicle Sensor Data and IoT for Injury Prevention.**

Christopher C. Yang (*Drexel University*), Ou Stella Liang (*Drexel University*), Santiago Ontanon (*Drexel University*), Weimao Ke (*Drexel University*), Helen Leob (*Children's Hospital of Philadelphia*), and Charlie Klauer (*Virginia Tech Transportation Institute*)

## **Session 12: Application – III**

**Chair:** Jia Zhang

**11:00 A.M. – 1:00 P.M., University11**

➤ **Hybrid Machine-Crowd Approach for Fake News Detection**

Shaban Shabani (*University of Basel*) and Maria Sokhn (*University of Applied Sciences Western Switzerland*)

➤ **Understanding the Determinants of Enterprise Social Network Use**

Gerald Stei and Alexander Rossmann (*Reutlingen University*)

## **Session 13: Industry/Government**

**Chair:** Bharat Rawal

**11:00 A.M. – 1:00 P.M., University12**

➤ **ysla: Reusable and Configurable SLAs for Large-Scale SLA Management**

Robert Engel (*Almaden Research Center, IBM Research*), Shashank Rajamoni (*Almaden Research Center, IBM Research*), Bryant Chen (*Almaden Research Center, IBM Research*), Heiko Ludwig (*Almaden Research Center, IBM Research*) and Alexander Keller (*Global Technology Services*)

➤ **Osmotic Collaborative Computing for Machine Learning and Cybersecurity Applications in Industrial IoT Networks and Cyber Physical Systems with Gaussian Mixture Models**

Emmanuel Oyekanlu (*Drexel University*)

➤ **Fault-Tolerant Real-Time Collaborative Network Edge Analytics for Industrial IoT and Cyber Physical Systems with Communication Network Diversity**

Emmanuel Oyekanlu (*Drexel University*)

➤ **Open Educational Resources Platform Based on Collective Intelligence**

Marcela Ribeiro de Oliveira, Israel Barreto Sant'Anna, Guilherme Scariot Ramos, Luis Carlos Erpen De Bona, Marcos Alexandre Castilho, Marcos Didonet Del Fabro and Eduardo Todt (*Federal University of Parana*)

➤ **Early detection of Cybersecurity Threats using Collaborative Cognition**

Sandeep Narayanan, Ashwinkumar Ganesan, Karuna Joshi, Tim Oates, Anupam Joshi and Tim Finin (*University of Maryland*)

## **TeC4C Workshop I (Day 1)**



**Chair:** Massimo Villari

**10:00 A.M. – 12:00 P.M., Benjamin Franklin 3**

- **Knowledge Modeling and Management for Mobility and Transport Applications**  
Pierfrancesco Bellini, Stefano Bilotta, Daniele Cenni, Paolo Nesi, Michela Paolucci and Mirco Soderi (*Università degli Studi di Firenze*)
- **Joint Cost Estimation Approach for Service Provider Legacy Network Migration to Unified Software Defined IPv6 Network**  
Babu R Dawadi (*Norwegian University of Science and Technology*), Danda B Rawat (*Howard University*), Shashidhar R Joshi (*Tribhuvan University*) and Martina M Keitsch (*Norwegian University of Science and Technology*)
- **Urban pollution monitoring based on Mobile Crowd Sensing: an osmotic computing approach**  
Antonella Longo (*University of Salento*), Andrea De Matteis (*University of Salento*) and Marco Zappatore (*Hesplora srl*)
- **Auditing and Assessment of data traffic flows in an IoT Architecture**  
Paolo Nesi, Gianni Pantaleo, Michela Paolucci and Imad Zaza (*University of Florence*)

## **TeC4C Workshop II (Day 1)**

**Chair:** Michela Paolucci

**2:00 P.M. – 3:30 P.M., Benjamin Franklin 3**

- **Designing a FIWARE Cloud Solution for Making your Travel Smoother: the FLIWARE Experience**  
Lorenzo Carnevale, Antonino Galletta, Maria Fazio, Antonio Celesti and Massimo Villari (*University of Messina*)
- **Intelligent Crime Anomaly Detection in Smart Cities using Deep Learning**  
Sharmila Chackravathy, Steven Schmitt and Li Yang (*University of Tennessee at Chattanooga*)
- **Assessment of an IoT Platform for Data Collection and Analysis for Medical Sensors**  
João Rei, Cláudia Brito and António Sousa (*Universidade do Minho*)
- **A Method for Large-Scale Resource Allocation in Smart Cities**  
Hadi Hajari and Hassan Ali Karimi (*University of Pittsburgh*)

## **ECISeH Workshop I (Day 2)**

**Chair:** Massimo Villari

**10:00 A.M. – 12:00 P.M., Benjamin Franklin 3**

- **Tapping into the Use of Social Media Applications for Harnessing the Citizens' Collective Intelligence in the Strategic Digital City**  
Carla Cavichiolo Flores, Denis Alcides Rezende and Luisa Aguilar Lopes (*Universidade Catolica do Parana*)
- **Visual Analytics Ontology-guided I-DE system: A case study of Head and Neck Cancer in Australia**  
Ahsan Morshed (*Swinburne University of Technology*), Abdur Rahim Mohammad Forkan (*Swinburne University of Technology*), Tejal Shah (*Newcastle University*), Prem Prakash Jayaraman (*Swinburne University of Technology*), Dimitrios Georgakopoulos (*Swinburne University of Technology*) and Rajiv Ranjan (*Newcastle University*)
- **Using fuzzy Geoparticipation Methods to Optimize the Spatial Development Process in a Smart City**  
Robert Olszewski and Agnieszka Turek (*Warsaw University of Technology*)
- **A Multilayer Perceptron-Based Distributed Intrusion Detection System for Internet of Vehicles**

Ayesha Anzer and Mourad Elhadeif (*Abu Dhabi University*)

## ECISEH Workshop II (Day 2)

Chair: Massimo Villari

**2:00 A.M. – 3:00 P.M., *Benjamin Franklin 3***

- **Towards The Basic Principles of Osmotic Computing: A Closed-Loop Gamified Cognitive Rehabilitation Flow Model**  
Alina Buzachis, Giuseppe Massimo Bernava, Mario Busà, Giovanni Pioggia and Massimo Villari
- **Train and Equip Firefighters with Cognitive Virtual and Augmented Reality**  
Li Yang (*University of Tennessee at Chattanooga*), Yu Liang (*University of Tennessee at Chattanooga*), Dalei Wu (*University of Tennessee at Chattanooga*) and Jim Gault (*Red Bank Fire Department*)

## ISCBD + I-CAPCHA Workshop (Day 3)

Chair: Karuna P Joshi

**11:00 A.M. – 1:00 P.M., *Benjamin Franklin 3***

- **Semantically Rich, Context Aware Access Control for Openstack**  
Vishal Rathod, Sandeep Nair Narayanan, Sudip Mittal and Anupam Joshi (*University of Maryland*)
- **Cold-Start User-Based Weighted Collaborative Filtering for an Implicit Recommender System for Research Facilities**  
Yogesh Kale (*North Carolina A&T State University*), Samantha E. Petrie (*University of North Carolina at Chapel Hill*), Marvan Bikdash (*North Carolina A&T State University*) and Michael D. Topal (*University of North Carolina at Chapel Hill*)
- **Multi-Stakeholder Consensus Decision-Making Framework Based on Trust: A Generic Framework**  
Lina Alfantoukh, Yefeng Ruan and Arjan Duresi (*Indiana University Purdue University Indianapolis*)
- **Analyzing CDR/IPDR data to find People Network from Encrypted Messaging Services**  
Adya V. Joshi (*Howard High School*), Madan Oberoi (Special Commissior of Police Special Cell and Technology Cell), Ranjan Bose (*Indian Institute of Technology Delhi*)