
Dr. Padmalochan Bera
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Qualification:

PhD, CSE (2011), Indian Institute of Technology, Kharagpur, India

- *Thesis:* **Formal Analysis of Security Policy Implementations in Enterprise Networks.**
- *Supervisor(s):* **Dr. S. K. Ghosh and Dr. Pallab Dasgupta, IIT Kharagpur.**

ME, CSE (2006), West Bengal University of Technology, Kolkata, India.

- *Specialization:* Distributed Systems, Network Security

BE, CSE (2001), Jadavpur University, Kolkata, India.

- *Specialization:* **Databases, Graph Theory, Operating Systems, Data Structure and Algorithms**

Research Area:

Network and System Security, Advanced Cryptography, Software Defined Networks, Access Control, Security Testing, Formal Verification and Optimization.

Teaching:

Computer Networks, Networks and System Security, Cryptography, Database Systems, Discrete Structure, Operating Systems

Work Experiences:

- Working as Assistant Professor of Computer Science and Engineering in IIT Bhubaneswar, Orissa, India from September 2013 till date
- Worked as Senior Research Scientist in Infosys Labs (Software Test Automation and Optimization Group), Bangalore, India from July 2012 to September 2013
- Worked as Researcher at General Motors India Science Lab (Control Software Validation Group), Bangalore, India from September 2011 to June 2012.
- Worked as Post-Doctoral Research Associate in CyberDNA Research Center, University of North Carolina at Charlotte, NC, USA from October 2010 to September 2011.
- Worked as a Senior Research Fellow in a Research Project titled “*Design & Development of Models and Tools for Vulnerability Assessment of Embedded Systems*” Sponsored by Ministry of Defense, India, New Delhi in Indian Institute of Technology, Kharagpur from July 2007 to September 2010.

- Worked as Sr. Lecturer in College of Engineering & Management, Kolaghat, West Bengal, India from August 2002 to July 2007.

Current Projects as Principal Investigator (at IIT Bhubaneswar, India):

- Design and Development of Distributed Controller for Software Defined Networks; Funding Agency: by Bharat Electronics Ltd., Bangalore, India (Cost: 63000 USD)
- NetAssure: A Formal Configuration Compliance checking, Security Policy Verification and Threat Diagnosis Tool for Enterprise Computing and Network Infrastructure; Funding Agency: Scientific Analytics Group, Defense Research and Development Organization, Govt. of India (Cost: 27000 USD)
- Automated Security Verification and Diagnosis of Smart Grid Advanced Metering Infrastructure - a formal analytics based approach; Funding Agency: Ministry of Human Resource and Division, Govt. of India (Cost: 15000 USD)
- Design of Lightweight Cryptographic Protocol for Secure Communication in Military Networks; Funding Agency: Ministry of Electronics and Information Technology, Govt of India (Cost: 120000 USD)

Previous Projects (at Infosys Labs, Bangalore, India)

- Quantification of Preventive Maintenance Metric for Enterprise Software
- Test Case Generation and Optimization for System of Systems Testing
- Fault Injection based Software Security Testing in Cloud Infrastructure

Previous Projects (at General Motors, India Science Lab, Bangalore, India):

Modern Technology Cars consist of a large number of Electronic Control Units (ECU) which are automatically managed by different embedded control software. These software essentially take inputs from different sensors at different time and accordingly triggers necessary actions to ensure consistent functionality and higher security and safety in different scenarios. My research at General Motors India Science Lab was focused on developing methodologies for automatic verification and validation of these control software in integration based on several safety-critical requirements and functional invariants/constraints. I was leading the following projects:

- RemoteGen: Requirement based Test Case Generation for Automotive Control software – End Applications: CSAV 2 Features (Supercruise, ACC)
- Modeling and Optimization of AUTOSAR based Control Design
- Model based Software Integration Testing

Previous Research (PhD @ IIT Kharagpur and Post-Doc @ UNC Charlotte):

My previous research was on Network Security and Formal Methods. The title of my PhD thesis is “Formal Analysis of Security Policy Implementations in Enterprise Networks”. The thesis primarily concentrates on formalizing organizational security policy and distributed access control implementations in an enterprise network and verifying whether the implementation conforms to the policy under static and dynamic topology environments. Through this research, I have developed a Formal Integrated Network Security Analysis Tool, namely, FINSAT, for systematic analysis of security policy implementations in enterprise networks. The tool allows users/network administrators querying about various service access paths in the networks with different security constraints towards hardening the security perimeter over the networks. I have also worked on policy

based security management in wireless networks (WLAN) supported by spatio-temporal role based access control models (STRBAC). I was actively involved in the following research activities throughout my PhD and Post-Doc tenure:

- Formal Verification of Access Control Models in IP Networks
- Fault Tolerant Policy based Security Implementations in IP Networks
- Formal Analysis of Security Threats in Smart-Grid Networks

Lead Research Projects (at UNC, Charlotte, USA):

- SmartAnalyzer: Framework for Analyzing Threats in Smart Grid Network Infrastructure sponsored by Duke Energy Systems, USA.
- ConfigLego: An Imperative approach of Security Configuration Analysis in Enterprise Networks sponsored by NSF, USA.
- ConfigSlider: Synthesizing Optimal and Usable Network Security Configuration using Constraint Satisfaction Checking sponsored by NSF, USA

Selected Research Publications:

Journals:

- **P. Bera**, Pallab Dasgupta, S. K. Ghosh, *Policy based Security Analysis in Enterprise Networks- A formal approach*, **IEEE Transaction on Network and Service Management (IEEE TNSM)**, vol. 7(4), pp. 231-243, December 2010.
- **P. Bera**, Pallab Dasgupta, S. K. Ghosh, *Integrated Security Analysis Framework for an Enterprise Network-A Formal Approach*, **IET Information Security Journal**, vol. 4(4), pp. 283-300, December 2010.
- **P. Bera**, S. K. Ghosh and Pallab Dasgupta, *A WLAN Security Management Framework based on Formal Spatio-Temporal RBAC Model*, **Journal of Security and Communication Networks, Wiley InterScience**, vol 4(9), pp. 981-993, August 2011.
- **P. Bera**, Pallab Dasgupta, S. K. Ghosh, *Formal Analysis of Security Policy Implementations in Enterprise Networks*. **International Journal of Computer Network and Communications (IJCNC)**, vol. 1(2), pp. 56-73, July 2009.
- **P. Bera**, M. Ashiqur Rahaman and Ehab Al-Shaer, *A Noninvasive Threat Analyzer for Advanced Metering Infrastructure in Smart Grid*. **IEEE Transaction on Smart Grid** vol 4(1), pp. 273-287, March 2013
- Soumya Maity, **Padmalochan Bera**, S. K. Ghosh and Ehab Al-Shaer. “*Formal integrated network security analysis tool: formal query-based network security configuration analysis*”. **IET Networks** vol. 4(2): 137-147, 2015
- Batakrisna Tripathy, **Padmalochan Bera**, Debiprosad Das, Swagat Jena. “*Risk based Security Enforcement in Software Defined Network*”, **Computer & Security, Elsevier**, vol 78 pp. 321-335 2018

Conferences:

- Madhukrishna Priyadarsini, **Padmalochan Bera**, Mohammad Ashiqur Rahman, "A New Approach for Energy Efficiency in Software Defined Network", **25th International Science Conference on Computer Networks (CN 2018)**, Gliwice, Poland, June 19-22, 2018.
- Madhukrishna Priyadarsini, **Padmalochan Bera**, "A New Approach for SDN Performance Enhancement", **IEEE International Conference on Software Defined Systems (SDS-2018)** Barcelona, Spain, April 23-26, 2018 (Best paper award)
- Kamalakanta Sethi, Anish Chopra, **Padmalochan Bera**, Bata Krishna Tripathy: "Integration of role based access control with homomorphic cryptosystem for secure and controlled access of data in cloud" **ACM SIN 2017**, pp.194-199, Jaipur, October 13-15, 2017.
- Kamalakanta Sethi, Shankar Kumar Chaudhary, Bata Krishna Tripathy, **Padmalochan Bera**: "A novel malware analysis for malware detection and classification using machine learning algorithms" **ACM SIN 2017**, pp. 07-113, Jaipur, October 13-15, 2017.
- Madhukrishna Priyadarsini, **Dr. Padmalochan Bera**, Rohan Bhampal, "Performance Analysis of SDN controller architecture- A Simulation Based Survey ", **IEEE WisPNET 2017 (IEEE COMSOC)**, Chennai, India, 22-24 March 2017
- Kamalakanta Sethi, Amartya Majumdar, **Padmalochan Bera**, "A Novel Implementation of Parallel Homomorphic Encryption for Secure Data Storage in Cloud", **International Conference on Cyber Security and Protection of Digital Services (Cyber Security 2017)**, pp-1-7, London, UK, June, 2017.
- Bata Krishna Tripathy, Ananta Gopal Sethy, **Padmalochan Bera** and Mohammed Ashiqur Rahman, A Novel Secure and Efficient Policy Management Framework for Software Defined Network, **40th IEEE COMPSAC**, pp. 423-430, Atlanta USA, June 10-14,2016.
- Bata Krishna Tripathy, **Padmalochan Bera**, Mohammad Ashiqur Rahman: Analysis of trust models in Mobile Ad Hoc Networks: A simulation based study. **COMSNETS:2016** pp. 1-8, Bangalore , November 2016
- Santosh Majhi and **Padmalochan Bera** "A Security Enforcement Framework for Virtual Machine Migration Auction". In **ACM Safeconfig 2015**, (Collocated with ACM CCS), pp. 47-53, Denver, USA, October 2015
- Santosh Majhi, **Padmalochan Bera**. Designing an Adaptive Firewall for Enterprise Cloud, **International Conference on Parallel, Distributed and Grid Computing**, Simla India, December 2014.
- Santosh Majhi, **Padmalochan Bera**. VM migration auction: Business oriented federation of cloud providers for scaling of application services, **International Conference on Parallel, Distributed and Grid Computing**, Simla India, December 2014.
- Santosh Majhi, **Padmalochan Bera**, Swapnil Kumar, Ehab Al-Shaer, Manoranjan Satpathy. Synthesizing Optimal Security Configurations for Enterprise Networks - A formal Approach. In **IET System Safety and Cyber Security Conference**, Manchester UK, October 2014.

- **Padmalochan Bera** and S. K. Ghosh, *A Query Driven Security Testing Framework for Enterprise Network*, In **IEEE SECTEST with IEEE ICST**, Luxembourg, March 2013
- **Padmalochan Bera** and A. Pasala, *A Framework for optimizing effort in Testing System-of-Systems*, In **IEEE ICSEM 2012**, Mysore, India, December 2012
- **P. Bera**, Pallab Dasgupta, S. K. Ghosh, *Formal Verification of Security Policy Implementations in Enterprise Networks*, In **International Conference on Information Systems and Security (ICISS 2009)**, LNCS 5905, pp. 117-131, Kolkata, India, December 2009.
- **P. Bera**, Pallab Dasgupta, S. K. Ghosh, *Fault Analysis of Security Implementations in Enterprise Networks*, In **IEEE International Conference on Network and Communication Systems (NetCom 2009)**, DOI: 10.1109/Netcom.2009.82, pp. 240-245, Chennai, India, December 2009.
- **P. Bera**, Pallab Dasgupta, S. K. Ghosh, *A Spatio-temporal Role-based Access Control Model for Wireless LAN Security Policy Management*, In **4th International Conference on Information Systems, Technology and Management (ICISTM-10)**, LNCS, Springer Verlag, pp 76-88, Bangkok, Thailand, March 2010.
- **P. Bera**, Soumya Maity, S. K. Ghosh and Pallab Dasgupta, *A Query based Formal Security Analysis Framework for Enterprise LAN*, In **10th IEEE International Conference on Computer and Information Technology 2010 (CIT 2010)**, Bradford, UK, pp. 407-414, IEEE Computer Society, June 2010.
- **P. Bera**, Soumya Maity, S. K. Ghosh and Pallab Dasgupta, *Generating Policy based Security Implementations in Enterprise Networks*. In **ACM SafeConfig Workshop, ACM CCS 2010**, Chicago, USA, October 2010.
- Saeed Al-Haj, **P. Bera** and Ehab Al-Shaer, *Build and Test Your Own Network Configuration*, In **7th International ICST Conference on Security and Privacy in Communication Networks (SecureComm 2011)**, London, UK, September 2011.
- M. Ashiqur Rahaman, **P. Bera** and E. Al-Shaer, *A Non-invasive Security Threat Analyzer for AMI Smart Grid*, **IEEE INFOCOM 2012**, pp. 2255-2263, Florida, USA, March 2012

Book Chapter:

- E. Al-Shaer, S.K.Ghosh, **P. Bera**, *Formal Analysis of Policy based Security Configurations in Enterprise Network*, In **Handbook on Securing Cyber-Physical Critical Infrastructure**, ISBN: 9780124158153, Morgan Kaufmann Publication, USA, June 2012

Technology Patents (granted):

- A. Pasala and **Padmalochan Bera**. Method and System for optimizing testing efforts in system of systems testing. US20150154094, 2015.

- A. Pasala and **Padmalochan Bera**. Method and system for generating stateflow models from software requirements, US20150261505 A1, 2018.

Professional Activities (Seminars, Workshops & Courses):

- **Doctoral Symposium Chair**, ICDCN (2017, 2018)
- **Tutorial Chair**, IEEE ANTS 2017
- **PC Member**, INFOCOM (2016, 2017), IEEE COMSNETS (2016, 2017, 2018), IEEE ANTS (2017, 2018), ICDCN (2016, 2017, 2018), COUFLESS 2015, ICSE 2015, ACM CCS (2010, 2011), Safeconfig 2016
- **Senior Research Scientist** in Infosys Labs (Software Test Automation and Optimization Group), Bangalore, India from July 2012 to September 2013
- **Researcher** in General Motors India Science Lab (Control Software Validation Group), Bangalore, India from September 2011 to June 2012.
- **Post-Doctoral Fellow** in CyberDNA Research Center, University of North Carolina, Charlotte, NC, USA from October 2010 to September 2011.
- **Senior Member**, IEEE and IEEE Control System Society, Bangalore Chapter
- **Member**, CyberDNA Research Centre, University of North Carolina, Charlotte, USA
- Reviewer of IEEE TNSM, IET Information Security, Wiley SCN, IEEE TNSM,

Invited Talks, Courses and Seminars:

- Invited Lecture on “Advanced Cryptosystems for Data and System Security”, Faculty Development Programme, NIT, Warrangal, India December 23, 2017
- Talk on “An implementation of parallel Homomorphic Encryption for data security”, Cyber Security 2017, London, UK, June 20, 2017
- Organized GIAN course on “Applied Cyber Security” in IIT Bhubaneswar during August 6-15, 2016 funded by Govt. of India.
- Invited Talk on "Formal Modelling Techniques for verification of Network Security Policy Implementations and device configurations", Scientific Analytics Group, DRDO, Govt of India, New Delhi, June 6 2016
- Invited Talk on “Software Defined Networks – Research & Development Roadmap”, Bharat Electronics Ltd., Bangalore, India, September 6, 2016.
- Invited Talk on "Software Defined Networks with Network Function Virtualization – a research roadmap", IEEE National Workshop on Wireless Sensor Networks with Internet of Things and Cloud Computing, Bhubaneswar January 15-16, 2016.
- Invited Talk on "Security Challenges on Network and Critical Infrastructure – Enterprise perspective", IBM Faculty Residency Program on Cyber Security at IBM Bangalore, June 2-6, 2014.
- Delivered Talk on Cyber Security Challenges in Smart Grid Infrastructure in National Workshop on Smart Grid Technologies (NWSGT) held in IIT Bhubaneswar during 8-9 November 2014.
- Delivered Talk on “Security and Safety Challenges in Smart Grid Advanced Metering Infrastructure” in IEEE CSS Symposium on Cyber Physical Systems at IISC Bangalore, India during November 2-3 2012.

- Attended Microsoft Research (MSRI) summer school on Programming Languages, Analysis and Verification in IISC, Bangalore during 16-28 June 2008.
- Delivered lecture on Network and Embedded System Security in a workshop on Information Assurance and Security organized by IIT Kharagpur during 7-17 April 2009.
- Delivered Lecture on Formal Analysis of Security Configurations in Enterprise Networks at CyberDNA Research Seminar in University of North Carolina at Charlotte, USA, March 18 2011
- Delivered Lectures on Cyber Security Challenges and Scope of Formal Methods under Advanced Network Security Course in University of North Carolina Charlotte, USA, Fall Semester 2011
- Delivered Talk on “Security and Safety Challenges in Smart Grid Advanced Metering Infrastructure” in IEEE CSS Symposium on Cyber Physical Systems at IISC Bangalore, India during November 2-3 2012.

Research Collaborators:

1. Prof. Ehab Al-Shaer, University of North Carolina Charlotte, NC, USA
2. Prof. Sajal Das, Missouri University of Science and Technology, Rolla, USA
3. Prof. Claude Crepeau, McGill University, Canada
4. Prof. Rajkumar Buyya, University of Melbourne, Australia
5. Dr. Mohammed Ashiqur Rahaman, Florida International University, USA
6. Mr. Sayan Das, Cisco Bangalore, India
7. Mr. Rakesh Kumar, CRL, Bharat Electronics, Bangalore, India
8. Ms Valluri Sarimela, CRL, Bharat Electronics Bangalore, India
9. Dr. Hemanth Rath, TCS Innovation Lab, Bhubaneswar, India
10. Mrs Kamini Malhotra, SAG, DRDO, Delhi, India
11. Mr Nitin Sharma, SAG, DRDO, Delhi, India
12. Dr. Debdeep Mukhopadhyay, IIT Kharagpur, India
13. Prof. C. Pandurangan, IIT Chennai, India
14. Prof. Pallab Dasgupta, IIT Kharagpur, India
15. Prof. Soumya Kanti Ghosh, IIT Kharagpur, India
16. Prof. S. Ramesh, General Motors, Detroit, USA