

SOUMYABRATA TALUKDER

3rd year PhD student ◊ Electrical Engineering ◊ Iowa State University

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CAREER OBJECTIVE

A self-motivated spontaneous researcher and team player, intrigued and inclined towards the areas of machine-learning, numerical optimization and formal methods with power systems as application domain, looking for a fellowship and/or internship opportunity.

EDUCATION

Iowa State University, IA, USA

Doctor of Philosophy (in progress)

Department of Electrical and Computer Engineering

Aug 2017 - present

CGPA: 4.00/4.00

Jadavpur University, Kolkata, India

Bachelor of Engineering (first class with honors)

Department of Electrical Engineering

Jun 2005 - Apr 2009

CGPA: 9.08/10.00

GRADUATE COURSES TAKEN

EE-571	Convex Optimization	EE-577	Linear Systems
EE-576	Digital Feedback Control	EE-578	Nonlinear Systems
STAT-554	Stochastic Processes	COMS-507X	Applied Formal Methods
EE-525X	Data Analytics	EE-526X	Deep Learning
ME-592X	Machine Learning for CPS		

ACCEPTED/SUBMITTED RESEARCH ARTICLES

1. **S. Talukder**, R. Kumar, *An Enhancement in Sum-of-Squares Optimization based Region of Attraction Estimation for Power Systems* - accepted in IEEE PES General Meeting 2019 ([link](#)).
2. **S. Talukder**, M. Ibrahim, R. Kumar, *Computation of Stability and Performance related Resilience Measures for Power Systems* - submitted in IEEE Transaction on Systems, Man and Cybernetics: Systems in Sep 2019 ([link](#)).

SKILLS

Research	Deep neural networks, deep reinforcement learning, partially observed Markov decision processes, learning Gaussian process models, numerical optimization, model predictive control, resilience of complex systems, formal methods, transient stability, differential-algebraic equations, cyber security.
Technical software	Tensor Flow, PyTorch, Keras, Scikit-learn, CVX, Sostools, PSAT, PSSE, PSLF, PSCAD, R, Nuxmv, Spin, Z3, AADL.
Programming language	Python, Java, C, C++, MATLAB.
Operating system	Windows, Linux (both Fedora and Debian distributions).
General tool	MS Office, MS Project, Latex.
Managerial	Managing scope, time, cost and quality of projects, leadership, stakeholder management, progress monitoring and reporting.

ACADEMIC RESEARCH EXPERIENCE

Iowa State University, IA, USA

Fall 2018 - present

Research assistant at ESSeNCE lab, supervised by Dr. Ratnesh Kumar

- **Sum-of-squares Optimization:** An algorithmic enhancement of the traditional *sum-of-squares optimization* based *region-of-attraction* (ROA) estimation for power systems is proposed, showing significant reduction in the overall computation time. The approach is further extended to compute the volume of the estimated ROA as a sub-level set of a *Lyapunov* function, which provides a metric to quantify the transient stability of a power system in polynomial time computational complexity.
- **Resilience:** A physical-topology guided notion of resilience for power systems is quantified as a six dimensional normalized vector, which is the probabilistic average of such vectors corresponding to the individual credible fault-sequences. A new way of computing *transient stability margin* and *critical clearance time* using sum-of-squares optimization is proposed. Also a novel approach to compute *relay margin* by solving an iterative *quadratic-constraint-quadratic-program* is introduced.
- **Deep-neural-networks:** A novel *long-short-term-memory* (LSTM) based deep-neural-network (DNN) is proposed for early prediction of *long-term voltage instability*, ensuing a large disturbance in a power-grid. The proposed DNN is capable to utilize both the pre-fault SCADA snapshot and a short-prefix of the post-fault time-series of PMU measurements for prediction, showing substantial improvement in its noise-robustness over a state-of-the-art decision-tree.
- **Deep-reinforcement-learning** (current research area): Recently, wide-area control schemes are proven to be more effective than their local counterparts, under emergency condition of a large power-grid. However, computing real-time centralized control utilizing the wide-area measurements using the conventional optimization-based techniques, may not be practical, especially when the control needs to be enacted within a very short time-window to regain normalcy. This motivates us to explore the possibility to design a deep-reinforcement learning based centralized controller, trained offline from simulation-data generated around the baseline operating condition, for real-time control synthesis using online measurements.
- **Future research plan:** The future research directions include development of an integrated framework for wide-area instability detection and control of power-grid using machine-learning. The objective encompasses detection of anomalous behaviour of measuring instruments to trigger back-up control as needed, identification of optimal islanding-strategy during inter-area oscillations. An efficient approach to verify safety and robustness of a DNN will be developed, using an ensemble method that leverages benefits of interval arithmetic, SMT solver and convex relaxation of input-output constraints and neural-network activations.

TEACHING EXPERIENCE

Iowa State University, IA, USA

Fall 2017 - Spr 2018

Teaching assistant for EE-324 (Signals and Systems - II)

- Responsibilities included course-recitation, lab-proctoring and grading.

INDUSTRIAL EXPERIENCE

GE Global Research Center, NY, USA

May 2019 - Aug 2019

Fellow Intern

- Worked with the formal methods team for the **Cyber Assured System Engineering** (CASE) project, led by DARPA. Proposed and developed an innovative graphical user interface that provides an intuitive and interactive *wizard* to set the mission-level cyber requirements as well as the cyber relations among the inter-dependent subcomponents involved in the mission.

- Got exposure to the state-of-the-art of cyber-security analysis and verification framework in aviation industry, and also to GE's popular Bayesian Hybrid Modelling tool, which uses a Gaussian process based learning technique for modelling and testing of dynamic input-output systems.

ITC Ltd., Bangalore, India

Dec 2012 - Jul 2017

Assistant Manager - Projects

- Led design, procurement and construction of electro-mechanical services for two large-scale building projects, spanning over 9 acres of plot area and 0.6 million sqft. of built-up space.
- Took the role of a key coordinator among the interdependent disciplines (e.g. structural, interior etc.) of the overall project.

GE Grid Solutions, Noida, India

Jul 2009 - Nov 2012

Project Engineer

- Led site installation and commissioning of *electrical balance of plant* for a 2 x 600 MW thermal power plant, together with a 400 kV generation switchyard.
- Led engineering, procurement and construction of six new power-transmission substation projects.

AWARDS AND HONORS

1. Received **Impact Award** from General Electric Global Research Center, USA, in Jul 2019 for developing an innovative graphical user-interface that made usage of a software toolset substantially easier.
2. Received **Certificate of Appreciation** from the CEO of ABD, ITC Limited, India, in Jun 2017 for timely delivery of a constrained project.
3. Received **Barindra Memorial Medal** from Jadavpur University, India, in Dec 2009 for distinguished academic performance during Bachelor of Engineering program.
4. Received **SEEA scholarship** from West Bengal State Electrical Engineers Association, India, in Aug 2008 for consistent academic excellence during Bachelor of Engineering program.
5. Received **National Merit Scholarship** from Govt. of India in Aug 2005 for academic distinction prior undergraduate program.

EXTRA-CURRICULAR ACTIVITY

Voluntarily promoting awareness about sustainability, and optimal usage of natural resources. A **certified trainer** of **Green Rating for Integrated Habitat Assessment**.