ANIK KUMAR SAMANTA

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Research Interests

Statistical Signal Processing, instantaneous frequency estimation, spectral estimation
Estimation theory, detection theory, hypothesis testing
Condition monitoring, motor signature analysis, embedded system development

Research Experience

June 2016 – present: Ph.D. Research Scholar, Advanced Technology Development Centre, IIT Kharagpur.
Synopsis seminar delivered on January 28, 2020.
Oct 2012 – June 2016: Research Engineer, Centre for Railway Research, IIT Kharagpur.
June 2011 – Oct 2012: Project Engineer, Real-Time Embedded System Lab, IIT Kharagpur.
Teaching Assistance: Embedded Systems Lab (3 semesters), Real-Time Signal Processing Lab (2 Semester), Statistical Signal Processing (2 semesters)

List of Publication

Patents Filed:

1. A. Routray, A. Naha, **A. K. Samanta,** Amey Pawar, Chandrasekhar Sakpal, "A system for assessment of multiple faults in induction motors", WO2019167086A1, 2019

Journal Publication:

1. **A. K. Samanta**, A. Routray, S.R. Khare, & A. Naha, "Minimum Distance-based Detection of Incipient Induction Motor Faults using Rayleigh Quotient Spectrum of Conditioned Vibration Signal," in *IEEE Transactions on Instrumentation and Measurement*, vol. 70, pp. 1-11, 2021.
2. **A. K. Samanta**, A. Routray, S.R. Khare, & A. Naha, "Direct Estimation of Multiple Time-varying Frequencies of Non-stationary Signals". *Signal Processing*, vol. 169, pp. April 2020
3. **A. K. Samanta**, A Naha, A Routray, AK Deb "Fast and accurate spectral estimation for online detection of partial broken bar in induction motors", *Mechanical Systems and Signal Processing*, vol. 98, January 2018
4. A. Naha, **A. K. Samanta**, A. Routray and A. K. Deb, "Low Complexity Motor Current Signature Analysis Using Sub-Nyquist Strategy With Reduced Data Length," in *IEEE Transactions on Instrumentation and Measurement*, vol. 66, no. 12, pp. 3249 – 3259, December 2016.
5. A. Naha, **A. K. Samanta**, A. Routray and A. K. Deb, "A Method for Detecting Half-Broken Rotor Bar in Lightly Loaded Induction Motors Using Current," in *IEEE Transactions on Instrumentation and Measurement*, vol. 65, no. 7, pp. 1614-1625, July 2016.
6. A. Naha, K. R. Thammayyabbabu, **A. K. Samanta**, A. Routray and A. K. Deb, "Mobile Application to Detect Induction Motor Faults," *IEEE Embedded Systems Letters*, vol. 9, no. 4, pp. 117 – 120, Dec 2017.
7. C. Pradhan, C. N. Bhende, and **A. K. Samanta**. "Adaptive Virtual Inertia-Based Frequency Regulation in Wind Power Systems." *Renewable Energy,* vol. 115, pp. 558-574, 2018.
8. A. Naha, **A. K. Samanta**, A. Routray, and A. K. Deb "Determining Autocorrelation Matrix Size and Sampling Frequency for MUSIC Algorithm," *IEEE Signal Processing Letters*, vol.22, no.8, pp.1016-1020, Aug. 2015.

9. A. Mukherjee, A. Routray, and **A. K. Samanta**, "Method for On-line Detection of Arcing in Low Voltage Distribution Systems", *IEEE Transactions on Power Delivery,* vol. 32, no. 3, pp. 1244 - 1252. June 2017.
10. **A. K. Samanta**, A. Naha, D. Basu, A. Routray, and A. K. Deb, "Online Condition Monitoring of Traction Motor", Book chapter in *Handbook of Research on Emerging Innovations in Rail Transportation Engineering*, IGI Global.

Academic Qualification

- Pursuing Doctor of Philosophy in signal processing from IIT Kharagpur, CGPA (till coursework): 8.67
  Thesis Title: *Frequency Estimation under Stationary and Non-stationary Conditions - A Case Study of Induction Motor Fault Diagnosis*
- Completed Master of Science (by Research) from IIT Kharagpur, CGPA: 9.69/10.
  Thesis Title: *Designing Real-Time Diagnostics for Squirrel Cage Induction Motors*
  (a) Setting up 22-kW squirrel cage induction motor fault experimental test bed. (b) Development of low-complexity, high-resolution spectral estimator. (c) Development of a real-time SCIM fault simulator.
- Passed B. Tech from Dr. B. C. Roy Engineering College (W.B.U.T) in Electronics and Communication Engineering with a GPA of (8.19/10) in 2011.
  Thesis Title: *An Intelligent Direction Monitoring Wireless System for Moving Objects*.
- (10+2) from South Eastern Railway Mixed Higher Secondary School (CISCE) with 78.8% in 2006.
- 10th from Sacred Heart High School (CISCE) with 80.6% in 2004.

Mentoring and Supervision

- 2019: Supervised a team of five interns for development of IoT-based fault detector, portable fault simulator, implementation of spectral estimators, and explored graph signal processing for earthquake epicenter estimation.
- 2018: Supervised two interns for non-stationary frequency estimation and detection of stationarity.
- 2017: Development of Wi-Fi current sensor, Internet based fault detection, and modification of Android based fault detection with four interns.
- 2016: Development of Android based fault detection system with one intern.
- 2015: Modification of the SCIM simulator with .mat initialization with one intern.
- 2014: Supervised a team of six interns for ARM implementation of the fault detection algorithm, efficient solvers for matrix inversion, and fast implementation of matrix multiplication.
- 2013: Mentored three interns in developing the SCIM fault simulation platform using SIMULINK real-time.
- 2012: Mentored a team of two interns in developing ARM-based signal processing application using CMSIS.

Hardware/Software Proficiency

- Hardware Platforms: Intel-based SBC, STM Discovery boards, and Raspberry Pi.
- Software Packages: MATLAB, Simulink, Simulink Real-time, Python, Google Colabs, Tensorflow, LaTeX.

Achievements

- Secured **All India Rank** of **225**, with a rank of **35 in chemistry** nationwide in National Science Talent Search Examination '05.
- An active member of organizing committee of Entrepreneurship Week '09, (champion's runners up.)

- Won the second prize for exhibiting **'Burning but not burning'** at S. E. Rly. Boys High School in 2006.

Extra-Curricular Activities

Professional Activities:

- Chair, IEEE Signal Processing Society Student Branch Chapter, IIT Kharagpur (2017-2019).
- Founding member and Treasurer of IEEE Signal Processing Society Student Branch Chapter, IIT Kharagpur (2016-2017).
- Graduate Student Member IEEE, and IEEE Signal Processing Society.
- Reviewer of
  - IEEE Transaction on Instrumentation and Measurement
  - IEEE Transaction on Industrial Applications
  - IEEE PES Transactions on Sustainable Energy
  - Elsevier Measurement
  - Elsevier Shock and Vibration
  - International Journal of Electrical and Computer Engineering (IJECE)
  - IEEE Engineering in Medicine Biology Conference
  - International Conference on Systems in Medicine and Biology 2016
- Hobbies:
  - Swimming
  - Numismatics.
  - Reading novels.

Personal Details

- Date of Birth: 10th January 1988.
- Father's Name: Pankaj Kumar Samanta.
- Languages Known: English, Hindi, and Bengali.

I hereby declare that the above information is true to the best of my knowledge.

Regards

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(ANIK KUMAR SAMANTA)

Date: February 22, 2021

Place: Kharagpur, WB.

Statement of Purpose

Anik Kumar Samanta

I have submitted my Ph.D. thesis under the supervision of Prof. Aurobinda Routray and Prof. Swanand Khare from the Advanced Technology Development Centre, Indian Institute of Technology Kharagpur, India. My dissertation is titled “Frequency Estimation under Stationary and Non-stationary Conditions - A Case Study of Induction Motor Fault Diagnosis.”

In the thesis, we have adopted a model-based approach to estimate the instantaneous frequency (IF) of multiple time-varying components using a linearized constrained Kalman filter. Previous state estimators could only estimate single component or their harmonics. Additionally, the phase retrieval property of the method can extract and remove dominant modes of a signal. The technique has been used for estimating chirp-like characteristic features of gravitational waves from colliding black-holes and was published in Elsevier Signal Processing. The thesis also proposed two spectral estimators for stationary signal analysis. The Rayleigh-quotient spectrum has high-accuracy, low-complexity, and is entirely data-driven. To incorporate the knowledge of the underlying model, a sequential Bayes maximum-a-posterior spectral estimator is also proposed. The detection and estimation of low-amplitude sinusoidal components have been practically applied for detecting weak induction motor faults. We also developed a minimum distance-based hypothesis test account for pre-existing fault frequency components. Recently, the works were accepted in IEEE Transaction on Instrumentation and Measurement, and Mechanical Systems and Signal Processing. A complete list of my publications, research highlights, and a brief about my technical abilities are presented in the curriculum vitae, for your kind perusal.

During my masters., I co-authored an IEEE signal processing letter for theoretically defining the resolution of the MUSIC algorithm. Your theoretical contribution in signal processing is fascinating and given a chance; I would like to work on the theoretical aspects of signal processing. I am also interested to understand the role of regularization in machine learning applied to inverse problemsSpecifically, how a network’s performance under non-optimal fitting can be compensated theoretically. In my Ph.D., I have dealt with interpretable features. However, in deep learning (DL) strategies, the features are typically uninterpretable. If suitable, I would like to explore the explainability of features. From the signal processing perspective, most deep learning algorithms are mainly used for detection and classification problems. I want to investigate the use of DL for estimation problems.

Previously, I have completed M.S. (by research) from the same institute in 2016 with a GPA of 9.69/10. The M.S. thesis dealt with the development of a real-time induction motor fault simulator and embedded system for fault detection. We started the embedded system development with Simulink Real-time and eventually

used the accelerometer of a mobile phone to record vibration signatures for fault detection. Currently, an IoT-based Wi-Fi current sensor has been developed for fault detection in a multiple-motor scenario.

Besides the technical aptitude, I have also acquired effective communication skills by training junior colleagues, delivering seminars, workshop presentations, and being a teaching assistant in multiple courses. Additionally, I have helped my supervisors guide summer interns and final-year masters' and bachelors' theses. I have also assisted my supervisors in writing project proposals for acquiring grants. Cumulatively, we were able to attract four projects (Indian Railways, Steel Authority of India Ltd., Airbus, Gas Authority of India Ltd.) on condition monitoring, data analytics, and prognostics. I am one of the founding members of the IEEE Signal Processing Society Student Branch of the Kharagpur section and have served two consecutive terms as its chair. We initiated the distinguished lecture program in the society, attracting multiple eminent speakers. I am proficient in the English language (both verbal and written). I can do independent research, as I have gained experience while designing my Ph.D. project, writing manuscripts, and guiding junior Ph.D. scholars. Also, I can quickly adapt to a collaborative environment, as evident from my collaborative work in designing embedded arc-fault detector and a simulation platform for wind power systems

I believe that my skill-set will equip me to contribute significantly to your research in theoretical signal processing. At the same time, getting selected will allow me to develop new skills and conduct research in an area that is more advanced, interesting, and challenging.

If selected, I can join the research group immediately.

Additionally, I have also provided the contact information of two referees for your kind reference. Thank you for your time and kind consideration.

Sincerely,

Anik Kumar Samanta
Indian Institute of Technology Kharagpur, India.

Contact Information of References

Ph.D. Supervisor
Prof. Aurobinda Routray
Professor, Dept. of Electrical Engineering
Indian Institute of Technology Kharagpur

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Ph.D. Co-Supervisor
Prof. Swanand R. Khare
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