Global Initiative of Academic Networks

Non-invasive Fault Diagnosis of Propulsion Motors used in Electric Vehicles

(Course ID: 2412132)

(17th – 21st Feb 2025)

Department of Electrical Engineering, NIT Warangal

About GIAN Course:

The Global Initiative of Academic Networks (GIAN) is a program of the Ministry of Education, Government of India. It is designed to tap the talent pool of scientists and entrepreneurs internationally to encourage their engagement with the institutes of higher education in India so as to augment the country's existing academic resources, accelerate the pace of quality reform, and elevate India's scientific and technological capacity to global excellence.

About the NIT Warangal

National Institute of Technology Warangal (NITW) formerly known as RECW is the first among seventeen RECs set up in 1959. Over the years, the Institute has established itself as a premier Institution in imparting technical education of a very high standard, leading to B.Tech, M.Tech and Ph.D. programs in various specializations of Science and Engineering streams. There are 14 departments offering 11 UG and 31 PG programs besides doctoral programs. It is fully residential campus sprawling over 250 acres with excellent infrastructures. National Institute of Technology Warangal campus is 2 km away from Kazipet railway station and 12 km away from Warangal railway station.

Electrical Engineering Department

The Department of Electrical Engineering is one of the oldest departments of the National Institute of Technology, Warangal (NITW). Established as one of the major departments of the Institute, in 1959, the department has been actively engaged in teaching and research in diverse fields of Electrical Engineering. With excellent faculty, the department offers Under Graduate (B.Tech) program in Electrical and Electronics Engineering and Post Graduate (M.Tech) programmes in “Power Electronics & Drives”, “Power Systems Engineering” ,“Smart Electric Grid”, newly started “ Control & Automation” and also offers Ph.D. programme in Electrical Engineering. The department has well-equipped state-of-the-art laboratories to augment the coursework and enhance the research potentials. The department has a dynamic group of faculties with profound experience in academics, research and industry, dedicated in teaching-learning process and actively engaged in the cutting-edge R&D activities with broad areas of expertise like; Power Electronic & Drives, Application of Power Electronics to Energy Efficient Lighting Systems, DSP controlled Industrial Drives, Electric Vehicle & Wireless Power Transfer and Power Quality Improvement, State Estimation and Real Time Control of Power Systems, Applications of ANN and Fuzzy Logic in Power Systems, Power System Deregulation, Power System Transients, Artificial Intelligence & Machine Learning etc

Overview

The proposed course is designed to cover topics related to non-invasive condition monitoring and fault diagnosis of propulsion motors used in Electric Vehicles.

Electric Vehicle (EV) user base is growing. With increase in recharging infrastructure and improved battery technology, there is a distinct possibility that EV will become prevalent within the next decade. Propulsion motor is a critical component of EV. Any unexpected failure of propulsion motor would have significant consequences. Therefore, there is a definite need for a technology that would detect faults in propulsion motor at an incipient stage.

Condition monitoring and fault diagnosis of electric motors reported in literature focus predominantly on industrial motors. EV motors differ from those in industries in many ways such as in (i) design & manufacturing, (ii) operating conditions, (iii) power rating, size, cost etc. One such difference is that the EV motors have much lower air gap compared to industrial counterparts. Consequently, asymmetry in the air gap distribution, called as eccentric condition, would have substantially more detrimental effect on propulsion motor performance and life. Moreover, unlike in industrial setup, smaller air gap makes it impossible to mount physical sensors to sense eccentricity fault in EV motors. Thus, it is critical to have a non-invasive fault diagnostic scheme that detects and estimates eccentricity faults in propulsion motors.

In this course, the attendees will be introduced to eccentricity faults, the conventional approaches to detect them and their limitations. The participants will then be familiarized with machine learning based approaches to detect eccentricity fault of varying severities using motor's line current data. The course is planned to be offered for one credit and the course duration will be 5 working days. Various aspects of the subject will be covered as part of the course with a proper blend of theory, simulation, and experimentation.

Course participants will learn these topics through lectures and hands-on experiments. Also, case studies and assignments will be shared to stimulate research motivation of participants.

<table>
<tr><td>Modules</td><td>
Schedule: February 17 - February 21 2025
Course Objectives: The primary objectives of this course are to introduce, expose, and train the participants on the following:
- Simulate airgap eccentricity faults.
- Implement a variety of machine learning methods for fault detection.
- Compare the performance of different machine learning methods in detecting and classifying eccentricity faults.
- Implement the developed algorithm on data collected from a research lab at the University of Victoria, Canada.
Number of Participants for the Course will be Limited to Forty (40).
</td></tr>
<tr><td>You Should Attend If…</td><td>
- You are a Faculty member / Design Engineer/Researcher/Scientist interested to learn Condition monitoring and fault diagnosis of electric motors in your profession.
- You are a UG/PG student or research Scholar from academic institution interested in learning how to do research or want work on a variety of machine learning methods for fault detection of electric motors.
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<tr><td>Fees</td><td>
The participation fees for taking the course is as follows:
<table>
<tr><td>Industry/ Research Organizations: Rs. 3,000/-
Faculty from Academic Institutions: Rs. 2,000/-
Students & Research Scholars: Rs. 1,000/-
Faculty/Scientists/Industry Participants from abroad: US $300
The above fee includes all instructional materials, tutorials and assignments.</td><td>Account Name: Director Research Account
Account No.: 62266262236,
Bank: State Bank of India, Branch: REC Warangal (NIT Campus)
Branch Code: 20149, IFSC: SBIN0020149
MICR Code: 506002030
SWIFT Code: SBININBBH14</td></tr>
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The participants from academic/research institutes and Industry will be provided with boarding and lodging on additional payment on sharing basis.
Fill the google form using the following link to complete the registration process
https://forms.gle/cQ6r8VfGxR9hzWXw6
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<tr><td></td><td>Last Date for Course Registration with Fee: 14-Feb-2025</td></tr>
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International Faculty

Dr. T.Ilamparithi, Electrical and Computer Engineering, University of Victoria, Canada

Dr. T.Ilamparithi received the B.E. degree from the Anna University, India in 2005. He received the M.Tech. degree from the Indian Institute of Technology, Delhi (IIT), India in the year 2007. He received the Ph.D. degree from the University of Victoria in 2013. Between 2013 and 2017, Ilamparithi worked as a Modelling and Simulation Specialist at OPAL-RT Technologies Inc., a Montreal based real time simulator manufacturer. Since May 2017, he has been working as an Assistant Teaching Professor at the University of Victoria.

Dr. Ilamparithi has published more than 20 papers in international journals and conferences. He has supervised 7 graduate students and has overseen many industrial consultancy projects worth about INR 17.00 lakhs. He is a member of the IEEE and the IEEE PES. He has also served as an Executive Committee Member of the IEEE PES Bangalore Chapter in the year 2016. His research interests includes condition monitoring of motors, real time simulation studies of smart grid and micro-grids and electrical power engineering pedagogy.For More Details Refer: **https://www.uvic.ca/ecs/ece/faculty-and-staff/home/faculty/ilamparithit.php**

SCHEDULE

Day 1
Lecture 1:
Airgap eccentricity: Basic definitions, conventional approaches for eccentricity fault detection and their limitations.
Tutorial 1:
Modelling airgap eccentricity faults in Finite Element simulation tools, applying traditional methods to detect and classify eccentricity faults.

Day 2
Lecture 2:
Introduction to machine learning methods for detecting airgap eccentricity faults.
Tutorial 2:
Implementing binary classification and Principal Component Analysis techniques to diagnose eccentricity faults.

Day 3
Lecture 3:
Building an experimental setup with different eccentricity faults of varying severities.
Lecture 4:
State of art and future scope for research investigations on fault diagnosis of motors used in Electric Vehicles (EV).
Tutorial 3:
Implementing Artificial Neural Network to classify eccentricity fault types.

Day 4:
Lecture 5:
Variable DC and PWM control of Switched reluctance motor Drive for EV/Pumping applications.
Tutorial 4:
Modeling Simulation on Switched reluctance motor and Switched reluctance motor control scheme.

Day 5
Lecture 6:
Opportunities and challenges of using artificial intelligence for condition monitoring of propulsion motors.
Tutorial 5:
Comparative analysis of convolutional neural network-based fault diagnosis with artificial neural network-based fault diagnosis.

Examination and Feedback

Course - Coordinator

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Co-Coordinator

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