Smart Grid Center Short Course

BIG DATA ANALYTICS FOR OUTAGE AND ASSET MANAGEMENT

Course Director Dr. Mladen Kezunovic

Description

The Big Data based prediction is an emerging area of data analytics for utility applications that offers many benefits in outage and asset management areas. Inherent in the prediction approaches is an ability to gain time to deploy mitigation techniques such as maintenance approaches to prevent failures or operating practices to reduce impact of failures. This course lays out some fundamental concepts related to the uses of Big Data in utility industry, as well as how one may integrate and pre-process data for outage and asset management uses. The course goes over details of the data sources, and related ownership ranging from utility measurements, government websites, and paid data from service providers. The course also outlines the foundation of the unique spatiotemporal data analytics model used to implement the predictions of power system events. The course objective is to provide the attendees with examples of advanced solutions with demonstrations illustrating the prediction benefits. Collectively the three course instructors have decades of experience in doing electric power system and data science studies, including engineering education (Hours: CEU 2.1, PDH 21).

Who Should Attend

The course is designed to provide a comprehensive coverage of the fundamentals of the Big data collection, management and processing, which may be used for operation, maintenance, planning and other utility applications. It is ideally suited for utility engineers with electrical or computer engineering background who have minimal experience in the concepts of Big Data analytics, including new graduates. The course if focused on operations and maintenance, but engineers from other areas of the utility industry will benefits from the source insights. The course will also be useful for managers who would like to gain and understanding of the Big data requirements, security of data resources, for those working in the policy and regulatory areas, for academics wishing to gain a practical understanding of the prediction concepts concepts, and for graduate students interested in careers in the power industry

Topics

1. Introduction to current outage and asset management practices
    - Reasons for outages and related impacts
    - Tools for outage management: engineering analysis, trouble calls, and restauration
    - Asset management objectives and different approaches to maintenance practices

2. Fundamentals of spatiotemporal data analytics

- Large dynamic spatiotemporal networks
- Network embeddings for outage occurrence prediction
- Structure-aware intrinsic representation learning of temporal networks for wind power prediction

3. Big data for outage and asset management uses:
   - Sources of Big Data: utility, government, paid services
   - Big data properties: 8 Vs
   - The critical steps in data management: ingestion, cleansing and curation

4. Examples of outage prediction:
   - Outages of transmission lines due weather impacts
   - Outages of distribution feeders due to impact of vegetation
   - Possible mitigation strategies

5. Typical implementation steps for outage and asset management:
   - Data selection and integration
   - Customization and configuration of data analytics
   - Development of risk maps and optimization aimed at risk reduction

6. Typical data analytics platforms for utility applications:
   - Data Analytics platform features
   - Configuration of data analytics platforms
   - Uses of data analytics platforms

7. Examples of data pre-processing and data models:
   - Combining network data with data from other sources
   - Selection of data processing graph's nodes and links
   - Overlaying the data analytics graph over the related electricity network graphs

8. Examples of prediction uses for asset management:
   - Failure of transmission line insulators
   - Failure of distribution transmission transformers
   - Possible mitigation strategies and related objective functions and constraints

9. Next steps in predictive data analytics:
   - Spatiotemporal scaling
   - Missing and bad data
   - Overfitting and data sensitivity

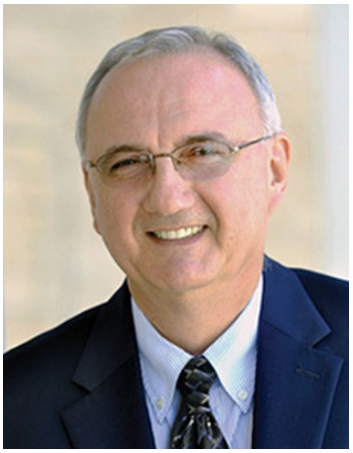
10. Next steps in predictive data analytics for utility applications:
    - Framework for risk assessment across the grid stakeholders
    - The role of predictions in developing mitigation strategies
    - Interaction with customers to share benefits of predictions

Itinerary

Day 1		
Instructor	**Time**	**Topic**
Kezunovic	8:30-9:30am	Overview: Course objectives
Kezunovic	9:30-10:15am	Part 1: Transmission Predictive Outage and Asset Management
	10:15-10:30am	**Break**
Obradovic	10:30-11:15am	Introduction : Predictive Data Analytics
Anderson	11:15-12:00am	Introduction: Data Analytics Platforms
	12:00-1:15pm	**Lunch**
Dokic	1:15-2:00pm	Demo #1: Transmission Outage prediction (TOP)
Pavlovski	2:00-2:45pm	Programming Example #1: TOP Implementation
	2:45-3:15pm	**Break**
Anderson	3:15-4:00pm	Use Cases: Data analytics platform
All	4:00-4:30pm	Summary of Day 1: Q/A and Discussion
Adjourn	4:30pm	Move from CIR to Stella Hotel
	5:30pm	**Reception**: **Hotel Stella**
Day 2		
Instructor	**Time**	**Subject**
Kezunovic	8:30-10:15am	Part 2: Distribution Predictive Outage &Asset Management
	10:15-10:30am	**Break**
Obradovic	10:30-12:15am	Spatiotemporal Data Analytics
	12:15-1:15pm	**Lunch**
Anderson	1:15-3:00pm	Configurable BD Platforms
	3:00-3:15pm	**Break**
Dokic	3:15-3:45pm	Demo #2: Distribution Outage Prediction (DOP)
Pavlovski	3:45-4:15pm	Programming Example #2: Advanced Implementations
Anderson	4:15-4:45pm	Use Case: Configurable platform
All	4:45-5:00pm	Summary of Day 2: Q/A and Discussion
Adjourn	5:00pm	Move from CIR to Stella Hotel
	5:30pm	**Dinner: Hotel Stella**
Day 3		
Instructor	**Time**	**Subject**
Kezunovic	8:30-9:30am	What is next: overall predictive framework
Obradovic	9:30-10:30am	What is next: cross-domain data analytics
	10:30-10:45	Break
Anderson	10:45-11:45	What is next: solution value proposition
ALL	11:45-12:00	Closing Discussion (all participants)
Adjourn	12:00pm	

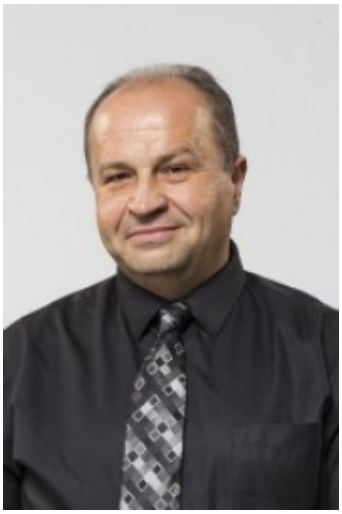
Instructors

Mladen Kezunovic, Regents Professor and Eugene E. Webb endowed Professor in the Department of Electrical and Computer Engineering at Texas A&M University



- Principal Consultant and CEO of XpertPower Associates, a consulting firm specializing in world-wide Smart Grid services
- Before his academic career, employed by Westinghouse Electric and Energoinvest Company in Europe developing digital substations
- Author of a widely used books on protective Relaying and on Time-Synchronized Measurements in Power Systems
- Gave 135 Invited Lectures and 45 short courses, tutorials and seminars worldwide
- Currently serves on the Electricity Advisory Committee of the Department of Energy's Office of Electricity
- Recipient of the IEEE Educational Activities Board Standards Education Award, IEEE Life Fellow
- Fellow, Honorary and Distinguished Member of CIGRE

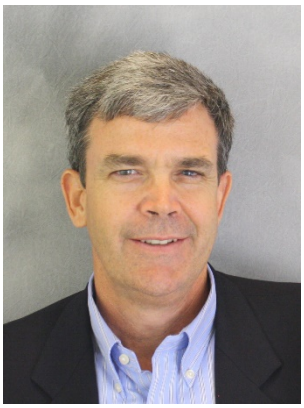
Zoran Obradovic, Temple University, Laura H. Carnell Professor of Data Analytics, Director, Center for Data Analytics and Biomedical Informatics, Professor, Computer and Information Sciences Department, Professor, Statistical Science Department, Fox School of Business (secondary appointment)



1. Academy of Sciences Member:
   - Academia Europaea (The Academy of Europe)
   - Serbian Academy of Sciences and Arts (foreign member)
2. Journal Service:
   - *Editor-in-Chief* - Big Data, 2018 – present
   - *Executive Editor* - Statistical Analysis and Data Mining, 2009-2018
   - Editorial Board Member – 12 journals, current
   - Guest Editor – 6 journals
2. Conference Service:
   - *Steering Committee Chair* - SIAM Int'l Conf Data Mining, 2018-2020
   - *General Chair* - SIAM Int'l Conf. on Data Mining, 2013; 2014
   - *Program Co-Chair* – 6 international conferences
   - *Track Chair* – 13 international conferences

4. Keynote Lectures: 20

Tom Anderson, Principal Systems Engineer with the SAS US Energy Division.



- 20+ years of analytical experience includes 18 years with SAS
- Concentrating on advanced analytics and data management in both Utilities Oil and Gas.
- Solutions in Asset Performance Analytics in both upstream and downstream O&G applications as well as Advanced Meter Infrastructure analysis and application development within electric utilities.
- Patents: Distribution Transformer Failure Awarded - June 2017; Monitoring Machine Health Using Multiple Sensors - Pending.