Statistical Methods for Transformer Condition Assessment

— Technical Presentation —
Thursday, March 29, 2018

by Luiz Cheim, Jim Dukarm and Tom Rhodes

1. Abstract

Maintenance, operation and management of the electric power grid in our digital era require processing of rapidly growing quantities of data. In this tutorial, we explain how machine learning (ML) and advanced statistical methods are beginning to affect areas of interest to Transformers Committee participants. For example:

- Statistical tools for improved data visualization
- ML algorithms for classifying transformer operational status
- Bayesian networks emulating transformer condition assessment by human experts
- Reliability statistics and thermochemistry providing a new approach to DGA

2. Learning Objectives

This presentation will cover:

- What are ML algorithms? How do they work? Do they really learn?
- Statistical graphical tools that help to understand the data
- Real applications of ML and statistical tools in the transformer business
- How chemical thermodynamics provides insight into DGA
- Reliability engineering statistics transforms DGA
- How reliability-based DGA and machine learning are applied at a big utility

3. Learning Outcomes

As a result of attending this presentation, attendees will gain an understanding of the following:

- The meaning of ML and how ML is applied to understand transformer condition
- Public domain statistical tools and algorithms readily available to the community
- How reliability-based DGA works and what information it provides
- How these advanced tools fit into asset management for an electric power system

4. Presenters' Biographies

Dr. Luiz Cheim (IEEE Member) is in charge of implementing multiple algorithms into the ABB Asset Health Center automated program to continuously assess fleet-wide transformer operational condition with an on-line Expert System that makes recommendations for action. Luiz is also a member of CIGRE and received the CIGRE Outstanding Technical Contribution Award in 2006 from the CIGRE Technical Committee and the ABB Global CEO Service Innovations Award in 2013. Luiz has led several R&D initiatives inside ABB, such as the proposal of the Transformer Inspection Robot in 2012, the on-line and continuous fleet wide assessment of power transformers (that later became AHC) and, more recently, a number of new initiatives involving Machine Learning tools. Luiz is a graduate Engineer from the Federal University of Rio de Janeiro, Brazil, and obtained his Ph.D. from The University of Nottingham, UK in 1993.

Dr. Jim Dukarm (IEEE Life Member) is the Chief Technology Officer of Delta-X Research Inc., in Victoria, BC, Canada, which he founded in 1992. The company's web-based software is used by over half of the largest electric utilities in North America, many smaller utilities and industrials worldwide. Jim was the Founder and President of AAL Autometrics Associates, which contracted development of successful industrial software products from 1985 through 1991, such as a factory switchgear monitoring system and a widely used insulation power factor testing application. His current research applies advanced statistical modeling to DGA and asset condition assessment. Jim has been a contributor to IEEE C57.104, C57.139 and C57.155, and he is also a member of CIGRE and ASTM. He has a Ph.D. in Mathematics from Simon Fraser University, Burnaby, Canada.

Tom Rhodes has chaired the Doble Insulating Materials Client Committee and authored and presented several industry papers. At CHAMPS Software, he was Implementer/Project Leader for new CMMS/asset management technology. Most recently, Tom has held the titles of Senior Science and Lab Services Specialist, Scientist and Senior Engineering Technologist at Duke Energy. He graduated from Upper Iowa University with a B.S. in Professional Chemistry.