Tutorial on

Some Applications of Lazy Learning and Partitional Clustering Methods for Wind Energy Conversion Systems

Abstract of Tutorial

In the last decade, diminishing fossil fuels, increasing air pollution and global warming concerns have led to an enormous interest on renewable energy. The electricity generation from renewable energy sources has reached to 5383 TWh in 2014 with the share of 23% in world electricity supply. Among them, wind energy is steadily becoming a greater part of global renewable energy. The most important indicator of this case is that the global wind power capacity has risen to 433 GW in 2015 and it is the second-largest source of renewable electricity generation in the world, behind only hydropower. In parallel with the evolving wind energy industry, numerous problems related to the unit commitment, load scheduling, frequency stability, voltage support, power quality and power balance have been emerged for the grid operators. In order to cope with such issues, many data mining methods are employed for revealing previously unknown, hidden, meaningful and useful patterns in large-scale databases. Particularly, the k-nearest neighbor algorithm as a lazy learning method and the k-means algorithm as a partitional clustering method take place among the top 10 algorithms in data mining.

The main objectives of this tutorial are, on the one hand, to make the very short term wind speed and wind power predictions using the k-nearest neighbor algorithm, to uncover the effects of neighbor numbers, distance measures and input tuples on the prediction performance, and to improve the prediction accuracy. On the other hand, with the usage of k-means algorithm, it is also aimed to identify the abnormal data points in the raw power curve data of a wind turbine and to construct the refined power curve, and to conduct the similarity analysis of multidimensional wind speed data and to evaluate the wind speed characteristics in-depth. This tutorial will provide an informative platform about the mentioned applications of lazy learning and partitional clustering methods for wind energy conversion systems. At the end of this tutorial, the attendees will be able to:

- have the basic knowledge about k-nearest neighbor classification and k-means clustering algorithms,
- characterize the prediction errors in terms of neighbor numbers, distance measures and input tuples,

- qualify the most powerful and the most inefficient meteorological parameters on the prediction accuracy,
- detect the highly-correlated data points and filter out the outlier observations in the raw power curve data,
- evaluate the clustering solutions in terms of mean silhouette coefficients for multidimensional wind speed data,

Organized by:

Prof. Dr. Ramazan Bayindir, Gazi University, Turkey.
E-mail: bayindir@gazi.edu.tr
Assist. Prof. Dr. Mehmet Yesilbudak, Nevsehir Haci Bektas Veli University, Turkey.
E-mail: myesilbudak@nevsehir.edu.tr

Prof. Dr. Ramazan Bayindir
Gazi University, Turkey

Ramazan Bayindir received the B.Sc., M.Sc. and Ph.D. degrees in electrical education from Gazi University, Ankara, Turkey, in 1992, 1998 and 2002, respectively. He is currently a Professor in the Department of Electrical and Electronics Engineering, Faculty of Technology, Gazi University. His current research interests include power systems, power factor correction, microcontroller, programmable logic controller and automation systems. He has authored or co-authored more than 150 scientific publications.

Assist. Prof. Dr. Mehmet Yesilbudak
Nevsehir Haci Bektas Veli University, Turkey

Mehmet Yesilbudak received the B.Sc. and Ph.D. degrees in electrical education from Gazi University, Ankara, Turkey, in 2008 and 2013, respectively. He is currently an Assistant Professor in the Department of Electrical and Electronics Engineering, Faculty of Engineering and Architecture, Nevsehir Haci Bektas Veli University. His current research interests include data mining, machine learning, software development, smart grids, renewable energy sources, wind energy systems and prediction. He has authored or co-authored more than 35 scientific publications.