Chapter 36
Applications of Big Data and AI in Electric Power Systems Engineering

Tahir Cetin Akinci
Istanbul Technical University, Turkey

ABSTRACT

The production, transmission, and distribution of energy can only be made stable and continuous by detailed analysis of the data. The energy demand needs to be met by a number of optimization algorithms during the distribution of the generated energy. The pricing of the energy supplied to the users and the change for investments according to the demand hours led to the formation of energy exchanges. This use costs varies for active or reactive powers. All of these supply-demand and pricing plans can only be achieved by collecting and analyzing data at each stage. In the study, an electrical power line with real parameters was modeled and fault scenarios were created, and faults were determined by artificial intelligence methods. In this study, both the power flow of electrical power systems and the methods of meeting the demands were investigated with big data, machine learning, and artificial neural network approaches.

INTRODUCTION

In today's modern societies, electric energy is an inevitable concept. Electrical energy is a social and economic requirement for the development of society. For the last thirty years, a great deal of research has been undertaken to analyze and solve the problems of electrical power systems. Most of the research is on control theory, power electronics drivers and economic analysis. In recent years, the development of artificial intelligence and its methods has made this technology applicable in many areas. In this study, some methods have been proposed in order to provide supply balance by investigating the methods of using electric power systems with artificial intelligence techniques. Research on electrical power system can be examined in two groups as modeling and analysis. In this study, fault scenarios were created by using the energy transmission line model: these defects were then determined by artificial intelligence methods.

DOI: 10.4018/978-1-6684-2408-7.ch036

BACKGROUND

Literature Review

Recent developments in energy system energy systems seek solutions for the ongoing liberalization of energy markets, optimization of power system efficiency and power quality, emergency energy demands and challenges in dispersed energy transmission lines (Hidayatullah et al., 2011; Kadar, 2013). As a solution, the connection of renewable energy systems to the power system necessitates the control of electrical power systems by artificial intelligence techniques (Fikri et al., 2018). Artificial Intelligence techniques, along with traditional analytical techniques, can significantly contribute to the solution of related problems. Recent scientific studies emphasize that an intelligent energy transmission and distribution system should be used with evolutionary programming and other artificial intelligence methods (Akinci, 2011; Jiang et al., 2016; Bogdan et al., 2009; Paracha, 2009; Russel & Norvig, 2016).

Nowadays identified as the information age, all activities performed during the day are getting recorded with several technologies. The most valid reason for this logging is to establish-confidence for the benefit of people and society, such as security and public service. However, the smart phones and watches that people carry unconsciously are continuously recording their activities in their daily life and converting them into data (Bryant, 2014; Zimmer & Kurlanda, 2017). During a regular home-based work trip, individuals who have been able to adapt to the information age allow the system to collect data as they open the security alarm of their house when they leave for work, pass by security cameras on their route to work and use their ID card to enter the workplace. During the day, all the performance at the workplace, photos taken and shared on social network by colleagues with their smart phone and data of heart rate monitoring by smart watches are constantly being recorded. Here, copious information and copious data, from the rotational speed of the industrial machine to its temperature, the profit-loss statements of the wage paid to the workers by the company and even the company's stock exchange, are recorded. In this human-machine interactive interface world, all information has the potential to be turned into data. This data eventually becomes so large that is defined as big data. Storing and analyzing processed and unprocessed data now requires special methods and tools. The recording of all these data in daily life has led to the creation of storages in massive sizes. These storages have become centers that provide specific information called cloud. The processing of this gigantic information as well as its storage enabled an important software branch to emerge that has revealed a new profession called data analytics (Begoli & Horey, 2012; Papageorgiou, 2019; Grover et al., 2018).

Data analysts undertake critical tasks such as making companies profitable by producing meaningful results from the data presented or extracting disease information from biological data. They also undertake vital tasks such as optimizing the continuity of the system by ensuring that the bearings of an industrial machine are integrally disengaged or optimizing and making plans to ensure the availability of continuous and reliable electrical energy. These tasks find their field of application in social sciences and engineering (Dong et al., 2009; Chen et al., 2014; Grover et al., 2018).

Electrical engineering has been the most affected by the development of information and communication technologies. The first input of artificial intelligence technology to electrical power engineering was with smart meters. In the first studies, smart meter and sensor technologies and data collection systems were installed on energy users (Ongsakul & Vo, 2013; Alahakoon & Yu, 2015). Thus, the data collection from the traditional data distribution systems can be performed instantaneously. Information layers were added to traditional transmission and distribution lines for the immediately analysis of the