Using intelligent systems for support operation in Electric Utilities

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Abstract

The purpose of this paper is to show the relevance of Artificial Intelligence (AI) techniques to support the operation of Electric Utilities when a disaster occurs. The paper provides an excellent view into some of the most significant and challenging problems facing the Electric Power Industry (EPI) and the effectiveness with which they can addressed using intelligent systems. Information technology has been introduced in power system operation, planning and control. However, these systems were not designed to operate in emergency conditions. When an emergency occurs generated by a natural disaster, human have to rely on their own experience. An emergency is shaped by a succession of events. The Electric Utilities demands new information systems that reduce the human working burden by proving operation support systems. Intelligent systems have been considered promising to deal with some emergencies that require human expertise and heuristic. One of the important features in intelligent systems is their ability to deal with incorrect, imprecise or uncertain information. The Information uncertain has been modelled based on randomness or stochastic models for random load variations, noise in measures for state estimation, fluctuations in model parameters, and so on. These uncertainties occur due to failures of protective delays and breakers, errors of local acquisition and transmission, and inaccurate occurrence time, etc. Taking a thermal power plant as an example, this paper shows feasible intelligent system architecture and a temporal probabilistic reasoning strategy is proposed for diagnosis of disturbances and events. The temporal probabilistic reasoning strategy is based on temporal bayesian network of events (TBNE). In a TBNE each node represents an event or state change and an arc corresponds to a causal-temporal relationship between the events. With this kind of knowledge representation for dealing uncertainty and time, we can diagnosis faults and estimated defects, and predict outcome events. The inference mechanism consists in the propagation of evidences through the net using a probabilistic inference mechanism. When an event is detected, the inference mechanism updates the marginal probabilities of each node (variable) of the network. This probabilities are used to determinate the most probable disturbance and the most probable event occurrence. An empirical evaluation is presented for a subsystem of power plant, in which this approach is used for fault diagnosis and event prediction with good results. The model can be used for the diagnosis of cascade of anomalies arising with certain delays; this situation is typical when an emergency or abnormal operation is presented. This approach can be extended to other power systems.