Journal of Mathematics and System Science 5 (2015) 289-295
doi: 10.17265/2159-5291/2015.07.003

Availability Assessment of Electric Power based on Switch Reliability Modelling with Dynamic Bayesian Networks: Case Study of Electrical Distribution Networks

Abdelaziz Lakehal[1], Zine Ghemari[2]

1. Department of Mechanical Engineering Mohamed Chérif Messaadia University, P.O. Box 1553, Souk-Ahras 41000, Algeria.

2. Electrical Engineering Department, University of M'sila, M'sila, Algeria.

Received: March 26, 2015 / Accepted: April 24, 2015 / Published: July 25, 2015.

Abstract: As a generalization of the successful hidden Markov models, Dynamic Bayesian Networks (DBNs) are a natural basis for the general temporal action interpretation task. This document provides a conditional probabilistic approach to analyze the energy availability in electrical distribution networks by using Bayesian networks (BN). Firstly a static BN modelling is presented to show the influence of the switch behaviour on the energy availability. Then, the dynamic behaviour of the switch is cared by switch reliability modelling using DBN which permits to predict the energy availability. The prediction by DBNs discussed in the case study of this paper gives a strong contribution on electrical network supervisory control and it can also be applied to transportation networks.

1. Introduction

An electrical distribution network depends on an operator that must ensure the operation and maintenance while ensuring the quality and continuity of supply, security of persons and property. Operating the network will lead to react to the result of various events occurring on this network. The fact that events are random, it is necessary to determine how to behave according to the situations, imagine the maximum failure scenarios to predict failures and ensure optimal network availability. The Bayesian networks (BNs) proposed in this paper were used in many fields and to resolve different problems. Modelling with static BN is similar to that of fault tree [1]. [2] have used BNs for estimation of overhead lines failure rate in electrical distribution systems. [3] showed that employing Bayesian methods could enhance transmission grid risk analysis. [4] used Bayesian method for electrical power system transient stability assessment. [5] developed a Bayesian belief network model for electrical load demand.

Geographic knowledge of network, topology and the electrical state knowledge of the network are necessary to master situations that occur each time one or more sections of the network are unavailable [6]. The operations manager must then seek to restore power supply of the largest possible number of customers taking into account any statutory priorities or the sensivity of customers regarding power outage. To do this in the best conditions, it is essential to prepare troubleshooting plans that allow designing in advance of the maneuver sequences to restore power.

Corresponding author: Abdelaziz Lakehal, Ph.D., research fields: maintenance, Bayesian networks, power system. E-mail: a.lakehal@univ-soukahras.dz, lakehal21@yahoo.fr.