

ASYMPTOTIC AVAILABILITY OF AN ELECTRICAL SUBSTATION VIA A SEMI-MARKOV PROCESS COMPUTED BY GENERALIZED APPROXIMATE INVERSE PRECONDITIONING

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ABSTRACT

The rapid increase of power consumption has become more intense nowadays due to the continuous economical and population growth. Consequently the demand for uninterrupted power supply or the minimization of the down time of such systems inevitably results into developing highly reliable and available energy plants.

The reduction of the down time of the power plants can be achieved by scheduled maintenance activities and including stand-by components which will be activated to replace the corresponding component in a case of failure during its repair. In power plants the maintenance is performed to the stand-by components, hence in a case of malfunction of the main components, an extensive down time period is observed due to the unavailability of the reserved units is resulted. The power supply will be restored only after the repair of the damaged component or the completion of the maintenance procedure. Consequently, the starting time of the preventive maintenance and its duration might have a great affect on the uninterrupted energy supply.

In this paper the behavior of an electric substation which is equipped with two power cables, one of which is under stand-by condition, and two high to medium voltage transformers is studied. Furthermore, scheduled maintenances of the lines and the transformers are modeled along with malfunctions of specific components. The system is modeled by a Semi-Markov process in order to capture events with non-exponential distributions, but the computation of the steady state probabilities for the asymptotic analysis is quite complex, especially on large scale systems.

In some cases, although the system has been modeled with a Semi-Markov process, it is possible to replace a non-exponential with an exponential distribution by setting its parameter equal to the inverse mean value of the non-exponential distribution, under specific conditions. The results of the system's stationary distribution in both cases will be the same.

The computation of the steady state probabilities can be achieved by the resolution of sparse linear system which is derived by the corresponding Homogeneous Markov Chain. Explicit approximate inverse preconditioning methods have been extensively used for solving efficiently sparse linear systems on multiprocessor systems. The effectiveness of inverse preconditioning schemes relies on the construction and use of efficient preconditioners that are

close approximants to the coefficient matrix and are fast to compute in parallel. Finally the performance and the applicability of the explicit preconditioned conjugate gradient schemes are discussed and the numerical results of the electrical substation availability are given.

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