Reliability Engineering & System Safety

Volume 99, March 2012, Pages 172 – 177

Identifying groups of critical edges in a realistic electrical network by multi-objective genetic algorithms

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http://dx.doi.org/10.1016/j.ress.2011.11.008, How to Cite or Link Using DOI

Abstract

In this paper, an analysis of the vulnerability of the Italian high-voltage (380 kV) electrical transmission network (HVIET) is carried out for the identification of the groups of links (or edges, or arcs) most critical considering the network structure and flow. Betweenness centrality and network connection efficiency variations are considered as measures of the importance of the network links. The search of the most critical ones is carried out within a multi-objective optimization problem aimed at the maximization of the importance of the groups and minimization of their dimension. The problem is solved using a genetic algorithm. The analysis is based only on information on the topology of the network and leads to the identification of the most important single component, couples of components, triplets and so forth. The comparison of the results obtained with those reported by previous analyses indicates that the proposed approach provides useful complementary information.

Keywords

Genetic algorithm; Multi-objective optimization; Network performance measure; Power system vulnerability

Figures and tables from this article:

Fig. 1. Italian high-voltage transmission network, drawn using Pajek [2].

Figure options

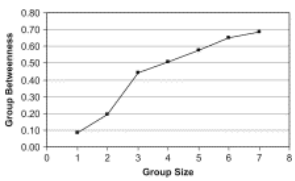

Fig. 2. Pareto front approximation: group size vs betweenness.

Figure options

Table 1. Examples of chromosome-coding of groups of edges in a network of 10 edges.

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Table 2. Multi-objective genetic algorithm parameters and rules.

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Table 3. Pareto optimal results of the multi-objective search for global efficiency relative variation and the corresponding groups betweenness values.

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Table 4. Pareto optimal results of the multi-objective search for betweenness centrality groups and values of the efficiency variation of the corresponding edges.

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Table 5. Pareto optimal results of the multiobjective search, and corresponding group betweenness and global efficiency relative variation.

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