Abstract

In the modern era of science and technology, reliability is an important pre-requisite in the operation of equipments, networks, and space research programs. The network reliability analysis is an important issue in system design, manufacture and maintenance.

In networks, the performance depends upon the probability of a specified set of nodes being communicable. Among the several approaches of reliability evaluation, the multiple-variable-inversion sum-of-disjoint product (MVI-SDP) approach provides the reliability expression in a most efficient and compact manner. However, it needs efficiently enumerated inputs depending on the output requirement i.e. required reliability measures (as input will be different for each reliability measure). Therefore, the major contribution in this work is to provide a minimal cutset based common framework to evaluate network reliability measures viz., *2-, g-,* and *k-terminal* reliability and *2-terminal* capacity related network reliability.

The work proposes an algorithm to enumerate *g*-minimal cutset, which is a new idea, directly from the adjacency matrix representation of a network. These *g*-minimal cutsets are used in conjunction with MVI-SDP approach to evaluate *g-terminal* reliability or global reliability. The work extends the global minimal cutset algorithm to enumerate *2*-and *k-terminal* cutset and proposes a minimal cutset based unified framework to evaluate these reliability measures. The work also proposes a new algorithm to enumerate minimal subset of minimal cutset of a network having heterogeneous link capacities to evaluate capacity related reliability.

Another attempt has been made in this thesis to provide an answer to the question as to when cutsets or pathsets are suitable for evaluating reliability measures. An exhaustive study has been conducted to provide some guidelines in this respect. Additionally, the previous algorithm has been modified to find all types of minimal cutset for directed networks. The algorithm of the previous works has been applied to determine a least cost capacitated communication network layout.

In short, it is hoped that this work serves as a useful tool for network reliability evaluation and design besides providing direction for future research.