CHAPTER 7

CONCLUSIONS AND FUTURE ENHANCEMENT

7.1 INTRODUCTION

The area of fault-based testing has received renewed attention in the recent years. A number of researchers are working in this area and proposing new methods to generate test cases to detect various faults. The main objective is to reduce the total software testing cost and the time involved in testing the software product completely.

A number of test generation methods have been proposed by a number of researchers. An important aspect of this thesis is to study the various test set generation methods with the aim of providing an improved test set generation method. A thorough analysis of various test set generation methods was carried out by taking some real life TCAS II specifications given by Weyuker et al (1994). The analysis required creating a number of mutants for a given specification and generating test sets to detect each mutant. To understand the effectiveness of the various test set generation methods, large sized formulae were taken along with some smaller ones. Most of the specifications taken for analysis were real life TCAS II specifications. The specifications varied from 5 to 14 literals and for larger formulas, each table contained 154 fields with 16,384 records.

A tool was developed to automatically generate test sets for all the faults individually and analysis was carried out to derive results.
7.2 CONTRIBUTIONS AND CONCLUSIONS

A number of faults have been defined in various literatures. Those fault classes were analyzed. A new fault is proposed namely, Term Insertion Fault.

The fault condition proposed by Kuhn (1999) to generate test sets for various faults was studied. It was observed that for larger sized formulae such as the 14 literal TCAS II specification given by Weyuker et al (1994), the fault condition proposed by Kuhn (1999) was complex and time consuming. A simplified fault condition is proposed for some faults.

The test sets generated using the simplified fault condition were analyzed. It was observed that the test sets for various faults can be derived from a single fault class because of the relationship between the test sets. This was further analyzed using Literal Reference Fault. The main motivation towards choosing Literal Reference Fault was that it is the lowest level fault in the hierarchy of fault classes that combines the test sets of all the faults. The relationship between Literal Reference Fault and other faults is analyzed and results are proposed.

Lau et al (2001) proposed the hierarchy of fault classes for seven faults. The hierarchy is extended by adding a new fault class, namely, Term Insertion Fault. Also, the theoretical results proposed by Lau et al (2001) are analyzed empirically.

The hierarchy proposed by Tsuchiya et al (2002) and Kuhn (1999) are analyzed for the fault model proposed by Lau et al (2001). Some exceptions in the hierarchy were analyzed and results are proposed. Literal Negation Fault is analyzed and expressions are derived to help overcome the shortcomings in the hierarchy.
The characteristics of various fault classes are studied with the aim of detecting an optimized fault condition. The study gave way to the new fault condition for various fault classes, which is a simplified procedure to generate test sets compared to the other test set generation methods. For some faults, the new fault condition generated smaller test sets.

A detailed comparison with the previous work is provided for all the proposed test set generation methods proposed in the thesis. Also, all the results proposed in the thesis are analyzed with real life Traffic Alert and Collision Avoidance Subsystem (TCAS II) specifications provided by Weyuker et al (1994).

7.3 FUTURE ENHANCEMENTS

The thesis deals with eight fault classes. New fault classes can be found and the proposed results can be applied to them. The faults analyzed in the thesis are different from the faults analyzed by Kuhn (1999) and Tsuchiya et al (2001). The results proposed in the thesis can be analyzed with the fault classes analyzed by Kuhn (1999) and Tsuchiya et al (2001).

All along the thesis, only one fault occurrence is considered at a time. The analysis of multiple faults can be carried out to find other interesting results. Literal Reference Fault can be considered as a multiple fault. It is a combination of Literal Omission Fault and Literal Insertion Fault.

The number of mutants that can occur in a specification is very large. Efficient generation of mutants is required to simplify the testing process and also reduce the testing time. Mutation adequacy can be studied to generate efficient mutants.