Constraints T-Way Testing Strategy With Modified Condition/Decision Coverage (MC/DC)

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Abstract

Modern society in today's digital era depends heavily on software in almost every aspect of daily life. In fact, whenever possible, most hardware implementation is now being replaced by the software counterparts. From the washing machine controllers, mobile phone applications to the sophisticated airplane control systems, the growing dependency on software can be attributed to a number of factors. Unlike hardware, software does not wear out. Thus, the use of software can also help to control maintenance costs. Additionally, software is also malleable and can easily be changed and customized as the need arises.

With the advent of advancement in computer hardware technology, software applications grow drastically in terms of lines of codes, that is, to keep up with ever increasing customer demands for new functionalities and innovations. As such, ensuring software quality can be a daunting task.

Exhaustive testing is practically infeasible given the large domain of inputs and possibly too many possible execution paths. Over the years, many sampling techniques (or strategies) have been proposed to select subsets of test cases for testing consideration. In many applications, sampling strategies based on boundary value analysis, equivalence partioning, cause and effect analysis, and decision tables are sufficiently useful but they are not designed to address faults due to interaction. In other applications particularly involving structural (predicate) testing (e.g. in avionic industry), sampling strategies based on coverage criteria such as statements, decisions, and path coverage are deemed necessary, however, they often suffer from the effect of masking (i.e. due to the resulting AND and OR operations).

Currently, researchers in combinatorial testing have already developed strategies based on interaction testing (termed t-way testing) in order to detect bugs due to interaction. Here, depending on the value of interaction strength (t), all desired t-way interactions are faithfuly covered in the resulting test cases. Although useful, much existing work t-way testing has not sufficiently considered modified conditions/decision coverage (MC/DC) as the criteria for test generation. In many critical applications particularly involving the airborne system, compliants to MC/DC are required by law [1]. Proposed by NASA in 1992, the MC/DC is a white box testing criterion ensuring each condition within a predicate can independently influence the outcome of the decision - while the outcome of all other conditions remains constant. In this manner, MC/DC criterion subsumes other well known coverage such as statements, decisions, and path [2].

Addressing some of the aforementioned issues, this research discusses the design of a new constraints based t-way strategy with MC/DC criterion for structural (predicate) testing. In doing so, this paper also highlights the possible implementations.