Introduction

Search Based Software Engineering (SBSE) has been applied in various Software Engineering area. Search Based Software Engineering is popular to apply for solving any problems in software testing (Harman et al., 2012, 2009). There are only two ingredients in Search Based Software Engineering which are the representation of problems and fitness function for finding the solution (Harman et al., 2012a, 2009). Evolutionary Algorithms are a search based heuristic which is applied to solve in Software Engineering problems (Harman et al., 2009). Evolutionary Algorithms is one of the effective approaches of Search Based Software Engineering that is used to solve their problem. For software testing, there are many ways of testing such as combinatorial testing, data flow testing and conformance testing.

For conformance testing, this testing involves with Finite State Machines (FSMs) which are computation models of software systems. Conformance testing has a protocol about Implementation Under Test (IUT) which is presented as a black box test (Guo et al., 2006; Yu and Liu, 1992). Conformance testing is used for verifying that an implemented product performs in line with the requirement, specification and specified standard (Derderian, 2005). Unique Input Output (UIO) sequences method, which can be called U-method, is a popular method for conformance testing of finite state machines. Unique Input Output (UIO) sequences method is used for obtaining unique identities for any states and transitions to any next states (Derderian, 2005; Yu and Liu, 1992). That is, unique input output (UIO) sequences will observe any input, output behaviours and transitions of finite state machines (Guo et al., 2004). Unique input output (UIO) sequences are used to check the end state of the transition sequence of finite state machines (Derderian, 2005). However, computing unique input output (UIO) sequences of finite state machines sometimes are difficult because output and transition sometimes look unlike as an expected output (Harman et al., 2009; Li et al., 2009).

A problem in conformance testing of finite state machines is the generation of unique input output (UIO) sequences (Lehre and Yao, 2014). This problem concerns the sequence generation of inputs and outputs of finite state machines (Derderian, 2005; Harman et al., 2009). The problem refers to the output faults and transfer faults of finite state machines. It means that an input is taken to the start state of a transition while the output and end state of this transition are different from one expected (Yu and Liu, 1992). It is therefore hard to predict

a correct output and correct transition. Furthermore, the computing of unique input output (UIO) sequences is therefore NP-hard problem in software testing area (Guo et al., 2006; Lehre and Yao, 2014). When the computation of unique input output (UIO) sequences is not show as expect one, it means that some parts of a software system may be fault. Therefore, this cause can affect the quality of a software product. This is an important problem in software testing area that is a natural optimisation problem.

For this problem, Evolutionary Algorithms are popular to use in conformance testing of finite state machines (FSMs) to seek unique input output (UIO) sequences (Derderian, 2005; Li et al., 2009). Evolutionary Algorithms (such as (1+1) Evolutionary Algorithm and Genetic Algorithm) are successful in finding unique input output (UIO) sequences of some finite state machines (Derderian, 2005; Guo et al., 2006, 2004; Lehre and Yao, 2014). Therefore, in this project, the problem of computing unique input output (UIO) sequences should be solved and considered by using Evolutionary Algorithms in Search Based Software Engineering (SBSE).

This project will focus on the problem of computing unique input output (UIO) sequences of finite state machines (simple FSM instances and real-world FSM instances). The Genetic Algorithm and Self-Adaptive Evolutionary Algorithm are applied to solve this problem. This project presents how the algorithms find unique input output (UIO) sequences for finite state machines (FSMs). The results between the Genetic Algorithm and Self-Adaptive Evolutionary Algorithm are compared and evaluated the performance of both algorithms.