Test Generation of TSTL based on Adaptive Random Testing Algorithm

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Description of ART

Random test is a very popular test method. It randomly choose the input sequence (or called action sequence) through all the reasonable input space. Because it almost does not cost time on choosing next action, it is proved to be an efficient test method. Other method, as breadth-first-search method, may be not good enough to be more efficient than random test.

Adaptive random test (ART) is a modified random test algorithm. The general idea is based on the fact that normally 80% defects are in 20% part of the software. So when we finding a bug in the software, it is easier to find another one "near" it. ART is based on this principle: A passed test, nearby tests may be passed; a failed test, nearby tests may be failed. So, select test cases "far away" from previous test cases.

Fixed-sized-candidate-set ART (FSCS ART) is the most common ART algorithm. Its algorithm can be described briefly below:

Randomly generate an input t, ran t and add t to set T;
While (stop criteria not reached)
{
    Randomly generate k candidate input $c_1, \dots, c_k$
    For each candidate c_i
        compute minimum distance d_i to T
    select one candidate t with maximum distance
    run t, add t to T
}

ART has other different modified algorithm, as Restricted Random Test (RRT), Partition Adaptive Random Test (PART), etc.

Estimation of ART efficiency

According to the original idea of ART, the distribution of defects in software has a big influence on ART efficiency. For most software, defects are not uniformly distributed. So ART is a modified algorithm from random test based on this fact, which tends to have high efficiency.

Also, ART will choose test case according to previous test case, so there is no chance to choose the same test case. This is also an advantage of ART compared with RT.

However, the efficiency ART algorithms changes according to the dimension of inputs. When the dimension of inputs increases, the efficiency of ART algorithm will decrease. It may be less efficient than RT with high dimension input space, but we can measure

this and see how bad it can be. If the disadvantage is not so serious, ART can still be regarded as a better test method.

Problem in ART

FSCS ART algorithm tend to choose test cases located near the edge of input space. So in the beginning of the test, FSCS ART algorithm will create more test case in the edge area than central area, which leads to an uneven distribution in the input space. So one problem for FSCS ART algorithm is to produce test cases evenly in a short time. Now some papers has come up with solutions about it.
"Distance" is an important concept in FSCS ART algorithm. Normally we should define distance according to the requirement of software. For avltree, I think we can define "distance" as the difference between two action sequences. For example, if two action sequences contains one different action and the others are the same, then the distance off these two action sequences is 1.

Project Plan

I plan to implement basic ART algorithm, FSCS ART algorithm, with TSTL. Although FSCS ART algorithm is a mature method, it still is a challenge to apply it on TSTL and test real software. Also, I can compare FSCS ART algorithm with origin random test algorithm.

References

[1] T.Y.Chen, H.Leung, I.K.Mak. Adaptive Random Testing[J]. M.J.Maher(Ed.): ASIAN 2004, LNCS 3321, pp.320-329,2004.
[2] T.Y.Chen, F.C.Kuo. Is Adaptive Random Testing Really Better Than Random Testing[C]. Proceedings of the First International Workshop on Random Testing, Jun 20, 2006.
[3] Johannes Mayer. Adaptive Random Testing with Randomly Translated Failure Region[C]. Proceedings of the First International Workshop on Random Testing, Jun 20, 2006.