Exploring Test Suit Diversification and Code Coverage in Multi-Objective Test Case Selection

Recently,a common strategy to select test case is finding a solution which has the maximum amount of

Code Coverage

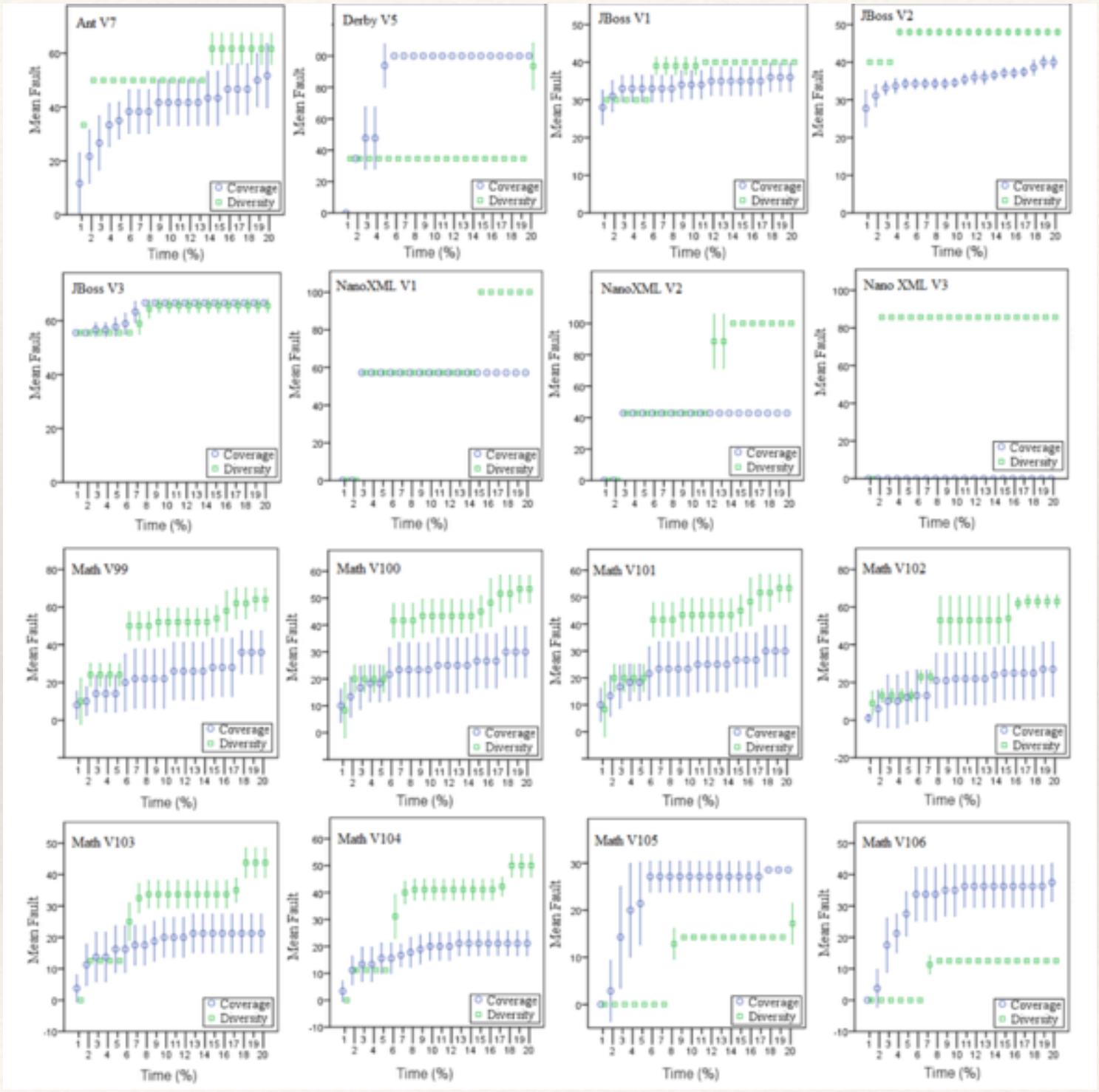
Sometimes it is effective.

- a new approach is “test case diversity”
- We prove that either of two approach is effective
- We are trying to combine the two approach so that they can potentially be complementary(互补的)

What we do

- The paper proposes a new approach for bi-objective optimization of diversity and test execution time, using α- Shape analysis of the Pareto front solutions.
- The paper compares the effectiveness of diversity-based &coverage-based test case selection,fault-detection rate, on sixteen versions of five real-world programs.
- The paper proposes a novel three-objective test case selection approach—Maximize the coverage & diversity,minimize the execution time.
- The paper compares the three-objective approach with the bi-objective approach.The front is better.

comparison of diversity & coverage about fault



the green is diversity
the blue is coverage

Though diversity is generally higher than coverage,we can not think the diversity donates the coverage

The method to calculate the diversity of test case pair

- Hamming diversity

1.Encoding the test case pair to two sequences of bits of equal length
2.Calculate the mismatches over the total number of positions
3.Calculate the Hamming distance

Example:

1. Suppose test case A is (1,1,0,1,0,0) and test case B is (1,0,1,1,0,1)
2. The total length of a test case is 6
3. The mismatches positions are 2、3、6,total number is 3
4. The Hamming distance is 3/6 =0.5

The method to calculate the diversity of test case pair

- Levenshtein Distance

1. minimum number of edit operations(INSERT/DELETE/REPLACEMENT).
2. It doesn't need equal length sequences.
3. One operation only operates one factor,in same position.

Example:

1. Suppose test case A is (f1,f3,f7,f8,f9),test case B is (f3,f4,f5,f8)
2. A transform into B
3. A's length is 5 ,B's length is 4 ,so delete f1—— 1 operation
4. f3 is equal to f3 ,no operation
5. f7 changes to f4——2 operations
6. f8 changes to f5——3 operations
7. f9 changes to f8——4 operations
8. So the Levenshtein distance is 4

(It is not the only way to change test case ,but it is minimum)

The method to calculate the diversity of test case pair

- Dice diversity(most effective)

1. It is similar to Hamming diversity
2. $div(A, B) = 1 - (|A \cap B| / (|A \cap B| + w(|A \cup B| - |A \cap B|)))$,$w = 0.5$

Example:

1. Suppose test case A is (1,1,0,1,0,0),B is (1,0,1,1,0,1)
2. $|A \cap B| = |$ (1,0,0,1,0,0) $| = 2$
3. $|A \cup B| = |(1,1,1,1,0,1)| = 5$
4. $div(A,B) = 1-(2/(2+0.5*(5-2))) = 0.428$

Algorithms

Single-Objective Optimization:

- Greedy Algorithm
- Additional-Greedy Algorithm
- Genetic Algorithm
- Ramanatham

Multi-Objective Optimization:

- Pareto Front
- α-Shape

Thank you!