

Test case generation for adequacy of floating-point to fixed-point conversion

Pham T.-H., Truong A.-H., Chin W.-N., Aoshima T.

Department of Software Engineering, College of Technology, Vietnam National University, Hanoi, 144 Xuan Thuy, Hanoi, Viet Nam; Department of Computer Science, School of Computing, National University of Singapore, 3 Science Drive 2, Singapore 117543, Singapore; Panasonic RandD Center Vietnam, No. 1 Lang-Hoa Lac, Hanoi, Viet Nam

Abstract: Porting an application written for personal computer to embedded devices requires conversion of floating-point numbers and operations into fixed-point ones. Testing the conversion hence requires the latter be as close as possible to the former. The closeness is orthogonal to code coverage and requires different strategies to generate a test suite that reveals the gap between the two functions. We introduce a new test adequacy criterion and propose several metrics to quantify the closeness of two functions. After that we propose a method to generate a better test suite from a given one for the test adequacy criteria. We also show experimental results on some well-known mathematical functions. ?? 2010 Elsevier B.V.

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Correspondence Address: Pham, T.-H.; Department of Software Engineering, College of Technology, Vietnam National University, Hanoi, 144 Xuan Thuy, Hanoi, Viet Nam; email: phamtuanhung@vnu.edu.vn

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Authors with affiliations:

1. Pham, T.-H., Department of Software Engineering, College of Technology, Vietnam National University, Hanoi, 144 Xuan Thuy, Hanoi, Viet Nam
2. Truong, A.-H., Department of Software Engineering, College of Technology, Vietnam National University, Hanoi, 144 Xuan Thuy, Hanoi, Viet Nam

3. Chin, W.-N., Department of Computer Science, School of Computing, National University of Singapore, 3 Science Drive 2, Singapore 117543, Singapore
4. Aoshima, T., Panasonic RandD Center Vietnam, No. 1 Lang-Hoa Lac, Hanoi, Viet Nam

References:

1. Belanovic, P., Rupp, M., Automated floating-point to fixed-point conversion with the fixify environment (2005) RSP '05: Proceedings of the 16th IEEE International Workshop on Rapid System Prototyping, pp. 172-178. , IEEE Computer Society Washington, DC, USA
2. Burch, R., Najm, F., Yang, P., Trick, T., McPOWER: A Monte Carlo approach to power estimation (1992) ICCAD '92: 1992 IEEE/ACM International Conference Proceedings on Computer-aided Design, pp. 90-97. , IEEE Computer Society Press Los Alamitos, CA, USA
3. Fang, C.F., Rutenbar, R.A., Chen, T., Fast, Accurate Static Analysis for Fixed-Point Finite-Precision Effects in DSP Designs (2003) ICCAD '03: Proceedings of the 2003 IEEE/ACM International Conference on Computer-aided Design, pp. 275-282. , IEEE Computer Society Washington, DC, USA
4. Giraud, L., Langou, J., Rozlo?n??k, M., Van Den Eshof, J., Rounding error analysis of the classical Gram-Schmidt orthogonalization process (2005) Numerische Mathematik, 101 (1), pp. 87-100
5. Glover, F., Laguna, F., (1997) Tabu Search, , Kluwer Academic Publishers Norwell, MA, USA
6. Goldberg, D.E., (1989) Genetic Algorithms in Search, Optimization and Machine Learning, , Addison-Wesley Longman Publishing Co,
7. Inc. Boston, MA, USA
8. Goubault, E., Putot, S., Static Analysis of Numerical Algorithms (2006) SAS, , pages 18-34
9. Goubault, E., Putot, S., Under-Approximations of Computations in Real Numbers Based on Generalized Affine Arithmetic (2007) Lecture Notes in Computer Science, 4634, pp. 137-152. , SAS
10. Herve, N., Menard, D., Sentieys, O., Data wordlength optimization for FPGA synthesis (2005) SIPS '05: Proceedings of the IEEE Workshop on Signal Processing Systems, , pages 623-628, Athens, Grece, November
11. Hvattum, L.M., Glover, F., Finding local optima of high-dimensional functions using direct search methods (2009) European Journal of Operational Research, 195 (1), pp. 31-45
12. Kapfhammer, G.M., The Computer Science and Engineering Handbook (2004) Chapter 105: Software Testing, , second edition CRC Press Boca Raton, FL
13. Keding, H., Willems, M., Coors, M., Meyr, H., Fridge: A fixed-point design and simulation environment (1998) DATE 98: Proceedings of the Conference on Design, Automation and Test in Europe, , pages 429-435
14. Korel Bogdan, Automated software test data generation (1990) IEEE Transactions on Software Engineering, 16 (8), pp. 870-879. , DOI 10.1109/32.57624
15. Korte, B., Vygen, J., (2007) Combinatorial Optimization: Theory and Algorithms, , 4th edition Springer Germany
16. Liberti, L., Maculan, N., (2006) Global Optimization: From Theory to Implementation (Nonconvex Optimization and Its Applications), , Springer
17. Menard, D., Serizel, R., Rocher, R., Sentieys, O., Accuracy constraint determination in fixed-point system design (2008) EURASIP J. Embedded Syst., 2008 (6), pp. 1-12
18. Menard, D., Chillet, D., Sentieys, O., Floating-to-fixed-point conversion for digital signal processors (2006) EURASIP Journal on Applied Signal Processing, 2006, pp. 1-19
19. Michael, C.C., McGraw, G., Schatz, M.A., Generating software test data by evolution (2001) IEEE Trans. Softw. Eng., 27 (12), pp. 1085-1110

20. Mitchell, M., (1998) An Introduction to Genetic Algorithms, , MIT Press Cambridge, MA, USA
21. Ng, C.-K., Li, D., Zhang, L.-S., Discrete global descent method for discrete global optimization and nonlinear integer programming (2007) Journal of Global Optimization, 37 (3), pp. 357-379
22. ??zer, E., Nisbet, A., Gregg, D., Stochastic bit-width approximation using extreme value theory for customizable processors (2004) Lecture Notes in Computer Science, 2985, pp. 250-264. , CC
23. Rocher, R., Menard, D., Herve, N., Sentieys, O., Fixed-point configurable hardware components (2006) EURASIP J. Embedded Syst., 2006 (1), p. 20
24. Shang, Y.-W., Qiu, Y.-H., A Note on the Extended Rosenbrock Function (2006) Evol. Comput., 14 (1), pp. 119-126
25. Zhu, H., Hall, P.A.V., May, J.H.R., Software unit test coverage and adequacy (1997) ACM Comput. Surv., 29 (4), pp. 366-427

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