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PROGRESS REPORT OF GRP ON 2004

Aim of Research

In our research, we focus on fault tree analysis and formal methods for Requirements Engineering, and propose an integrated system analysis model that will enable engineers to find, analyze, and solve problems more efficiently and effectively.

Research Approach

Fault Tree Analysis (FTA) is a traditional deductive safety analysis technique that is applied during the system design stage. However, traditional fault trees often suffer from a lack of formal semantics to check the correctness or consistency of the descriptions, especially in complex system analysis.

To overcome this limitation, we first propose a novel formal fault tree construction model based on observational transition system (OTS) model, in which the correctness of the fault tree is guaranteed by the construction process; along with the discovery of subtler and more precise system safety properties. Then, we demonstrate how CafeOBJ, a wide spectrum specification language based on multiple logical foundations, can be used not only as a practical tool, to write the formal fault tree specifications in which some automated logic deduction mechanisms are provided, but also as a powerful way to formally model, specify, and verify a system as well as its important safety properties based on the result of FTA. Moreover, we also demonstrate how to describe and verify OTS's with Maude (a sibling language of CafeOBJ). Here, Maude provides linear temporal logic (LTL) and model checking facilities as for finite state system analysis, while CafeOBJ supports hidden algebra and theorem proving for infinite state system analysis. Both of them complement each other organically.

The Progress of This Year

We have made some achievements (see Publications) this year. Currently, I am concluding our work and writing my PhD thesis. I am supposed to graduate in Sep, 2005.

Future Directions

- An semi-automatic fault tree construction tool is going to be developed;
- Research on assisting theorem proving with FTA;
- An automatic theorem proving tool then is desired and is going to be developed;
- Some other possible researches on formal methods and requirements engineering.

Publications

- Jianwen Xiang, Kokichi Futatsugi and Yanxiang He, ``Formal Fault Tree Construction Model and Specification", *Proceedings of The Eighth IASTED*

International Conference SOFTWARE ENGINEERING AND APPLICATIONS (SEA 2004), pp.374-381, November 9-11, 2004, Cambridge, MA, USA.

- Jianwen Xiang, Kokichi Futatsugi and Yanxiang He, ``Fault Tree and Formal Methods in System Safety Analysis", *Proceedings of The 4th International Conference on Computer and Information Technology (CIT 2004)*, IEEE Computer Society Press, pp.1108-1115, September 14-16, 2004, Wuhan, China.
- Jianwen Xiang, Kokichi Futatsugi and Yanxiang He, ``Formal Fault Tree Construction and System Safety Analysis", *Proceedings of IASTED International Conference on Software Engineering (SE 2004)*, pp.378-384, February 17-19, 2004, Innsbruck, Austria.
- Jianwen Xiang, Kokichi Futatsugi and Yanxiang He, ``Fault Tree Analysis of Software Reliability Allocation", *Proceedings of 7th World Multiconference on Systemics, Cybernetics and Informatics (SCI 2003)*, Volume II - Computer Science and Engineering, pp.460-465, Orlando, USA, July 27-30, 2003 (The Best Paper).
- Jianwen Xiang, Yanxiang He, Kokichi Futatsugi, and Weiqiang Kong, ``Constructing Projection Frequent Pattern Tree for Efficient Mining", *Wuhan University Journal of Natural Sciences*, Vol. 8 No. 2A, pp.351-357, June 2003.
- Weiqiang Kong, Kazuhiro Ogata, Jianwen Xiang, and Kokichi Futatsugi, ``*Formal Analysis of an Anonymous Fair Exchange E-Commerce Protocol*", Proceedings of The 4th International Conference on Computer and Information Technology (CIT 2004), IEEE Computer Society Press, pp.1100-1107, September 14-16, 2004, Wuhan, China.
- Jing Tian, Yoshiteru Nakamori, Jianwen Xiang and Kokichi Futatsugi, ``Knowledge Management in Academia: Survey, Analysis and Perspective", *Proceedings of The 17th International Conference on Multiple Criteria Decision Analysis* (MCDM2004), August 6-11, 2004, Whistler, Canada.
- Jing Tian, Yoshiteru Nakamori, Jianwen Xiang and Kokichi Futatsugi, ``Knowledge Management in Academia: Survey, Analysis and Perspective", *Int. J. Management and Decision Making* (to appear).