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Research Areas

Specifications and computer-aided software evolution.

Research Description

Formal methods and associated automated decision aids have a large potential for practical impact that has not been fully realized. To help bring this about, we have developed a formal specification language specifically designed for large scale applications that include parallel, distributed, and real-time systems. We are currently investigating a variety of methods and tools for partially automating many aspects of software development.

We seek to develop fundamental theory and practical methods for combining several changes to a software system with mathematically provable guarantees of correctness. The main goal of this research effort is to enable a higher level of computer-aided design in development and maintenance of large software systems. Combining changes to software is a fundamental problem in software engineering. This process is important in all phases of developing large software systems, where multiple changes must be developed concurrently and then combined. This work has potential applications to software maintenance, view integration in specifications, version control in design databases, and multiple inheritance in specification or programming languages.

We have investigated change merging for specifications and for software prototypes of real-time systems. We integrated a change merging mechanism for specifications with an inheritance mechanism and investigated both applications and formal properties of the resulting structure. We have developed an analog of the program slicing method for the PSDL language. PSDL presents new problems because it includes explicit real-time constraints

and parallel operations. We have also designed an automated design management and job assignment system. The main advance provided by this system is automated scheduling and job assignment for teams of engineers in an environment where plans are uncertain, partially known, and subject to change while the work is in progress.

Relevance to DoD/DoN

Reducing costs and improving quality of software is a major concern in DoD. Software maintenance and evolution accounts for the lion's share of the cost.

Our work is addressing these issues via development of soundly based methods that can support partial automation, particularly in software maintenance and evolution. Since the existing theoretical basis for this area is inadequate to support sufficient levels of automation, we are also doing foundational work to accomplish our goals.

Recent Publications

V. Berzins and Luqi. An Introduction to the Specification Language Spec. *IEEE Software*, March 1990, pp. 74-84.

V. Berzins, Software Merge: Models and Methods for Combining Changes to Programs, *Journal of Systems Integration*, 1, no. 2, August 1991, pp. 121-141.

V. Berzins, Luqi, and A. Yehudai. Using Transformations in Specification-Based Prototyping, *IEEE Transactions on Software Engineering*, May, 1993, pp. 436-452.

D. Dampier, Luqi, and V. Berzins. Automated Merging of Software Prototypes. *Journal of Systems Integration*, 4, 1, February 1994, pp. 33-49.

V. Berzins and D. Dampier. Software Merge. Combining Changes to Decompositions. *Journal of Systems Integration*, 6, 1, 1996, 135-150

V. Berzins, three articles in *Software Slicing and Merging*, IEEE Computer Society Press Tutorial, 1995, pp. 77-89, 106-134, and 180-200.

(See pages 10-11 for illustrations of the CAPS project.)