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              CALIFORNIA UNIV BERKELEY ENGINEERING RESEARCH CENTER
              R E BARLOW 03 AUG 87 N00014-85-K-0384
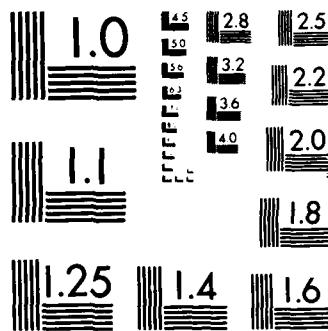
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August 3, 1987

FINAL REPORT

ELECTRONIC SYSTEM RELIABILITY AND EFFECTIVENESS

CONTRACT: N00014-85-K-0384

April 10, 1985--April 9, 1987

Principal Investigator: Richard E. Barlow

U. C. Berkeley

Reports:

Barlow, R. E. and S. Iyer. Computational Complexity of Coherent Systems

and the Reliability Polynomial. Operations Research Center

Technical Report ORC 85-6, July 1985. Tentatively accepted for

publication in Mathematics of Operations Research. Under revision.

Resende, L. "Extensions to Polychain: Nonseparability Testing and

Factoring Algorithm", ORC 85-14, 1985. Operations Research Center,

University of California, Berkeley, CA (Also a project with the

same title but with extensive applications to the ARPA network.)

Resende, L. "An Implementation of the Factoring Algorithm for

Reliability Evaluation of Undirected Networks." Submitted to IEEE

Transactions on Reliability. (Publication revision of previous

report.)

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L. Resende. "A Preprocessing for Monte Carlo Algorithms for the K-Terminal Network Reliability Problem." Unpublished preprint relative to Ph.D. thesis research work.

Shachter, R. D. and L. J. Bertrand. "Efficient Inference on Generalized Fault Diagrams." Paper Delivered at the <u>Third Workshop on Uncertainty in Artificial Intelligence,</u> Seattle, Washington, July 10-12, 1987.

Barlow, R. E. "Using Influence Diagrams for Built-in-test," talk given at the ATAC Workshop Navair Meeting organized by Jim Smith of the Naval Air Systems Center in Mountain View, CA., Wednesday, October 30, 1985.

Barlow, R. E. "Influence Diagrams." Operations Research Center Technical Report ORC 86-21, November 1986. To be published in the <u>Encyclopedia of Statistical Sciences,</u> S. Kotz and N. L. Johnson, editors.

RESEARCH SUMMARY

This research contract was motivated by the Naval Air System Center's desire to obtain efficient computational methods for evaulating the reliability of avionics sytems with built-in-test (BIT). The methodology in use in 1985 was based on Markov modelling. Unfortunately this methodology involves an unacceptably large number of states and the attendant computations require exponential running time in the number of states. Network reliability research at Berkeley had shown that efficient algorithms are available for special classes of network problems. Under this contract, Lucia P. Resende developed a computer program called <u>Polychain</u> for the reliability of undirected networks as part of her Ph.D. thesis research. This program was made available to Dr. Randall Fleming of Systems Control Technology, Inc.,

Palo Alto, CA (a Navy contractor) and has been submitted to the IEEE Transactions on Reliability for publication.

Also in conjunction with this contract, an Advanced Study Institute on System Reliability and Computational Complexity was held at Berkeley from June 24-July 3, 1985. The featured speaker was Professor A. Satyanarayana from the Stevens Institute of Technology in New Jersey. I also gave a lecture on "Computational Complexity of Coherent Systems and the Reliability Polynomial." The purpose of this lecture was to tie network reliability research with that of fault tree research. BIT reliability can also be computed using fault tree diagrams. This was pointed out at an ONR sponsored workshop in Palo Alto October 30, 1985.

Fault trees are special cases of so-called influence diagrams. Since this was a related, emerging research field, considerable research was done on influence diagrams. An Encyclopedia article by myself on influence diagrams made the subject more accessible to statisticians. Work with Ross Shachter on influence diagram operations applied to fault trees resulted in the paper on "Efficient Inference on Generalized Fault Diagrams."

STUDENTS AND FACULTY SUPPORTED BY THIS CONTRACT

Richard E. Barlow, P. I.

Srinivas Iyer.   Ph.D. May 1, 1986.   Thesis: Domination Theory,   Network
    Reliability and the Factoring Algorithm.

Lucia Resende.   Ph.D. student in progress.   Project: Extensions to
    Polychain: Nonseparability Testing and the Factoring Algorithm.

Professor A. Satyanarayana.   Computer Science Department, Stevens
    Institute of Technology.   Travel expenses for lectures in the
    Advanced Study Institute on System Reliability and Computational
    Complexity.

Professor Ross Shachter, Department of Engineering Economic Systems,
    Stanford University.   (I worked with Professor Shachter during the summer
    of 1985 on influence diagram applications to fault trees.)

END

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