9-X60-D1200-1 Task 85

Los Alamos Report

LA-UR-95-138

Unlimited Release

Printed, 1994

$\Sigma\P$ -PATREC USER'S GUIDE AND REFERENCE MANUAL

by

A. Sharif Heger

Jayaram K. Bhat

Dale V. Talbott

Desmond W. Stack

RECEIVED

MAY 28 1998

OSTI

Prepared by:

Los Alamos National Laboratory

Los Alamos, New Mexico 87545

For the United States Department of Energy

Under Contract 9-X60-D1200-1

DRAFT

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

**Portions of this document may be illegible
electronic image products. Images are
produced from the best available original
document.**

Distribution Category

LA-UR-94-....

Unlimited Release

Printed, 1994

$\Sigma\Pi$ -PATREC

USER'S GUIDE AND REFERENCE MANUAL

by

A. Sharif Heger
Jayaram K. Bhat
Dale V. Talbott
Desmond W. Stack

Abstract

$\Sigma\Pi$ -Patrec is a computer program for the evaluation of exact top-event probability of fault trees. Exact value of top-events are necessary for real applications with large basic events probabilities (i.e.: $P \geq 0.1$). $\Sigma\Pi$ -Patrec allows the user to evaluate the exact value which would otherwise lead to erroneous, overly conservative results. $\Sigma\Pi$ -Patrec requires an IBM compatible PC with an 80386 or newer processor, VGA graphics capability, and a mouse.

Acknowledgments

The ideas for a PC-based version of $\Sigma\Pi$ was originated by Desmond Stack of Los Alamos National Laboratory, further guidance for the design and implementation of the code was provided by Gururaj Shamanna. This document was reviewed and finalized by Kathleen Banjac.

Obtaining $\Sigma\Pi$ -Patrec

A process to obtain a copyright for $\Sigma\Pi$ -Patrec is in progress. A unique data representation scheme, which has made efficient execution for this program possible, has been developed. A patent application process is also in progress. The executable version of $\Sigma\Pi$ -Patrec will be made available on 3.5" high density disks. Information concerning how to acquire $\Sigma\Pi$ -Patrec may be obtained by contacting:

Desmond W. Stack
Los Alamos National Laboratory
TSA-6
P. O. Box 1663
Los Alamos, NM 87545
(505) 667-4613 (voice)
(505) 665-2817 (FAX)

A. Sharif Heger
University of New Mexico
Nuclear Engineering
FEC 247
Albuquerque, NM 87131
(505) 277-2640 (voice)
(505) 277-5433 (FAX)
heger@hydra.unm.edu (Internet)

1. Introduction

$\Sigma\Pi$ -Patrec is a computer program developed at the University of New Mexico (UNM) in cooperation with Los Alamos National Laboratory (LANL). This program is ideal for fault tree evaluation that models human behavior and ecological processes. In these two application domains, basic event probabilities can be large where conventional approximate methods could lead to erroneous and overly conservative top-event values. $\Sigma\Pi$ -Patrec may be used for risk assessment applications with several hundred or thousand minimal cutsets. This method calculates the exact top event probability in a fast and efficient manner.

The operation of complex systems depends on a variety of factors, both human as well as mechanical. Moreover, most of these systems are real time systems and have well-defined time constraints. Performance of these systems should, therefore, be predicted as quickly as possible or these systems may fail. Various methods have been developed to model these systems and evaluate their performance. Fault trees, graphs, and networks have been used to obtain practical methods for evaluating the performance of these systems. The number of operations required to compute the failure probability of a system increases exponentially with an increase in the number of basic events associated with the system. Hence, these methods have either been limited to small problems that do not reflect realistic applications in probabilistic risk assessment or have used approximate methods which are commonly used. The most dominant among these methods is the "rare-event approximation method". This method gives an upper bound of the top-event probability, which is fairly accurate for problems associated with small probabilities. However, for problems involving basic events with large probabilities of occurrence, the method can lead to inaccurate and misleading results. $\Sigma\Pi$ incorporates a number of noteworthy features, including:

- direct interface with sets, TEMAC, IRRAS, and sets,
- Latin Hypercube Sampling and Monte Carlo interface for uncertainty analysis, and
- sensitivity analysis.

DRAFT

There are many potential uses for $\Sigma\Pi$ -Patrec. Some of the known uses are:

- Any application that consists of human action, typically these human factors are characterized with a relatively large probability of occurrence;
- Any ecological risk assessment, large probability events are common in these application areas; and,
- any system with an incoherent structure, $\Sigma\Pi$ -Patrec can evaluate both coherent and incoherent structures.

The current version of $\Sigma\Pi$ -Patrec is limited in the following areas:

- size of files that can be edited is limited to 32K, and
- input file names are limited to those described in the on-line help; $\Sigma\Pi$ -Patrec cannot recognize other file names. In addition, the input files must be located in the $\Sigma\Pi$ -Patrec home directory.

2. Installation

This chapter lists the basic equipment needed to install and use $\Sigma\Pi$ -Patrec properly. The chapter also discusses the basic installation process of the program onto your system.

2.1 Hardware and Software Requirements

The following is a list of the minimum requirements for installing and using $\Sigma\Pi$ -Patrec:

Processor – The current version of $\Sigma\Pi$ -Patrec requires an IBM Compatible PC with 80386 or higher processor. Memory management is handled by the Windows^{®1} environment.

¹ Windows[®] is a Microsoft Corporation trademark.

DRAFT

Operating System – ΣΠ-Patrec requires Windows®3.1 or higher.

Monitor/Graphics Requirements – ΣΠ-Patrec requires VGA graphics capability.

Storage – A hard disk is required. At least 1MB of available hard disk storage is recommended. Approximately 700 KB of disk space is required to load the program and sample files from the installation disk.

Mouse – A mouse is required with a Microsoft Compatible mouse driver that supports VGA graphics.

Printer – The use of a printer is not required for use with ΣΠ-Patrec.

Tested Configuration – Appendix •• contains a partial list of the hardware configuration that has been used to test ΣΠ-Patrec.

2.2 Before Installing

Prior to installation, the user should verify that the available computing system is compatible with ΣΠ-Patrec based on the information provided in Chapter 1 and in Appendix ••. You will need to modify your AUTOEXEC.BAT to set the proper path name for ΣΠ-Patrec. A Microsoft compatible mouse driver that supports VGA graphics must be loaded before installing ΣΠ-Patrec. This driver is usually loaded from the AUTOEXEC.BAT or CONFIG.SYS file.

The user should verify that appropriate space is available on a hard disk drive (at least 1MB). Finally, before beginning the installation procedure, the user should make a backup copy of the ΣΠ-Patrec disks.

Note: The installation procedure below and the startup discussion in Chapter 3 assume that the user has at least a rudimentary knowledge of Windows®. The user should refer to a Windows® manual if additional clarification is needed.

2.3 Installation Procedure - First Time Installation

DRAFT

Insert the diskette into drive B and enter the following command at the DOS prompt:

```
C:\> B:\INSTALL
```

SIGPI is now installed on your computer in the C:\SIGMA-PI directory. The following files should be in the SIGPI directory:

1. SIGPI.EXE
2. ICON DIRECTORY
3. EXAMPLES DIRECTORY

Also a file BWCC.DLL will be copied into the C:\WINDOWS\SYSTEM directory.

Add the following command to the path variable in AUTOEXEC.BAT:

```
C:\SIGMA-PI
```

To set up the icon for SIGPI, go to the windows environment and maximize the group in which you want SIGPI to reside. Go to FILE | NEW and click on PROGRAM ITEM. You will get a dialog box (PROGRAM ITEM PROPERTIES). Enter the following:

DESCRIPTION:	SIGMA-PI
COMMAND LINE:	SIGPI.EXE
WORKING DIRECTORY:	C:\SIGPI
SHORT CUT KEY:	NONE

Now click on the O.K. button and the icon will be established. YOU may go to SIGPI by clicking on its icon. If you, however, want to go to SIGPI from DOS you can do so by typing WIN SIGPI at the DOS prompt.

DRAFT

Appendix 1 Quality Assurance

A quality assurance program has been implemented for $\Sigma\Pi$ -Patrec. Prior to this release, a test version was released to internal and selected external users. Problems found during that testing have been corrected, and a number of test problems have been used for further verification. Records and descriptions of the pre-release testing has been performed and are on file. It is our intention that future versions of $\Sigma\Pi$ -Patrec will fully comply with applicable Los Alamos software requirements, along with DOE NQA-1 and other requirements.

Programs that run on PCs often suffer from compatibility problems when changing from one computer to another. An attempt has been made to develop $\Sigma\Pi$ -Patrec in a manner that should be compatible with most 386 and 486 PCs, and Table •• identifies a few of the computer systems upon which $\Sigma\Pi$ -Patrec has been successfully tested.

Table ••
Tested Computer Configurations

PARAMETER	SYSTEM 1	SYSTEM 2	SYSTEM 3	SYSTEM 4
Manufacturer	Gateway			
Processor	80486/33			
Math Co-Processor	yes			
Monitor	VGA			
Mouse	Microsoft Serial			
DOS Version	3.1			
Printer	HP LaserJet III			

DRAFT

Appendix 2

Reporting Problems

While $\Sigma\Pi$ -Patrec was subjected to the Quality Assurance prescribed in Appendix •••, a certain number of unexpected problems may occur in any new program. It is our intent to provide periodic updates and new versions of the program. As a new version is released, we will attempt to correct known deficiencies. You can assist in this process by promptly reporting problems to us using the form contained on the next page. This form can be mailed to UNM at the following address:

A. Sharif Heger
University of New Mexico
Chemical and Nuclear Engineering Department
FEC 247
Albuquerque, NM 87131-1341
heger@hydra.unm.edu (Internet)

Alternatively, the form can be sent to the following FAX number:

(505) 277-5433 – FAX
(505) 277-5431 – verification

DRAFT

ΣΠ-Patrec Problem Reporting Form

Name _____ Log No _____
Organization _____ Date _____
Address _____ Phone _____
_____ Code Version Used _____

Type of Problem (check appropriate items):

☐ Unclear Documentation ☐ Obvious Coding Error ☐ Other/Unknown ☐ Missing Feature
☐ Inadequate Use Protection ☐ Suggested Improvement

Problem Description: _____

(Use additional pages if necessary. Also, where possible, attach copies of results or screen dumps that demonstrate the error or send a disk containing the event tree containing the error.)

Severity of Problem (check appropriate items):

☐ Inconvenience ☐ Program Died ☐ Lost Data and Results

Urgency of Repairs (check appropriate items):

☐ Can Work Around It for Now ☐ Can't Use Program Until It Is Repaired
☐ Need Immediate Repair and Willing to Supply Funding

Computer Systems Information:

Hardware Manufacturer _____
CPU: ☐ 80386SX ☐ 80386DX ☐ 80486 ☐ Other (specify) _____
Memory: _____kB Conventional _____MB Expanded _____MB Extended
Printer: ☐ HP Series II ☐ HP Series III ☐ Other (specify) _____
Other Peripherals: _____

Date Logged In _____ Priority Assigned _____

Receipt Acknowledged to Sender _____ Date Resolved _____

Resolution _____

Resolution Acknowledged to Sender (and date) _____

DRAFT

SIGPI

Installation :

Insert the diskette into B drive and enter the following command from the DOS prompt.

```
C:\> B:\INSTALL
```

$\Sigma\pi$ is now installed on your computer in the C:\SIGMA-PI directory. The following files/directories should be in the SIGMA-PI directory :

1. SIGPI.EXE
2. HELP.HLP
3. ICONS sub-directory
4. EXAMPLES sub-directory

Also file BWCC.DLL will be copied in C:\WINDOWS\SYSTEM directory.

Add the following to the path variable in AUTOEXEC.BAT .

```
C:\SIGMA-PI
```

To set up the icon for $\Sigma\pi$, go to the windows environment. Maximize the group in which you want $\Sigma\pi$ to reside in. Go to FILE | NEW and click on PROGRAM ITEM. You will get a dialog box (PROGRAM ITEM PROPERTIES). Enter the following.

DESCRIPTION :	Sigma-Pi
COMMAND LINE :	SIGPI.EXE
WORKING DIRECTORY :	C:\SIGMA-PI
SHORT CUT KEY :	NONE

Click on the O.K. button and the icon will be setup. You may go to SIGPI by clicking on its icon. If you, however, want to go to SIGPI from DOS you can do so by typing **WIN SIGPI** at the DOS prompt.

18 July, 1994