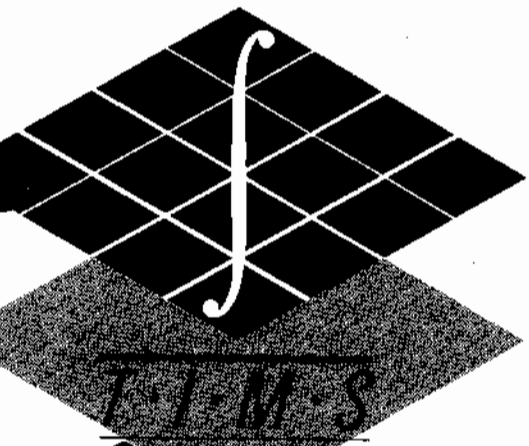


TIMS College on Simulation

BARRY L. NELSON

Volume 14
Number 2
Fall 1990

THE INSTITUTE OF MANAGEMENT SCIENCES

NEWSLETTER

Officers

President
W. David Kelton
Department of Operations
and Management Science
University of Minnesota
Minneapolis, MN 55455
(612) 624-8503
dkelton@umnacvx.bitnet

Vice-President/President-Elect
Barry L. Nelson
Department of Industrial
and Systems Engineering
The Ohio State University
1971 Neil Avenue
Columbus, OH 43210-1271
(614) 292-0610
nelson-b@eng.ohio-state.edu

Secretary-Treasurer
David Goldsman
School of Industrial
and Systems Engineering
Georgia Institute of Technology
Atlanta, GA 30332-0205
(404) 894-2365
dgoldsma@gtri01.bitnet

Newsletter Editor
James J. Swain
University of Miami
Department of Management
Science
417 Jenkins Building
Coral Gables, FL 33124-6544
(305) 284-6595
jswain@umiami.bitnet

President's Message

Stepping into a position such as the Presidency of the College is always a daunting task, but is made especially difficult for me in view of the act I have to follow.

Jim Wilson's two-year service in this position saw his applying his usual vigor to College activities, including solidifying our two awards, seeing through the development of a new logo, fostering a dramatic improvement in the *Newsletter*'s content and appearance, and doing the fundamental work for a possible monograph series to be published by the College. In addition to all of that, he has worked tirelessly as Simulation Department Editor for *Management Science*; there is currently no better place for high-quality simulation research anywhere. And as though this were not enough for one person to do for the simulation community, Jim's own research defines the very best in what simulation work ought to be, and his many excellent Ph.D. students are themselves now major contributors. As I recently found out, you have to work very hard to find an area in simulation where Jim has not made several fundamental contributions. So we're all quite fortunate to have Jim in the simulation area, and expect a lot of him in the golden years of his ex-Presidency.

The College appears to be in very good condition right now. Thanks primarily to a string of major successes of the Winter Simulation Conferences, our financial condition has never been better. Membership is growing, and the *Newsletter* is now seeing much wider distribution outside the College membership, giving us enhanced visibility. As mentioned above, our awards are by now established institutions, and the student-paper sessions we sponsor at the WSCs have been quite popular.

During the next two years, I hope to continue the excellent traditions of the College. Some specifics are expanding support for the WSC student-session participants and bringing to fruition the monograph series. Oddly, perhaps, a challenge we face is how best to use some of the funds that are now available to us. My hope is that we can find creative ways to use these funds in support of simulation activities at large.

I'm looking forward to working with the new College officers over the next two years. Barry Nelson is Vice-President and President-Elect, and has primary responsibility for organizing the invited-paper sessions we sponsor at each national TIMS/ORSA conference. Dave Goldsman, the new Secretary-Treasurer, will look after the treasury and keep the business of the College running smoothly. Jim Swain, *Newsletter* Editor, will continue his upgrading of this much-enhanced publication. —*David Kelton*, President
TIMS College on Simulation

Table of Contents

Advertisements

Editor's Corner

The *Newsletter* is intended to provide members of the College with news of the College in advance of the business meetings, the Fall and Spring TIMS/ORSA meetings, and the Winter Simulation Conference. In addition, we hope to be a general source of information about simulation and those involved with simulation. Thus, in addition to minutes of business meetings, we publish information about conferences, awards of the College, sessions sponsored by the College, and abstracts of papers not yet in the published literature. Starting with the last issue we also provide advertisements, which both help to underwrite the expenses of the *Newsletter* and inform our audience about products in simulation.

The *Newsletter* is being distributed to attendees of several conferences in hopes of reaching those who do not know about us and wish to join. To date, this has induced some to finally become official members ($2 or $3, depending upon whether you are a TIMS member), and over a dozen have done so. All members are reminded that the Fall TIMS/ORSA business meeting of the College will be held Tuesday, 30 October, from 5:30 until 6:30 in Salon 6. As usual, refreshments will be served. This is always a good opportunity to meet and interact with members of the College.

As editor, I would like to see the *Newsletter* to begin to include short articles of interest to our general audience which address either topical or survey issues. We might also consider short book reviews (e.g., the "telegraphic reviews" published by the American Mathematical Society). As always, I encourage you to send meeting announcements, paper abstracts, and so forth for inclusion in the *Newsletter*. The **editorial deadline** for the Spring 1991 issue will be 29 March, 1991.

Dave Goldsman has been elected Secretary/Treasurer of the College and will no longer be co-editing the *Newsletter*, though his "by-line" will be appearing regularly with the minutes and treasurer's report. The *Newsletter* has changed a great deal under his leadership and we will certainly miss his energetic work. Finally, please note that I have moved to the University of Miami; send material for inclusion in the *Newsletter* to Miami. — *jjs*

TIMS College on Simulation Newsletter is published twice each year, in the Spring and Fall, by TIMS College on Simulation. Membership in the College on Simulaton is independent of membership in The Institute of Management Sciences. Annual dues for non-TIMS members is $3; TIMS members may join for $2. Dues for those outside of the U.S./Canada is $3.

To join, send name, address, e-mail address (if applicable), and the appropriate dues to: David Goldsman , School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0205. Make checks payable to "TIMS College on Simulation." If you know people who might be interested in joining, please pass along this announcement.

Bulk rate postage paid at Atlanta, GA and additional mailing offices. POSTMASTER: Send address changes to ***TIMS College on Simulation Newsletter***, 290 Westminster St., Providence, RI 02903.

The ***TCS Newsletter*** is produced for TIMS College on Simulation by Lionheart Publishing Inc. (see page 8 for address).

```
VehicleObj = OBJECT
   course: [ 0 .. 359 ];
   speed: INTEGER;
   position: LOCType;
   TELL METHOD ProceedTo(IN Dest: LocType);
   ASK METHOD Stop;
END OBJECT;

AircraftObj = OBJECT(VehicleObj,GraphicsObj);
   altitude: INTEGER;
   OVERRIDE
      ASK METHOD Stop;
END OBJECT;
```

MODSIM II -- the new object-oriented language with built-in graphics

Now for Universities
MODSIM II -- Now Available for Teaching Object-Oriented Programming with Graphics

MODSIM II™ simplifies your teaching of object-oriented programming with graphics.

MODSIM II supports multiple inheritance and dynamic object creation. Objects may redefine methods, and communicate through message passing.

MODSIM II has the facilities your students need to develop and maintain reusable code. Students' programs can be divided into separately compiled modules, and common constructs can be imported from libraries.

Simulation constructs are built-in, if you need them.

Easy-to-understand graphics

Designing a graphical interface is simplified through the use of the SIMGRAPHICS II Graphics Editor.

Students see exactly what their graphics will look like -- no struggling with graphics primitives. Their input forms can contain menu bars, buttons, and other powerful input tools.

The graphs, icons, and input forms described using the Graphics Editor are connected directly to variables and control code in the student's program.

Low cost to universities

CACI recognizes the benefits of having this state-of-the-art language used by universities.

For that reason we make the MODSIM II object-oriented programming teaching package available to universities for only a low distribution fee.

The package includes training, support, complete documentation, and sample programs -- everything you need to conveniently teach object-oriented programming.

We also provide paper copies of a complete set of course transparencies.

Act now -- limited offer

This offer is limited to 150 universities, and 35 have already signed up. We want to work closely with the academic community. Don't be disappointed -- call today.

For immediate information

In the U.S., call Mike Fredenburg at (619) 457-9681, Fax (619) 457-1184. In Europe, call Karlyn Griggs, in the UK, on (081) 332-0122, Fax (081) 332-0112.

Rush information on MODSIM II.

Also send information on:

- ☐ NETWORK II.5® for teaching computer network analysis -- no programming.
- ☐ COMNET II.5™ for teaching communication network analysis -- no programming.
- ☐ LANNET II.5™ for teaching local area network analysis -- no programming.
- ☐ SIMFACTORY II.5® for teaching factory planning -- no programming.
- ☐ SIMSCRIPT II.5® for teaching simulation with graphics.

Name _____

Organization _____

Address _____

_____

_____

Tel _____ Fax _____

Computer _____ O/S _____

TIMS

Return to:
CACI Products Company
3344 North Torrey Pines Court
La Jolla, California 92037
Call Mike Fredenburg at (619) 457-9681
Fax (619) 457-1184

In Europe:
CACI Products Division
Palm Court, 4 Heron Square
Richmond, Surrey, TW9 1EW, UK
Call Karlyn Griggs on (081) 332-0122
Fax (081) 332-0112

Minutes of College Meeting at TIMS/ORSA Las Vegas

Members attending: Paul Sanchez, Andy Seila, Dave Goldsman, Barry Nelson, Diane Bischak, Dean Hartley, Jim Swain, David Kelton, Osman Balci, Sheldon Jacobson, Keebom Kang, Ron Dattero, Bill Cosgrove, Paul Sanchez and Christos Alexopoulos. Nonmembers attending: Chuck Reilly and John Charnes.

1. The meeting was called to order by David Kelton at 6:10 p.m. on May 8, 1990.

2. The Treasurer's report and the minutes of the business meeting at the WSC '89 meeting were read and approved.

3. Kelton discussed the role of the College in organizing sponsored sessions for TIMS/ORSA meetings: We select session chairs who invite speakers. We typically have nothing to do with contributed paper sessions. The primary benefit to speakers in invited sessions is that they do not have to pay an abstract fee in advance, and there are usually fewer speakers in invited sessions.
   The next international TIMS meeting will be in Rio de Janeiro, June 15-17, 1991.

4. *Newsletter* co-editor Jim Swain reported on the new format for the college newsletter, which is now published by Lionheart. One thousand copies of volume 14, number 1 were produced and mailed to WSC '89 registrants in addition to College members to stimulate interest in the College. Swain plans to give copies to WSC '90 and 1990 Summer Simulation Conference registrants, also. The newsletter cost approximately $2400 to produce and mail, with ad revenues offsetting $1300 of that cost. Additional ad revenues are anticipated for future newsletters. Since the newsletter has been expanded from 10 to 15 pages, more material is needed for future newsletters. The editorial deadline for volume 14, number 2 is September 1, 1990.

5. Kelton read reports from the following College representatives:
   (a) Steve Roberts, College representative to the WSC Board: Everything is fine.
   (b) Peter Glynn, College representative to the SIAM Conference on "Simulation in the 1990s": Peter will report further when SIAM finishes its review of the conference.

6. September 1, 1990 is the deadline for nominations for the Service Award. Nominations should be sent to Bob Sargent.

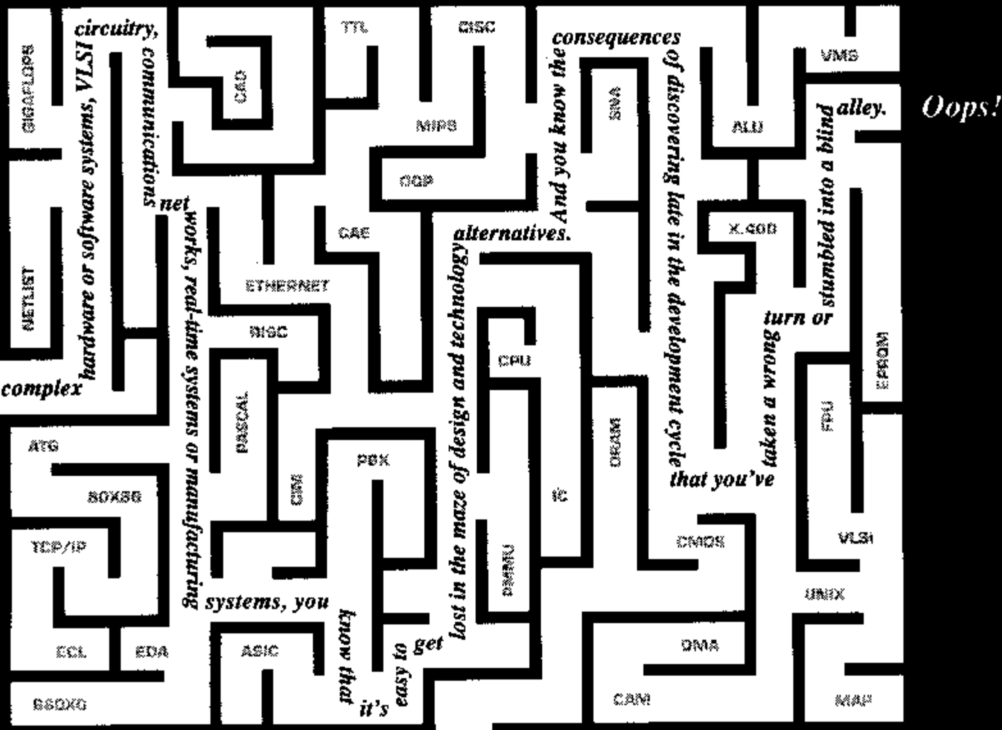
7. The following motion, introduced by Kelton for Bob Sargent and modified by the members present, was passed:
   > The TIMS College on Simulation will reimburse speakers at the Ph.D. Colloquium session of the Winter Simulation Conference $50. To be eligible, the speaker must be a Ph.D. student or recent graduate, have a dissertation topic that is consistent with the mission of the Winter Simulation Conference, and must present their research at the Colloquium. The student's advisor must certify the student's eligibility in writing, with final approval given by the President of the College. A student may receive this award only once.

8. The possibility of a College-sponsored monograph series was discussed. The goal of the series would be to publish high quality work that might be difficult to publish in standard outlets. A committee of Dean Hartley and Osman Balci was formed to investigate.

9. Problems with the organization and execution of the TIMS/ORSA Las Vegas meeting were discussed. These problems included late notification of session times and composition, shortened session length, room changes for sessions, and having College-sponsored sessions scattered throughout the program. Kelton will draft a letter to TIMS, on behalf of the College, that expresses our concern.

10. The meeting was adjourned at 7 p.m.

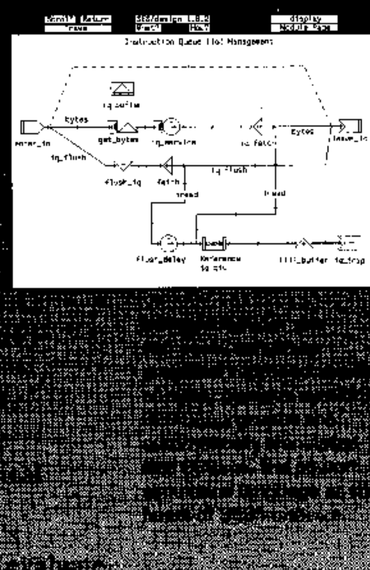
Respectfully submitted,
Barry L. Nelson
Secretary-Treasurer



urn Your
esigning
laze Into
mazing
esigns.

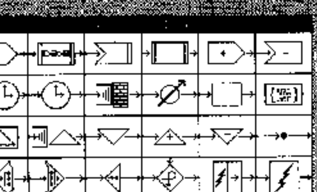
SES/*workbench*™

System-Level Design Simulation and Modeling Software



the development cycle. From the earliest conceptual stages, through system specification and design, to functional and performance verification.

SES/*workbench* advances the state of the art in system-level design and evaluation software.



S/*design* provides rich set of graphical modeling primitives that are the basic building blocks for system level design.

- Its unique graphical interface, **SES**/*design*, allows you to create a pictorial representation of a system's structure and to specify its behavior at a high level.
- You can quickly analyze design alternatives and tradeoffs with a few clicks of a mouse button.
- Comprehensive statistical reports provide a precise description of the system's behavior, so that you can evaluate system performance.

Free trial licenses are available. Call or write to us for additional information.

SES/*workbench*
A testbed for the imagination.

Scientific and Engineering Software, Inc.
1301 West 25th Street, Suite #300
Austin, Texas, U.S.A.
Phone: 512/474-4526 Fax: 512/479-6217

Treasurer's Report

For the period 7/5/90 through 9/15/90 the college had the following transactions at the First National Bank of Atlanta, Atlanta, Georgia.

Balance forward: (from BancOhio National Bank, Columbus, Ohio)			$27734.73
Revenues:			
Interest earned from $418.09 in 4.48% checking account	33.32		
Interest earned from $24000.00 in 7.55% CD	299.00		
WSC '90 reimbursement	4721.50		
Dues	8.00		
Total revenues		5061.82	
Disbursements: none			
Net (revenues - disbursements)		5061.82	
Balance Forward (previous balance + net)			$29721.09

In addition to the above funds, the College has on account at TIMS Headquarters the sum of $1110.00 (as of 9/15/90), bringing the College's net worth to $30831.09.

Respectfully submitted,
David Goldsman, Secretary-Treasurer
September 17, 1990

ORSA Journal on Computing
Simulation Area Policies and Scope

The Simulation Area of the *ORSA Journal on Computing* seeks to publish high-quality papers consistent with the aims of the Journal. We are interested in traditional research in simulation, as well as new and innovative directions.

A paper must make a new and substantial contribution to the literature in at least one of the following areas:

Simulation as applied to a computer-science problem. For example, using simulation to:
- Design an operating system
- Analyze communications protocols
- Evaluate neural networks

Computer science as applied to a simulation problem. For instance, using computer-science approaches for:
- Data structures and sorting/searching algorithms to manage event lists
- Obect-oriented simulation
- Cognitive simulation model building

Results drawn from both simulation and computer science. Examples here might include:
- Parallel and distributed simulation
- Efficient algorithms for statistical methodology in simulation
- Expert systems for generating simulation code

Results enter uncharted areas that have the potential of advancing simulation and/or computer science and lie in their interface.

Tutorials in the above areas that are comprehensive and integrate from multiple sources will also be considered. All papers are refereed by at least two reviewers and an Associate Editor. Submissions may be sent to the Area Editor (four copies, plus a copy to the Editor). For more information on policies, manuscript style, etc., contact the Area Editor:

W. David Kelton
Dept. of Operations and Management Science
Carlson School of Management
University of Minnesota
Minneapolis, Minnesota 55455
(612) 624-8503
dkelton@vx.acs.umn.edu
or dkelton@umnacvx.bitnet

1991 George E. Nicholson Student Paper Competition

The ORSA Student Affairs Committee announces the 1991 George E. Nicholson Student Paper Competition to determine the best student papers in operations research. There are three conditions for eligibility: First, an entrant must have been a student on or after January 1, 1990. Second, the submitted paper must present original research results obtained by the entrant with no more than minimal assistance from other individuals. Third, the paper must be written entirely by the entrant, with only minor outside editorial assistance.

Completed entries must include three (3) copies of the submitted paper and a letter from a faculty advisor stating that the entrant and the paper satisfy each of the three eligibility requirements.

Entrants should submit one self-contained paper with sufficient background material so that a reader trained in operations research can evaluate the significance of the research. The first- and second-place winners will receive awards of $600 and $300, respectively; a few additional finalists will receive honorable mentions with $100 awards. Although there is no formal limit, entrants should try to submit papers under 25 double-spaced pages. Prizes will be awarded and winners will be invited to present their papers at the Nashville TIMS/ORSA Joint National Meeting, May 12-15, 1991.

Complete entries must be delivered before **February 15, 1991** to:

Prof. David Goldsman
School of Industrial Systems and Engineering
Georgia Institute of Technology
Atlanta, GA 30332
(404) 894-2365
E-mail: dgoldsma@gtri01.bitnet

For information regarding eligibility requirements or other aspects of the competition, please call: **Michael H. Schneider** at **(301) 338-7781**

Simulation Software Survey

Early next year *OR/MS Today* is planning to publish a survey of Simulation Software programming that is currently available or in development. We are asking for your help to begin this process. We would like you to send us information on simulation packages that you are aware of and the company or organization from which the software can be obtained. This will enable us to properly survey the field and provide you with a comprehensive list of systems and vendor similar to the survey on these pages.

Photocopy and complete the form below and sen it—by **December 15, 1990**—to: **John Llewellyn, Edi tor, OR/MS Today, 2555 Cumberland Pkwy., Suit 299, Atlanta, GA 30339** Alternatively, you can cal (404) 431-0867, or send the information by Fax (40· 432-6969, or Bitnet to IE832JL@GITVM1.

Program name	Company/Organization	Address	Tel. No.

Your name	Address	Tel. No.

Announcements

Outstanding Simulation Publication Awards for 1990 and 1991

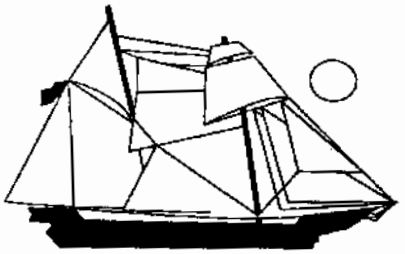
To recognize outstanding contributions to the simulation literature, the College on Simulation annually sponsors an **Outstanding Simulation Publication Award.** The 1990 Award will be presented by Professor Peter Welch, the outgoing Chairperson of the Awards Committee, at the Opening Session of the 1990 Winter Simulation Conference.

Nominations for the 1991 Outstanding Simulation Publication Award should be sent by December 31, 1990 to the incoming Chairperson of the Awards Committee:

Professor Doug Miller
Department of Operations Research& Applied Statistics
School of Information Technology and Engineering
George Mason University
Fairfax, VA 22030
(703) 764-4688, Fax (703) 323-2680

The complete set of rules governing the Outstanding Simulation Publication Award appeared in Vol. 9, No. 2 of this *Newsletter* (Fall 1985). In summary, anyone is eligible to win the Award. Journal articles, proceedings articles, books, and monographs copyrighted in 1987, 1988, and 1989 are eligible for the Award to be presented in 1991. Technical reports, research memoranda, working papers, theses, and dissertations are not eligible.

Nominations may be made by anyone, including the author(s), but they may not be made anonymously. Nominations should include: (a) a copy of the written work including all bibliographical information (in the case of books, the Awards Committee will obtain copies); (b) a short statement suitable for reading at the award ceremony if the work is chosen; and (c) any other information thought relevant by the nominator.



SCSC 1991

Baltimore, Maryland
July 22-24

Call for Papers

Enhancing Simulation Utility
1991 Summer Computer Simulation Conference (SCSC 91)

Hyatt Regency Hotel (Inner Harbor), Baltimore, Maryland
July 22-24, 1991

The Program

he 1991 Summer Computer Simulation Conference (SCSC 91) will feature innovative presentations, panel discussions, state-of-the-art reviews, tutorials, nd trade show exhibits designed to provide comprehensive coverage of the field of computer simulation. The spectrum of topics for SCSC 91 ill include:

- Simulation Methodologies
- Computer Performance & Advanced Processing
- Intelligent Simulation Environments
- AI/KBS in Simulation
- Robotics & CAD/CAE/CAM
- Simulators & Simulation Use in Training
- Government, Management, & Social Sciences
- Physical/Chemical/Engineering Applications
- Biomedical Sciences
- Communications & Radar Systems
- Undersea Systems
- Missile Systems
- Strategic Defense Initiative (SDI) Applications
- Aerospace Simulations

Frontiers of Simulation in Asia

Paper Submissions & Proposals

nly original papers which have not been previously published should be submitted. Authors will be expected to register early (at a reduced fee) d to attend the conference at their own expense to present accepted papers. When submitting material, include full names, affiliations, address- , and phone numbers (and FAX numbers when available) for every participant. Extended abstracts and proposals for tutorials or panel sessions ould be mailed to:

Dr. Dale K. Pace
Johns Hopkins University Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20723-6099
Phone: (301) 953-5650
FAX: (301) 953-5910

Deadlines & Dates:

Abstracts & Proposals	Nov 15, 90
Acceptance Notification	Jan 15, 91
Camera Ready Papers Due	Mar 15, 91
SCSC 91	July 22-24, 91

SCSC 91 Committee

General Co-Chairs:
Mr. Richard J. Hunt
(Johns Hopkins University Applied Physics Laboratory)
Dr. Iwao (Pete) Sugai
(Soviet Electronics Digest Dissemination Service)

Program Chair:
Dr. Dale K. Pace
(Johns Hopkins University Applied Physics Laboratory)

Associate Program Chair:
Mr. Dennis Baker
(Martin Marietta Aero & Naval Systems)

Local Arrangements/Exhibits Co-Chairs:
Mr. William E. Buchanan
(Johns Hopkins University
Applied Physics Laboratory)
Mrs. M. Connie Finney
(Johns Hopkins University
Applied Physics Laboratory)

Budget Chair:
Mr. Paul F. Bohn
(Johns Hopkins University
Applied Physics Laboratory)

Sponsored by:

SCS

The Society for Computer Simulation
P.O. Box 17900, San Diego, CA 92117
Phone: (619) 277-3888, FAX: (619) 277-3930

SCS

Abstracts of Papers

Soren Asmussen and Reuven Y. Rubinstein, "The Efficiency and Heavy Traffic Properties of the Score Function Method in Sensitivity Analysis of Queueing Models," Technical Report, Chalmers Institute of Technology, Gothenburg, Sweden.

This paper studies computer simulation methods for estimating the sensitivities (gradient, Hesslan, etc.) of the expected steady-state performance of a queueing model with respect to the vector of parameters of the underlying distribution (an example is the gradient of the expected steady-state waiting time of a customer at a particular node in a queueing network with respect to its service rate). It is shown that such a sensitivity can be represented as the covariance between two processes, the standard output process (say, the waiting time process) and what we call the score function process, which is based on the score function. Simulation procedures based upon such representations are discussed, and in particular, a control variate method is presented. The estimators and the score function process are then studied under heavy traffic conditions.

Soren Asmussen and Reuven Y. Rubinstein, "The Performance of the "What if" Estimators viathe Score Function Method," Technical Report, Chalmers Institute of Technology, Gothenburg, Sweden.

Estimating systems performance and the associated sensitivities (gradient, Hessian, etc.) for several scenarios via simulation generally requires a separate simulation for each scenario. Here we show how the score function (SF) method handles this problem by using a single simulation run and then discuss the efficiency of the SF estimators for performance evaluation of simple queueing models. In particular, we consider the following problems:

1. Given a stable queueing model, that is assuming that the traffic intensity ρ is less than unity, what is a 'good' reference system (if any) to simulate in order to obtain reasonably good SF estimators? What is the optimal reference intensity ρ_0 of such a system?
2. For a given reference value ρ_0, how does the SF estimator perform in various ranges of ρ? How to choose ρ_0 in order to increase the variation range of ρ without affecting substantially the performance of the SF estimators?

Here we give explicit solutions for the above problems and some the associated ones while considering the M/M/1 queue. We show that our M/M/1 studies provide some insight and give basic guidance on how to deal with the problems (1)-(2) for more complicated queueing models. As a result, one of our main recommendations is to choose the reference traffic intensity ρ_0 moderately larger than the underlying one ρ. Numerical examples supporting our theory are presented, as well.

John M. Charnes and W. David Kelton, "Multivariate Autoregressive Techniques for Constructing Confidence Regions on the Mean Vector," Technical Report, Department of Management Science, University of Miami, Coral Gables, Florida.

We develop an asymptotically valid method for constructing confidence regions on the mean vectors of multivariate processes that is based on a multivariate autoregressive representation of the data-generating process. The confidence-region construction algorithm for a general autoregressive model of order p is given, as well as the the algorithm for the special case of first-order autoregressive modeling. The performance of the new method compares favorably with that of several competing methods used with simulated data.

George S. Fishman, "Confidence Intervals for the Mean in the Bounded Case," Technical Report UNC/OR/TR-89/8, Department of Operations Research, University of North Carolina, Chapel Hill.

This paper describes a $100(1-\alpha)$ percent confidence interval for the mean of a bounded random variable that holds for every sample size n and avoids the error of approximation that assuming normality induces.

George S. Fishman, "Exploiting Special Structure to Improve Future Event Set Management in Simulation," Technical Report UNC/OR/TR-90/8, Department of Operations Research, University of North Carolina, Chapel Hill.

Every discrete event simulation programming language or package has a built-in procedure for managing the scheduling and execution of events. Most rely on linear search, either to schedule an event or to select an event for execution. This paper describes alternative procedures that exploit special structure to reduce management time substantially, especially as the size of the problem grows.

For a simulation with r types of resources, M resources per type and exponentially distributed event times, the paper describes an event management plan that for M finite, can reduce work from $O(Mr)$ to $O(1)$ mean number of comparisons and to $O(\log r)$ mean number of comparisons, more generally, for any M. For r types of events each with a distinct deterministic event time, the paper describes another event management procedure which has $O(r)$ worst-case number of comparisons. All proposals made here lead to scheduling and selection times independent of the number of events in the system and, at most, a function of the number of types of events. The procedures for exponentially distributed and determinisitic times can be integrated

"I had no idea I could use simulation to..."

The Society for Computer Simulation

SCS is now entering its 38th year of service to the simulation community. As projects of all types become larger and more expensive, it is essential to reduce the risk of failure to a negligible level. Simulation is the most valuable tool available to accomplish the task.

One of the most frequently heard comments from newcomers to SCS conferences is *"I had no idea I could use simulation to..."* And an enormous variety of applications complete that sentence.

Everyone can benefit from simulation in some way, and SCS, its conferences, and proceedings, can be of particular use to you and your company.

Join the growing number of individuals and companies that have come to realize the power of simulation, and the benefits of being involved with the leading organization in the field.

Become an SCS member

In addition to the following benefits, membership in SCS includes a number of "intangibles" which can only come from being a part of the leading society in its field.

SIMULATION...

Our monthly journal comes to you, at no additional cost, with articles written by researchers and developers like you who are working with computer simulation tools.

At least a 25% discount on SCS books...

You will see how this discount will start paying for your membership with the first books you order. SCS offers a wide variety of publications covering virtually every topic involved with simulation.

Discounts on conference registrations...

SCS sponsors the Western Multiconference, the Eastern Multiconference, the Summer Computer Simulation Conference, the premier simulation event of the year.

These meetings are an excellent opportunity to exchange information with your colleagues. In addition to these events, SCS also co-sponsors the annual Winter Simulation Conference and numerous regional meetings.

TRANSACTIONS...

The SCS quarterly journal, is available to members for $30 per year, a savings of over 50% off the non—member price.

To become a member of SCS...

Simply fill out the form below.

You are eligible for these benefits as soon as your application is received. Your first issue of *SIMULATION* will arrive the following month.

Mail to:
The Society for Computer Simulation
P.O. Box 17900
San Diego, CA 92117-7900
Telephone: (619) 277-3888
FAX: (619) 277-3930

In Europe:
The Society for Computer Simulation
c/o Philippe Geril
University of Ghent
Coupure Links 653, B-9000
Ghent, Belgium

SCS

Please identify only up to FIVE main areas of your interest in priority order

Highest Priority ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ Lowest Priority ➲

Check mailing address: Home ☐ Business ☐

Last name _____ First _____ M.I. _____

Home mailing address _____

City, province, country (if not in U.S.) _____ State _____

ZIP or postal code _____ ( ) - X Telephone number _____

Company name _____

Department and mail code _____

Business mailing address _____

City, province, country (if not in U.S.) _____ State _____

ZIP or postal code _____ ( ) - X Telephone number _____

E-Mail Address: _____

☐ **Member** U.S. $60/yr. (open to those professionally engaged in the field)

☐ **Associate member** U.S. $50/yr. (open to those interested in in the field)

☐ **Student member** U.S. $20/yr. Instructor signature _____

$40 of your annual dues is for a subscription to ***SIMULATION.***

I would also like to subscribe to *TRANSACTIONS*
☐ member of SCS, $30 ☐ non-member, $120

☐ **Bill me** ☐ **Check enclosed** (Drawn on U.S. or Canadian banks only)

Charge my (circle one): **Mastercard, Visa, or American Express** account:

Card Number _____

Authorizing signature _____ Expiration date _____

List one reference who knows you professionally (students list an advisor):

Name _____

Address _____

City _____ State _____ ZIP _____

A Aerospace
A1 Air traffic control
B Applied mathematics
C1 Artificial intelligence
C2 Array processors
D Behavioral sciences
E Business & economic planning
F CAD/CAM
G Chemical engineering
H Computer networks
H1 Communications systems
I Continuous systems
J Discrete systems
K Education
L Electrical engineering
M Environmental
N Financial modeling
O Geophysical systems simulation
P Life sciences
Q Management sciences
R Marine applications
S Mechanical systems
T Medicine
T1 Tactical
U Microcomputers
V Numerical integration
W Operations research
X Physical sciences
X1 Power plant simulation
Y Signal processing
Z Simulation for training
01 Graphics output
1 Simulation languages
1A Simulators
2 Simulation & public policy
3 Social systems
3A Speech recognition & synthesis
4 Statistics
5 Systems dynamics
6 Validation of models
7 VLSI & simulation
9 Emergency planning
10 Energy
11 Manufacturing
12 Military
13 Parallel processing
14 Transportation
20 Control engineering
Ø Inventory & production control
00 Other: _____

with a more general-purpose event management procedure for handling other randomly, but not exponentially, distributed event times.

A large-scale telecommunication network simulation with a set of deterministic flow capacity rates applied to standardized packets and exponential interdemand, failure and repair times can reduce the rate of growth of its event management time as the network grows by implementing the techniques described here. A like benefit would accrue to a large-scale manufacturing simulation with many classes of machines with identical deterministic task times.

1990 Winter Simulation Conference

December 9-12, 1990
The Fairmont Hotel
New Orleans, LA

Topics in all aspects of discrete event and combined (discrete/continuous) simulation will be covered in sessions following several formats: contributed and invited papers, tutorials, reviews and panel discussions. A special feature is the focus sessions: centering on highly topical problems and issues.

Contributions are solicited in the following categories:

- Papers treating applications and methodology. Application papers should emphasize positive and negative lessons to be learned in modeling, analysis, and implementation.
- Both broad and in-depth reviews designed for practitioners and researchers.
- Proposals to organize panel discussions or regular paper sessions, present state-of-the-art reviews, present tutorials, or serve as a discussant.
- Demonstrations of hardware and software.
- Papers and presentations in simulation education.

Send all correspondence to:

Richard E. Nance
Systems Research Center
320 Femoyer Hall
Virginia Tech
Blacksburg, VA 24061
(703) 231-6144
nance@vtopus.cs.vt.edu
or
nance@vtvm1.bitnet

Please include your full address, affiliation, telephone number and, if available, an electronic mail address with all correspondence.

George S. Fishman, "Generating a Sample from a k-Cell Table with Changing Probabilities in $O(\log_2 k)$ Time," Technical Report UNC/OR/TR-90/10, Department of Operations Research, University of North Carolina, Chapel Hill.

This paper presents an algorithm for generating samples from a discrete k -cell probability distribution whose probabilities may change between successive generations. The algorithm take $O(\log_2 k)$ time in contrast to the inverse transform approach which takes $O(k)$ time. Its data storage requirements are $3k/2-1$ for k a power of 2 but no greater than $\lfloor k/2 \rfloor + 2^{\lfloor \log_2 k \rfloor} - 1$ for k an arbitrary integer. Sample path generation of a Markov chain with varying state probabilities provides one example that can benefit from this method. Generating s elements with k unequal weights from a finite population of N elements without replacement illustrates a second use that takes $O(s \log_2 k)$ time compared the the $O(s \log_2 N)$ time that other published proposals would take.

Bennett L. Fox and Peter W. Glynn, "Discrete-Time Conversion for Simulating Finite-Horizon Markov Processes," Department of Mathematics Technical Report TE11089, University of Colorado, Denver, Colorado.

We estimate via simulation the expectation of certain integrals of functionals of continuous-time Markov chains over a finite horizon, fixed or random. By computing conditional expectations given the sequence of states visited (and possibly other information), we reduce variance. This is discrete-time conversion. We further increase efficiency by combining discrete-time conversion with stratification and splitting.

Paul Glasserman, "Structural Conditions for Perturbation Analysis Derivative Estimation: Finite-Time Performance Indices," AT&T Bell Laboratories, Holmdel, New Jersey 07733.

In recent years, there has been a surge of research into methods for estimating derivatives of performance measures from sample paths of stochastic systems. In the case of queueing systems, typical performance measures are mean queue lengths, throughputs, etc., and the derivatives estimated are with respect to system parameters such as parameters of service and interarrival distributions. Derivative estimates potentially offer a general means of optimizing performance, and are also useful in sensitivity analysis. This paper is concerned with one approach to derivative estimation, known as *infinitesimal perturbation analysis*. We first develop a general framework for these types of estimates, then give simple sufficient conditions for them to be unbiased. The key to our results is identifying conditions under which certain finite-horizon performance measures are almost surely continuous functions of the parameter of differentiation throughout an interval. The sufficient conditions we introduce are formulated in the setting of general-

ized semi-Markov processes, but translate into readily verifiable conditions for queueing systems. These results vastly extend the domain of problems in which infinitesimal perturbation analysis is provably applicable.

Peter W. Glynn and Philip Heidelberger, "Experiments with Initial Transient Deletion for Parallel, Replicated Steady-State Simulations," IBM Research Division, T. J. Watson Research Center, P. O. Box 704, Yorktown Heights, New York 10598.

A simple and effective way to exploit parallel processors in discrete even simulations is to run multiple independent replications, in parallel, on multiple processors and to average the results at the end of the turns. We call this the method of parallel replications. This paper is concerned with using the method of parallel replications for estimating steady-state performance measures. We report on the results of queueing network simulation experiments that compare the statistical properties of several possible estimators that can be formed using this method. The theoretical asymptotic properties of these estimators were determined in Glynn and Heidelberger (1989a and 1989b). Both the theory and the experimental results reported here strongly indicate that a nonstandard (in the context of steady-state simulation), yet easy to apply, estimation procedure is required on highly parallel machines. This nonstandard estimator is a ratio estimator. The experiments also show that use of the ratio estimator is advantageous even on machines with only a moderate degree of parallelism.

Philip Heidelberger, "Monte Carlo Methods for Performance Evaluation, Sensitivity Analysis, and Optimization of Stochastic Systems," IBM Research Division, T. J. Watson Research Center, P. O. Box 704, Yorktown Heights, New York 10598

This paper surveys Monte Carlo methods for performance evaluation, sensitivity analysis, and optimization of discrete-event computer simulation models, with particular emphasis on the score function (SF) method. It is shown that using the SF method, which is based on the change of the probability measure, enables us to estimate *simultaneously*, from a *single* simulation experiment (run): (i) system performance, (ii) all its sensitivities (gradients, Hessians, etc.), and (iii) the optimal solution of an entire optimization problem. In the last case, the SF method constructs a stochastic counterpart to the original deterministic optimization problem, and the optimal solution of this counterpart is taken as an estimator for the optimal solution of the original problem. Numerical examples justifying the efficiency of the proposed method are given.

Jack P. C. Kleijnen, "Super Computers for Monte Carlo Simulation: Cross-Validation versus Rao's Test in Multivariate Regression," Technical Report FEW 447, Katholieke Universteit Brabant, Tilburg, Netherlands

Part I covers supercomputers, especially vector computers, which require thinking in vector mode. This mode is examined in the context of Monte Carlo experiments with regression models. The vector mode needs to exploit a specific dimension of the Monte Carlo experiment, namely its replicates. The resulting code computes Ordinary Least Squares estimates on a Cyber 205 in 2 % of the time needed on a VAX 8700. For Generalized least Squares estimates, however, the code runs slower on the Cyber 205 than on the VAX, if the regression is small; for large models the Cyber 205 runs much faster.

Part II covers regression models with dependent errors. To test the validity of the specified regression model, Rao (1959) generalized the F statistic for lack-of-fit, whereas Kleijnen (1983) proposed cross-validation using Student's t statistic combined with Bonferroni's inequality. An extensive Monte Carlo experiment compares these two methods. Whereas cross-validation turns out to be conservative, Rao's test realizes its nominal α error and has high power. The MC experiment further compares several confidence interval procedures for individual regression parameters.

Jack P. C. Kleijnen, "Sensitivity Analysis of Simulation Experiments: Regression Analysis and Statistical Design," Technical Report FEW 440, Katholieke Universteit Brabant, Tilburg, Netherlands.

This tutorial gives a survey of strategic issues in the statistical design and analysis of experiments with deterministic and random simulation models. These issues concern what-if analysis, optimization, and so on. The anlsysis uses regression (meta) models and Least Squares. The design uses classical experimental designs such as 2^{k-p} factorials, which are efficient and effective. If there arevery many inputs, then special techniques such as group screening and sequential bifurcation are useful. Applications are discussed.

George C. Runger and Joseph J. Pignatiello Jr., "Adaptive Sampling for Process Control," Industrial and Management Engineering, University of Iowa, Iowa City, Iowa.

Statistical process control procedures typically entail monitoring the process by selecting rational subgroups of equal size after equal time intervals. A generallzation of this standard paradigm removes the restriction of equal waiting times between subgroups. We consider process control procedures where the time until the next subgroup is shortened when there is evidence that the process is off-target, with a compensating lengthening of the waiting time otherwise. This adapting of the waiting time significantly improves the performance of the proceşs control procedure. Using the Shewhart $\bar{X}$ procedure as an example, the adaptive sampling strategy is introduced. A simple, dual waiting time procedure is described and shown to be optimal and easy to implement in practice. Performance comparisons to classical procedures are provided.

P. A. W. Lewis and J. G. Stevens, "Nonlinear Modeling of Time Series using Multivariate Adaptive Regression Splines," Technical Report, Naval Postgraduate School, Monterey, California.

MARS is a new methodology, due to Friedman, for nonlinear regression modeling. MARS can be conceptualized as a generalization of recursive partitioning that uses spline

How to join TIMS College on Simulation

You can join the College on Simulation even if you aren't a member of The Institute of Management Sciences. The cost of annual dues for non-TIMS members of the College is only $3; TIMS members pay only $2. To join, please fill out this form and send it, along with a check for the appropriate amount, to: **Barry L. Nelson, Dept. of Industrial and Systems Engineering, The Ohio State University, Columbus, OH 43210.** Make your check payable to "TIMS College on Simulation."

Name _____ Tel: (_____) _____

Address _____

City _____ State _____ Zip _____

E-mail address (if applicable) _____

NOTE: If you know people who might be interested in joining, please pass along this announcement.

fitting in lieu of other simple functions. Given a set of predictor variables, MARS fits a model in the form of an expansion in product spline basis functions of predictors chosen during a forward and backward recursive partitioning strategy. MARS produces continuous models for high dimensional data that can have multiple partitions and predictor variable interactions. Predictor variable contributions and interactions in a MARS model may be analyzed using an ANOVA style decomposition.

By letting the predictor variables in MARS be lagged values of a time series, one obtains a new method for nonlinear autoregressive threshold modeling of time series. A significant feature of this extension of MARS is its ability to produce models with limit cycles when modeling times series data that exhibit periodic behavior. In a physical context, limit cycles represent a stationary state of sustained oscillations, a satisfying behavior for any model of a time series with periodic behavior. Analysis of the Wolf suspot numbers with MARS appears to give an improvement over existing nonlinear threshold and bilinear models.

Peter A. W. Lewis and Richard L. Ressler, "Variance Reduction for Quantile Estimates in Simulations via Nonlinear Controls," Technical Report, Naval Postgraduate School, Monterey, CA.

Linear controls are a well known simple technique for achieving variance reduction in computer simulation. Unfortunately, the effectiveness of a linear control depends upon the correlation between the statistic of interest and the control, which is often low. Since statistics often have a nonlinear relationship with the potential control variables, nonlinear controls offer a means for improvement over linear controls. This paper focuses on the use of nonlinear controls for reducing the variance of the quantile estimate in simulation. It is shown that one can substantially reduce the analytic effort required to develop a nonlinear control from a quantile estimator by using a strictly monotone transformation to create the control. It is also shown that as one increases the sample size for the quantile estimator, the asymptotic multivariate normal distribution of the quantile of interest and the control reduces the effectiveness of the nonlinear control to that of the linear control. However, the data has to be sectioned to obtain an estimate of the variance of the controlled quantile estimate. Graphical methods are suggested for selecting the section size that maximizes the effectiveness of the nonlinear control.

Reuven Y. Rubinstein, Alexander Shapiro, and Michael Shalmon, "Efficiency of the Score Function Method for Sensitivity Analysis of Queueing Networks with Decomposable Performance Measures," Faculty of Industrial Engineering, Technion, Haifa, Israel.

We show that many typical steady-state performance measures of queueing networks, like the sojourn time, the number of customers, etc., can be viewed as decomposable functions with respect to the underlying parameters. For such decomposable performance measures we define a new class of sensitivity measures based on the *score function* (SF) method, called the *decomposable score function* (DSF) estimators. We show that the DSF estimators can handle efficiently both the expected performance and the expected sensitivities (gradients, Hessians, etc.) of quasi-reversible queueing networks of moderate and large size (hundreds of parameters) in the sense that their variance is substantially smaller (by a factor of thousands) than that of the standard SF method. Numerical results supporting our theory are given.

Paul Glasserman, "Stochastic Monotonicity, Total Positivity, and Conditional Monte Carlo for Likelihood Ratios," AT&T Bell Laboratories.

The derivative of an expectation can often be expressed as an expectation involving a differentiated likelihood ratio. This representation is used in Monte Carlo estimation of derivatives. Replacing the differentiated likelihood ratio with its conditional expectation often reduces variance, but not always. Using heavy traffic analysis, Asmussen and Rubinstein have shown that for the waiting time in a GI/G/1 queue conditioning reduces variance in an asymptotic sense. This paper considers other settings and a different approach to showing that conditioning is advantageous. We use stochastic order relations to get positive dependence from which variance reduction follows. Our analysis supports the following rough statement: for increasing functionals of monotone processes with (parametrically) TP_2 densities, conditioning reduces variance. Examples are drawn from recursively defined processes, Markov chains in discrete and continuous time, and processes with Poisson input.

Kerry W. Fendick, Vikram R. Saksena, and Ward Whitt, "Investigating Dependence in Packet Queues with the Index of Dispersion for Work," AT&T Bell Laboratories, c/o Room 1F-401, Holmdel, New Jersey.

This paper continues an investigation of the way diverse traffic from different data applications affects the performance of packet queues. This traffic often exhibits significant dependence among successive interarrival times, among successive service times, and between interarrival times and service times, which can cause a significant degradation of performance under heavy loads (and often even under moderate loads). This dependence and its effect on performance (specifically, the mean steady-state workload) is partially characterized here by the cumulative correlations in the total input process of work, which we refer to as the index of dispersion for work (IDW). This paper evaluates approximations for the mean steady-state workload based on the IDW by making comparisons with computer simulations.

TCS-Sponsored Philadelphia Sessions

Following are descriptions of three sessions to be sponsored by the TIMS College on Simulation for the Fall 1990 ORSA/ TIMS Conference in Philadelphia.

Simulation Methods for Stochastic Networks

Session Chair: Christos Alexopoulos, School of Industrial & Systems Engineering, Georgia Tech, Atlanta, GA 30332

A New Class of Perturbation-Analysis Algorithms for Piecewise-Constant Sample Performance Measures

Yorai Wardi, School of Electrical Engineering, Georgia Tech, Atlanta, GA 30332, Wei-Bo Gong and Christos Cassandras, Department of Electrical and Computer Engineering, University of Massachusetts, Amherst, MA 01003

A class of performance measures, where infinitesimal perturbation analysis (IPA) has not had simple algorithms, involved piecewise-constant sample performance measures. In this talk we present a new, general method of perturbation analysis for such problems. The method is flexible and yields simple algorithms. The proposed technique will be demonstrated for the zero-finding probability in a *GI/G/1* queue, and for the threshold-delay probability in a serial network.

Fast Simulation of Dependability Models with General Failure, Repair and Maintenance Processes

Victor Nicola, Philip Heidelberger, and Ambuj Goyal, IBM Research Division, P.O. Box 704, Yorktown Heights, NY 10598, and Marvin K. Nakayama, Department of Operations Research, Stanford University, Stanford, CA 94305

The evaluations of dependability measures for repairable systems with general failure and maintenance processes are hard problems. Since the system failure is typically a rare event, we present a simulation method based on importance sampling which results in large reduction in run lengths. We illustrate the effectiveness of the proposed technique for a large computing system.

Shortest-Path Problems in Stochastic Networks with Dependent Arc Lengths

Christos Alexopoulos, School of Industrial & Systems Engineering, Georgia Tech, Atlanta, GA 30332

We present methods for evaluating probability distributions related to the shortest path length in networks whose arcs have random dependent lengths. Since the time requirements for exact methods can increase exponentially with the number of arcs, we also propose variance-reducing Monte Carlo methods based on bounds which are very efficient for large-scale networks.

Choosing among Competing System Designs Using Monte-Carlo Simulation

Session Chair: Michael R. Taaffe, Department of Industrial and Manufacturing Engineering, The University of Rhode Island, Kingston, RI 20881

Batching Strategies for Multiple Comparison in Steady-State Simulation

Lynne Goldsman and Barry L. Nelson, Department of Industrial & Systems Engineering, The Ohio State University, 1971 Neil Avenue, Columbus, OH 43210

To use multiple-comparison procedures in steady-state simulation analysis at least two issues must be addressed: the possibility of point estimators with unequal variances, and the problem of assigning appropriate degrees of freedom to the point estimators. We propose batching strategies to handle both problems.

Procedures for Selecting the Simulated Population with the Largest Mean

David Goldsman, School of Industrial & Systems Engineering, Georgia Tech, Atlanta, GA 30332

We present procedures for selecting that one of k competing normal populations having the largest mean under various assumptions about the population variances. We then extend the results for use in computer simulations.

A Strategy for Designing Robust Systems Using Discrete-Event Simulation

Rosemary H. Wild, Decision Science Department, University of Hawaii at Manoa, 2404 Maile Way, Honolulu, HI 96822, and Joseph J. Pignatiello Jr., Department of Industrial Engineering, The University of Iowa, Iowa City, IA 52242

We propose an experimental-design strategy for designing robust systems using discrete-event simulation. The proposed strategy is motivated by Genichi Taguchi's strategy for improving product and process quality in manufacturing. Our strategy emphasizes designing for robustness upfront rather than relying on post-optimality sensitivity analysis.

Monte-Carlo Post-Experiment Analysis for Choosing among System Designs

Bruce W. Schmeiser and Wei-Ning Yang, School of Industrial Engineering, Purdue University, West Lafayette, IN 47907

We consider statistical (including stochastic-simulation) experiments that compare system designs. Given various assumptions and parameters, existing methodologies (e.g., ranking-and-selection or multiple-comparisons-with-the-best) calculate constants (e.g. , sample sizes or quantiles) necessary to guarantee some minimal nominal performance (e.g., probability of correct selection or overall confidence). We discuss Monte Carlo methods for a practitioner to estimate actual performance.

Statistical Issues in Simulation

Session Chair: Nabil R. Adam, Graduate School of Management, Rutgers University, Newark, NJ 07102

An Application of Variance-Reduction Techniques to a Naval-Gunfire Simulation Model

Keebom Kang, Michael P. Bailey, Alexander Callahan, and Marcelo Bartoli, Department of Operations Research, Naval Postgraduate School, Monterey, CA 93943-5000

In this study, we examine the effects of ammunition component reliability on the performance of a naval gunfire support system. Due to the large number of possible component configurations, we were motivated to explore variance reduction through the use of control variates. In this talk, we share our results, as well as our experiences in applying control variates for a nontechnical client.

A Flexible Method for Estimating Inverse Distribution Functions in Simulation Experiments

Athanassios Avramidis and James R. Wilson, School of Industrial Engineering, Purdue University, West Lafayette, IN 47907

To generate random variates from an unknown continuous distribution via the inverse-transform method, we present a flexible, computationally tractable procedure for estimating the associated inverse distribution function based on sample data. We present the results of an extensive Monte Carlo study to demonstrate the effectiveness of the method.

Estimating Acceptance-Sampling Plans for Dependent Production Processes

Barry L. Nelson, Department of Industrial and Systems Engineering, The Ohio State University, 1971 Neil Avenue, Columbus, OH 43210

When acceptance sampling is used to judge the quality of an ongoing production process, the quality of successive items may exhibit statistical dependence that is not accounted for in standard acceptance-sampling plans. This talk presents an efficient method for estimating single-sampling attributes plans for any production process model that can be simulated.

E-Mail Directory

Below is the latest update of the e-mail directory. If you would like to have your address included, please send it to the *Newsletter* Editor at jswain@umiami.bitnet.

Name	Affiliation	E-mail address
Christos Alexopoulos	Georgia Tech	calexopo@gtri01.bitnet
Osman Balci	Virginia Tech	balci@vtpus.cs.vt.edu
Russell Barton	Cornell	barton@gvax.cs.cornell.edu
David Briskman	General Foods	brisk@crnlimap.cornell.edu
Gerald Brosnan	AT&T Bell Labs	gab@hound.att.com (arpa) .att!hound!gab (usenet)
Ted Brown	Queens College	brownt@qcvax.bitnet
John Charnes	U. Miami	jcharnes@umiami.bitnet
Gordan Clark	Ohio State	clark-g@eng.ohio-state.edu
Tom Clark	Florida State	tclark@fsu.bitnet
John Comfort	Florida International	comfort@servax.bitnet
Luc Devroye	McGill	luc@mujunior.ce.mcgill.ca
Remko Dur	Delft Tech	winfdur@hdetud1.bitnet
Paul Fishwick	Florida	fishwick@fish.cis.ufl.edu
Bob Foley	Georgia Tech	rfoley@gtri01.bitnet
Ben Fox	Col.-Denver	bfox@cudenver.bitnet
James Gentle	IMSL	uunet!imsl!gentle
Paul Glasserman	AT&T Bell Labs	pg@hocus.att.com
Peter Glynn	Stanford	glynn@sierra.stanford.edu
Dave Goldsman	Georgia Tech	dgoldsma@gtri01.bitnet
David Grier	George Washington	dagrier@gwuvm.bitnet
Jorge Haddock	RPI	ffye@rpitsmts.bitnet
Phil Heidelberger	IBM	berger@yktvmh.bitnet
Sheldon Jacobson	Case Western	jacobson@cwru.bitnet jacobson@cwru.cwru.edu
Keebom Kang	Naval Postgraduate School	5030p@navpgs.bitnet
Dave Kelton	Minnesota	dkelton@umnacvx.bitnet
Jack Kleijnen	Tilburg (Netherlands)	kleijnen@htikub5
Robert Klein	Indianapolis	idjd100@indyvax.bitnet
Peter Lewis	Naval Postgraduate School	1526p@navpgs.bitnet
J Jung Lyu	Iowa	aeglynpa@uiamvs.bitnet
D.C. McNickle	U. Canterbury (New Zealand)	opre001%canterbury.ac.nz@relay.cs.net
Susumu Morito	Waseda (Japan)	opremori@jpnwas00
Edward Mykytka	Auburn	mykytka@auducvax
Barry Nelson	Ohio State	nelson-b@eng.ohio-state.edu
Norman Nielsen	SRI Internat'l	nielsen@kl.sri.com
E. Joel Rahn	Laval	rahnj@lavalvm2.netnorth
Charles Reilly	Ohio State	reilly-c@eng.ohio-state.edu
Steve Roberts	Purdue	steverob@gb.ecn.purdue.edu
Paul Sanchez	Arizona	paul@tucson.sie.arizona.edu
Bruce Schmeiser	Purdue	schmeise@ecn.purdue.edu
Tom Schriber	Michigan	userk2bu@michub.bitnet
Lee Schruben	Cornell	lee@orie.cornell.edu
Andy Seila	Georgia	aseila@uscn.bitnet
Henk G. Sol	Delft Tech	winfsol@hdetud1.bitnet
Wheyming Tina Song	Purdue	wheyming@pink.ecn.purdue.edu
Bob Storer	Lehigh	rhs2@lehigh.bitnet
Jim Swain	U. Miami	jswain@umiami.bitnet
Mike Taaffe	Rhode Island	taaffe@gb.ecn.purdue.edu
Jeff Tew	Virginia Tech	iele95@vtum2.bitnet
Enio Velazco	Worcester Poly	evelazco@wpi.wpi.edu
Alexaner Verbraeck	Delft Tech	winfave@hdetud1.bitnet
Peter Welch	IBM	welch@yktvmh.bitnet
Folkert W. Wierda	Delft Tech	winffww@hdetud1.bitnet
Ward Whitt	AT&T Bell Labs	wow@research.att.com
Jim Wilson	Purdue	wilsonj@yellow.ecn.purdue.edu
Jeff Wright	Purdue	wrightje@simplex.ecn.purdue.edu .inhp4!pur-ee!wrightje.bitnet
Helio Yang	San Diego State	q200250@calstate
Enver Yucesan	Cornell	vohy@cornella.bitnet

Event Calendar

TIMS/ORSA Joint National Meeting, October 28-31, Wyndham Hotel, Philadelphia, PA. For further information, contact Benjamin Lev, Department of Management, 100 Institute Road, Worcester Polytechnic Institute, Worcester, MA 01609. Phone: (508) 831-5548.

European Simulation Symposium, November 8-10, Het Pand, Ghent, Belgium. For further information, contact Philippe Geril, University of Ghent, Coupure Links 653, B-9000 Ghent, Belgium. Electronic mail: geril@bgerug51.bitnet or scsi@bgerug51.bitnet. Phone: 0032.91.236961, ext. 233.

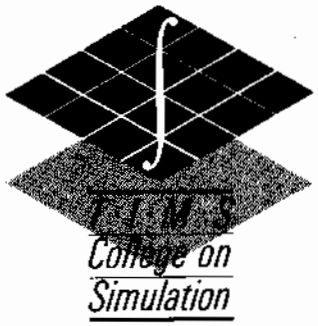
1990 Winter Simulation Conference, December 9-12, New Orleans, LA. Contact Randall P. Sadowski, Systems Modeling Corporation, 504 Beaver Street, Sewickley, PA, 15143, (412) 741-3727, or Richard E. Nance, Computer Science Department, Virginia Tech, Blacksburg, VA 24061. Phone: (703) 961-6144.

1991
TIMS/ORSA Joint National Meeting, May 12-15, Opryland Hotel, Nashville, TN. For further information, contact Michael Beasley, Dover Elevator Corp., P.O. Box 6400, Horn Lake, MS 38637. Phone: (601) 393-2110, ext. 630.

Summer Computer Simulation Conference, July 22-24, Hyatt Regency Hotel (Inner Harbor), Baltimore, MD. For further information contact The Society for Computer Simulation, P.O. Box 17900, San Diego, CA 92117. Phone: (619) 277-3930.

TIMS/ORSA Joint National Meeting, November 3-6, Hilton Hotel, Anaheim, CA. For further information, contact Carlton Scott, Graduate School of Management, University of California, Irvine, CA 92717. Phone: (714) 856-5336.

1992
TIMS/ORSA Joint National Meeting, April 26-29, Marriott World Center, Orlando, FL. For further information, contact Bill Swart, Industrial Engineering Department, University of Central Florida, Orlando, FL.



290 Westminster St.
Providence, RI 02903

Bulk Rate
U.S. Postage
Paid
Atlanta, GA
Permit No. 4292

010462
BARRY NELSON
OHIO STATE UNIV - I S E
1971 NEIL AVENUE
COLUMBUS, OH 43210