TIMS College on Simulation

THE INSTITUTE OF MANAGEMENT SCIENCES

NEWSLETTER

President's Message

Officers

President
W. David Kelton
Dept. of Operations and Management
    Science
University of Minnesota
Minneapolis, MN 55455
(612) 624-8503
dkelton@vx.acs.umn.edu

Vice-President/President-Elect
Barry L. Nelson
Dept. of ISyE
Ohio State University
Columbus, OH 43210-1271
(614) 292-0610
nelsonb@random.eng.ohio-state.edu

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

Newsletter Editor
James J. Swain
Lionheart Publishing
2555 Cumberland Parkway, #299
Atlanta, GA 30339
(404) 434-2187/432-6969 (office/FAX)
iefacdg@gitvm1.bitnet

Associate Editor
Jeffrey D. Tew
Dept. of Industrial Engineering
    and Operations Research
Virginia Polytechnic and State Univ.
Blacksburg, VA 24061-0118
(703) 231-7099/3535 (office/FAX)
ieie95@vtvm2.bitnet

It's time to elect the College officers for the next two-year term. The last page of this issue of the *Newsletter* contains your ballot. It is critical for the College's vitality that as many members as possible participate. So please take a moment to mark your ballot, detach it, and return it to me (my address is on the ballot). For your ballot to be valid, make sure that your mailing label is attached before sending it to me.

At WSC'91 in Phoenix, the Distinguished Service Award went to Alan Pritsker for his longtime dedication to the College and to simulation in general. The Outstanding Publication Award was presented to Ward Whitt for his excellent research on designing and analyzing simulations. My congratulations to both for their fine work, and for accepting our awards. Our thanks go to the committees for these awards: Tom Schriber chaired the Service Award Committee, whose members were Bob Sargent and George Fishman. The Publication Award committee was chaired by Douglas Miller, and the members were Jim Wilson and Peter Welch.

As the senior members of the awards committees rotate off, I have been lucky enough to secure strong replacements. On the Service Award committee, Bob Sargent's term is up, and he will be replaced by Dick Nance. Peter Welch's term on the Publication Award committee is coming to an end, and he is being replaced by Luc Devroye. My thanks go to Bob and Peter for their three years' work, and my appreciation goes to Dick and Luc for agreeing to serve in these important roles. George Fishman will chair the Service Award committee for this year, and Jim Wilson will chair the Publication Award committee.

This is my last President's message, and I'd like to take this opportunity to thank the many people whose work has made the College's activities a success over the two years in which I've been fortunate enough to serve. As VP and President-Elect, Barry Nelson has done a great job of setting up and securing chairs for our sponsored sessions at the biannual ORSA/TIMS conferences; as Barry takes over the Presidency we can look forward to two years of strong and vigorous leadership. As Secretary-Treasurer, Dave Goldsman has guarded the treasury and been a diligent note-taker at our meetings; his great taste in refreshments has been in evidence as well. As *Newsletter* Editor, Jim Swain has presided over a dramatic improvement, in terms of circulation, content and layout; *Newsletter* Associate Editor Jeff Tew's input has been clear as well. Steve Roberts has served us well in his role as our representative to the WSC Board (Steve has just assumed the chair of the WSC Board). In addition to the award-committees' members mentioned above, I'd like to thank Lee Schruben and Steve Roberts for their work on these committees last year. The Simulation Department of *Management Science*, for which the College has partial responsibility, has been managed
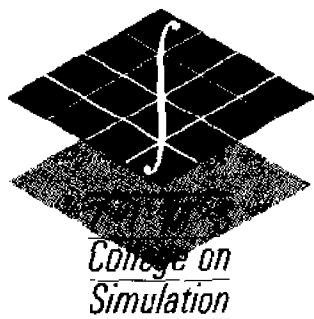
Table of Contents

Editor's Corner

Please take a moment to vote for the new officers of the College and mail to Dave Kelton, taking care to insure that you have included your mailing label (only to verify that members are voting). The voting deadline is 1 June 1992. The results of the election will be announced in the Fall *Newsletter*.

Members (and nonmembers!) of the College are reminded that the Business Meeting will be held at ORSA/TIMS in Orlando: Tuesday (April 28) 5:45-6:45 in Crystal Ballroom P. Refreshments will be served and all are invited.

Jeff will be assuming the editor's position of the *Newsletter* with this issue. Please send your abstracts, e-mail updates, and other materials to him — his address appears on the front cover. Electronic submissions are encouraged, but material in any medium will be accepted! The editorial deadline for the Fall issue will be 15 September 1992.

It has been our goal to build on the efforts of our predecessors in making the *Newsletter* a publication for both the College and the simulation community. To that end, we have expanded our distribution, added new features, and improved the quality of the layout. I would like to thank both Dave Goldsman and Jeff Tew, who shared in this transition as Editors, and the officers of the College who were instrumental in their support for these changes, particularly Presidents Jim Wilson and David Kelton. Thanks also go to John Llewellyn at Lionheart Publishing who has assisted us in the important task of getting advertising set up. By underwriting some of our expenses, the advertisers are making these improvements possible. Please give them your support as well. I've enjoyed my tenure as Editor, and I look forward to the continued improvement of the *Newsletter* under its new Editor, Jeff Tew.

—jjs and jdt

Six Simulation Solutions
Special offer for faculty members only

NETWORK II.5
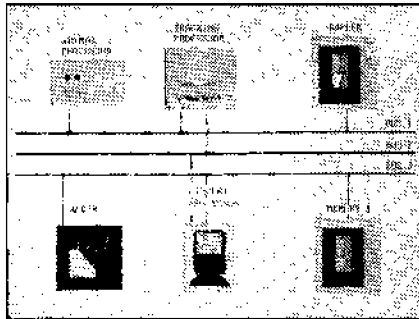
Predict computer/communications network performance. You graphically define your network of processors and storage devices, interconnected by communication channels. Animation follows immediately—no programming.

COMNET II.5

Predict LAN, LAN/WAN, voice, and data network performance. You graphically define the topology of your network through routing nodes and transmission links. Animation follows immediately—no programming.

LANNET II.5
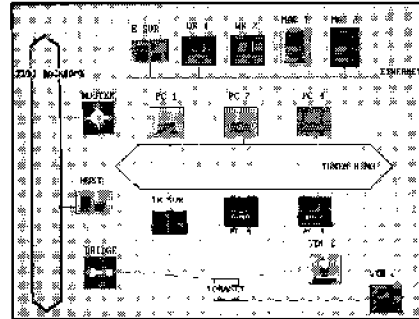
Predict LAN performance. You graphically define your network of stations and gateways interconnected by LAN's. Animation follows immediately—no programming.

SIMSCRIPT II.5

A widely used language for development of process-oriented models. This English-like language, with built-in graphics, is in use at 5,565 sites worldwide.

MODSIM II
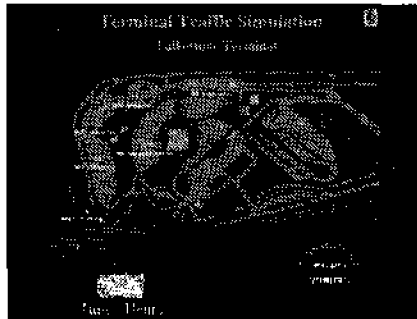
A new object-oriented language with built-in graphics. It incorporates the key elements of modern software engineering: block structure, modularity, and strong typing.

SIMFACTORY II.5
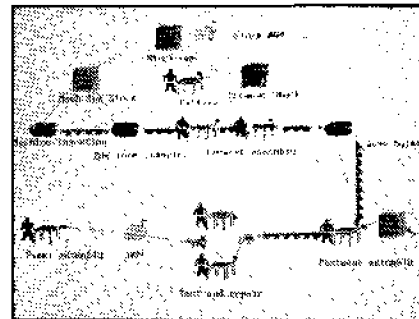
Predict factory performance. You graphically describe your factory through an easy-to-use interface. Animation follows immediately— no programming.

Principles of Simulation Analysis: Guidelines for Practitioners

By Barry Nelson

In the Fall 1991 issue of the Newsletter, Editor Jim Swain summarized some "design and analysis principles" that I proposed for stochastic simulation experiments (see "Change of Vantage Point," Vol. 15, No. 2, pp. 8, 10). I asked Jim if I could elaborate on that summary.

The principles are part of a chapter of a second edition of the Handbook of Industrial Engineering (Nelson 1992). The audience for the chapter, as specified by the editor, is practicing industrial engineers, operations management personnel, and educators. Since I teach an undergraduate course in computer simulation, I defined that to mean a student who had just finished my course.

Here are the principles, plus some comments:

The assignment of random number streams or seeds is part of the design of a simulation experiment. Assigning the same streams or seeds to different simulations induces dependence, while assigning different seeds or streams to different simulations induces independence between simulation results.

All stochastic simulation languages have seeds or streams. This principle seems like the minimum knowledge of the "source of randomness" that a practitioner must have to produce an intelligent experiment design.

Outputs within a replication may be neither independent nor identically distributed, and the number of observations may be random. Statistical analysis should therefore typically be based on multiple replications, with each replication supplying one observation of the performance measure of interest.

I included this principle to protect practitioners from some of the within-replication statistics—particularly standard deviations—that many simulation languages print automatically, even though the statistics may be misleading. I chose to emphasize experimental designs based on replications because, in my judgement, most practical simulations are either of terminating systems, or are inexpensive enough that it is possible to obtain an adequate number of replications.

The sample average of i.i.d. outputs is an unbiased estimator of their common expectation. The standard error of the estimate decreases at rate $1/\sqrt{K}$, where k is the number of replications. This is the most important statistical principle, I think.

A probability p can be represented as the expected value of an indicator (0,1) random variable, where the value 1 corresponds to occurrence of the event of interest. The variance of an indicator random variable is $\sigma^2 = p(1 \cdot p)$.

The chapter covers estimation of means, probabilities and quantiles. In this principle I was trying to show that estimating probabilities is just a special case of estimating expectations, so that all of the tools I had developed for expectations could be directly applied. I am not sure now that it was worth the effort.

A point estimator should be accompanied by a measure of its potential error.

My students get tired of hearing me say this, but it is critical. Estimates can be meaningless without a measure of error.

The first nonzero digit in the standard error indicates an uncertain digit in the corresponding decimal place of the point estimator.

This is a rule of thumb that I borrowed from Bruce Schmeiser. Although it is somewhat crude, it is useful if you just want to report a point estimate without an explicit measure of error: Simply round from the first uncertain digit. Students like this much better than confidence intervals, but I do not.

Increasing the number of independent replications does not decrease the bias of the sample average. If the number of replications is increased at the expense of decreasing the length of each replication, then increasing the number of replications may even increase the bias.

This principle is in a section on initial-condition bias; it seems necessary because I emphasize replications so much. In short, you cannot replicate away initial-condition bias so you must do something else.

Statistical inference on a metamodel is typically based on the assumption that outputs from different design points (factor settings), and the replications at a single design point, are statistically independent. Thus, different random number streams or seeds should be assigned to each design point unless the analyst plans to account directly for the dependence induced by using common streams.

I included this principle because most practitioners follow text-book experiment designs and text-book statistical analysis (which is really the more critical problem). This principle is related to principle number 1.

Positive correlation between the sample performance of two systems can often be induced by assigning the same ("common") random number streams or seeds to the simulation of

BUILD YOUR IDEAS WITH
TUTSIM

The Instructors Perplexity:

How to provide meaningful laboratory problems for control courses, and in the face of declining budgets?

Solution:

Teach the course theory and methods in the classroom. Then assign illustrative systems for the students to build with TUTSIM simulation.

The TUTSIM Way

Problem:

Mathematical Model:

$$y'' = \frac{1}{M}\left(F - Ry' - \frac{1}{C}y\right)$$

Block Model:

Results:

- VELOCITY
- POSITION
- STEP INPUT
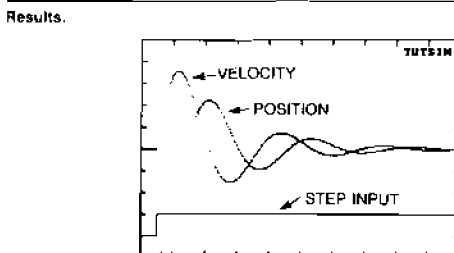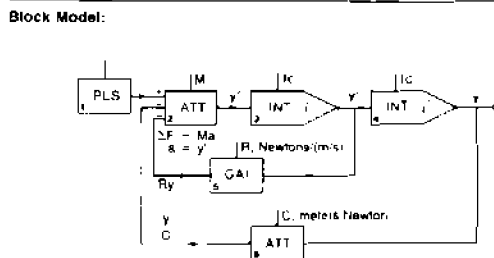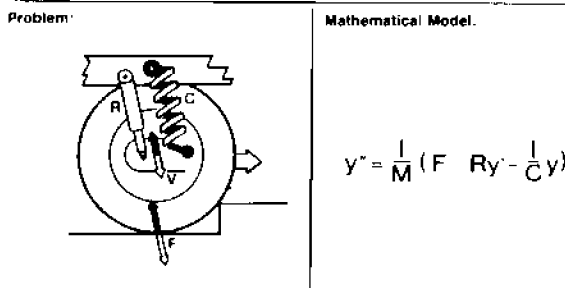
TUTSIM BLOCK INDEX

Source Blocks

Block Name	
CLK	Clock/Square Wave Source
CON	Constant Source
CRP	Chirp Source (Changing Frequency)
DAI	Filed Data Input
FRQ	Frequency (Sine Wave) Source
NOI	Random Noise Source
PLS	Pulse or Step Input Source
TIM	Time Source

Conditional Blocks

IFE	If Condition Then Input1 Else Input?
LOC	Latch on Condition
INT	Adams-Bashford Integrator
IWZ	LaPlace Integrator With Zero
L	Electrical Inductance

Z-Blocks

ZAC	Z-block Accumulator
ZCC	Z-block Cross Correlation
ZDF	Z-block Difference
ZDL	Z-block Delay Function
ZDT	Z-block Delta Time
ZGC	Z-block General Correlation
ZGN	Z-block Gain
ZHS	Z-block History Block
ZIN	Z-block Real Time I/O IN Block
ZIR	Z-block Infinite Response
ZNI	Z-block Real Time I/O INI Block
ZOT	Z-block Real Time I/O OUT Block
ZSE	Z-block See Display Function
ZSP	Z-block Sample And Hold
ZUD	Z-block Unit Delay

Thermodynamic Property Blocks

AIR	Thermodynamic Properties of Air
GAS	Thermodynamic Properties of Gas
H₂O	Thermodynamic Properties of Water

Simulation Notes:
From my vantage point

By Jim Swain

The Winter Simulation Conference celebrates its Silver Anniversary this year. The program will include a number of reminiscences and presentations from founders and early contributors. The plenary session will be a joint presentation with speakers from the first meeting and the different "ages" of simulation. They will provide an overview of the history of the meeting and the discipline, with speculation about the future. In a related vein, this is roughly the Golden anniversary of operations research, while ORSA turns 40 (TIMS is 40 next year).

Technical fields, such as simulation, tend to fragment over time. For instance, within simulation we usually distinguish between the deterministic (and largely numerical) and the stochastic, and between these and both gaming and 'man-in-the-loop' simulations — though some of the boundaries are blurry. Within the College, discrete-event, stochastic simulators dominate, though there are probably a few mixed discrete/continuous simulators as well.

Simulation Gaming in the News
It was not so long ago that gaming was part of the title of this College and thus part of our official interest. Several stories by Bill Hendrick of the *Atlanta Journal/Constitution* piqued my interest in this area of simulation. One story dealt with an inventory game (the "Beer Game"), which captures some salient features of retail distribution. This simple board game has four players acting as a team and represents the chain from producer to retailer. Different teams compete against each other in an attempt to minimize the amount of excess stock while meeting customer demand, simulated by cards dealt during the game. What is striking about this game is how people playing the game behave. The system is often unstable, even when demand is not. John Sterman has analyzed this instability in *Management Science* (March, 1989: 321-339). John is a member of the College and now the Director of the Systems Dynamics Group at MIT.

The System's Dynamics Group also puts out Sterman's People Express Management Flight Simulator. This simulator allows you to be the CEO of the airline during the period of its explosive growth. The challenge is to balance company expansion with cash flow and avoid bankruptcy, the result in actual life. The lag between investment and income, or ordering and delivery (as in the beer game) is crucial here. They use it in executive training classes at MIT and as part of the systems dynamics course, where it has doubled the enrollment. My guess is that this simulation would be a useful adjunct to any quantitative business program. You can purchase a copy for your own from the Systems Dynamics Group, to try your hand as CEO. I suspect that, like Tycoon (see last month), it will be both challenging and fun.

In a sense, gaming turns things around from our normal use of simulation. That is, often we try to embed the human within the simulation to determine how a system will work. The two items above suggest that this will not always be easy, but an outgrowth of John's work seems to be an understanding about how human decision makers actually work. In games, the system is given, and it is human performance that is examined.

Bill Hendrick has also written about Jay Forrester and systems dynamics work related to "long waves" in economics. A simulation model is crucial to the theory. I am curious about press coverage of technical topics, such as simulation, and I would like to start collecting stories about simulation that appear in the "lay" press. I would appreciate copies of any stories that you see.

Using Simulation Models Effectively
Simulation and modelling are used by every technical discipline. Many of the issues that we study are therefore applicable to a wide variety of technical fields, including model construction and parsimony, verification and validation, random number generation, output analysis, sensitivity analysis, optimization, and so on. In this sense, much of our simulation methodology, like statistics, can be considered an expertise that cuts across the usual disciplinary boundaries.

To address the need of engineering professionals, particularly in the design and manufacturing areas, Russ Barton and Lee Schruben have designed a course in modelling. The course, "The Iterative Use of Simulation Models for Engineering Design," has now been successfully offered at both Penn State (IE 597) and Cornell (ORIE 516) with students drawn from a variety of disciplines. Within the course the students use case studies to study modelling issues, random variate generation, sensitivity analysis, metamodeling, and optimization. The case studies, cover such topics as microwave circuits, the design of an ink-jet print head, a manufacturing line, and computer communications.

The design of the course has been supported by the NSF through its Coalition of Schools for Excellence (ECSEL), one of two coalitions formed to study revisions in the engineering curriculum. Support for the

WINTER SIMULATION CONFERENCE

WSC'92

1967 *Twenty-Fifth Anniversary* 1992

December 13–16, 1992
Crystal Gateway Marriott • Arlington, Virginia

The Winter Simulation Conference (WSC) is an important event for everyone with an interest in computer simulation. WSC focuses on discrete and combined discrete-continuous simulation. This technology is used to design and analyze such diverse operations as computer and communication systems, distribution, health-care delivery, manufacturing, military systems, production and inventory control, and transportation.

The technical program covers the full spectrum of topics and interests in the field of simulation—

- Introductory Tutorials are designed for newcomers to the field.
- Sessions on Modeling and Analysis Methodology provide practitioners and researchers with up-to-date techniques for building and analyzing simulation models.
- State-of-the-Art Reviews provide researchers and advanced practitioners with an overview of recent fundamental advances in the field.
- Sessions on Manufacturing and General Applications are oriented toward the practice of simulation in all disciplines.
- Software/Modelware Tutorials provide expository presentations on simulation languages as well as software and hardware systems for development, animation, and presentation of simulation models.

There will also be an extensive exhibits area for demonstrations of the latest simulation software and hardware by the leading simulation vendors.

In addition to the technical program, WSC '92 will commemorate the twenty-fifth anniversary of the Winter Simulation Conference in a special keynote presentation. The WSC General Chairs and Program Chairs for the period from 1967 to 1974 will then participate in a Twenty-Fifth Anniversary Panel Session on the history and traditions of the conference as well as its future.

For more information on WSC '92, please contact:

Pete Youngs
EPIC Management, Inc.
8720 Red Oak Blvd., Suite 224
Charlotte, NC 28217
Telephone: (800) 722-6832 and (704) 529-1725
FAX: (704) 525-2880

Simulation Notes

course and its case studies have come from Ft. Monmouth Electronic Technology and Devices Laboratory, the Xerox Design Research Institute at Cornell, David Sarnoff Research Center, Systems Modeling Corp and Digital Equipment Corp. An advisory group to the course is making recommendations about improvements to the course, which will be offered at both schools in 1993; several other schools have expressed interest and may offer a similar course at that time. Further information about the course can be obtained from *Forefronts* (March-April, 1992), published by the Cornell Theory Center (607-254-8686 or kathy@theory.tc.cornell.edu).

The course originators hope that this systematic treatment of model manipulation will replace the largely *ad hoc* methods often used by practising engineers. The current course is offered to graduate students, but parts of the course may be offered as part of a new undergraduate course.

Data Analysis: Artificial, or Assisted?

In the last issue I discussed two aspects of output analysis: fostering some sort of minimum knowledge in users, and the possibility of computerized expertise to guide simulation experimentation. Elsewhere in this issue, Barry Nelson expands on his principles of good practise, introduced there. I am certain that rule-based systems are already being considered for output analysis, though it may be years before software is generally available to assist users.

While output analysis is a suitable area for the development of expert systems, users could be assisted by software that collects data directly from simulation runs, and then summarizes results interactively. Such software would materially reduce the amount of re-keying of output into statistical input formats, and help guide users in the correct choice of analysis techniques. Some software products already help collect run results or assist the user by making transfer to spreadsheets or other software packages easier, and this is a big help to the user.

AT&T has demonstrated ATOMS at several meetings in the last two years, most recently at the 1991 Winter Simulation Conference. This program is set up to collect data directly from QPLUS models and then interactively present the data in a variety of graphical views to assist in the statistical analysis. Time plots and diagnostic plots of the batch means, for instance, can be used to guide choice of the batch size, prior to the use of performing the batch means. The program has the capability to design and analyze factorial and fractional factorial designs, perform regression modelling, and of course examine both the response surface and the residuals. The heavily graphical presentation should make it easy for users to get a feel for their data and to choose an analysis approach from one session. By comparison to an expert system, the expertise remains with the user, but the user is given assistance in the choice of analysis methodology.

It appears that AT&T will not be producing ATOMS commercially. Among commercial products, SIMSTAT, by MC^2 Analysis Systems, seems to come closest to the model offered by ATOMS, which also offers support for input (distribution) modelling. SIMSTAT can obtain data from GPSS/H, ProModelPC, SIMAN, and SLAM models and operates on DOS machines running Windows 3.0. The run data can be edited in a spreadsheet format and then plotted and analyzed. SIMSTAT has been demonstrated at the last two Winter Simulation Conferences and represents a definite step forward in the analysis of simulation models.

On the input side, there are several options. Averill Law & Associates have been offering UniFit II for several years for choosing and fitting input distribution, and producing the selection for a wide range of simulation products. This versatile product has been demonstrated at several meetings; fitting is performed not only by a variety of statistical procedures, but also includes a proprietary weighting scheme which accounts for several factors used by experts in the choice of input models. Systems Modeling now has its own Input Processor for SIMAN which can assist in the selection of a distribution through graphical and statistical methods, and then provides the code that can be entered into the simulation model.

Books

I recently found a copy of *The Goal*, by Goldratt and Cox. It is a novel about a manufacturing plant whose shutdown is narrowly averted through the leadership of the plant manager and the advice of a consultant (who resembles Goldratt). *The Goal* has a sort of underground following and serves as an introduction to Goldratt's thinking on manufacturing. The description of manufacturing problems is clear and believable, and the tutorial aspects of the book do not interfere with the story. I was particularly taken with some of his illustrations, including a simple game (the match game) to illustrate the effect of uncertainty in a series production system. I also enjoyed seeing a story involving a technical topic done intelligently, with an engineering protagonist.

Finally, I have recently discovered the MAA Notes series published by the Mathematics Association of America, a series aimed for those who teach undergraduate mathematics. By their own design the books are to be "readable, informative, and useful", which is what I have discovered. While the focus is on mathematics, much of what is written will be applicable for teaching in other topics. For instance, Notes 16 is *Using Writing to Teach Mathematics* (Sterrett) describes the

rationale and experience in using writing to improve student involvement in learning math as well as improving their ability to write. Important nuts and bolts issues, such as grading for grammar, are covered, and contributors include comments by students. I have not seen Notes 14, _Mathematical Writing_, by Knuth, Larrabee, and Roberts, but it may also be of interest. Notes 19, _Visualization in Teaching and Learning Mathematics_ (Zimmermann and Cunningham) and Notes 21, _Perspectives on Contemporary Statistics_ (Hoaglin and Moore), look like they will be "must read" for anyone who interested in either of these topics. Visualization includes quite a few examples, and the statistics volume contains contributions from authorities such as Velleman, Thisted, Tanur, and Snee. I recommend both volumes highly.

Principles of Simulation Analysis Expanded
[continued from p. 4]

each system. The magnitude of the correlation can be increased further by synchronizing the pseudorandom numbers, as described [later in the section].

This is in the section on common random numbers (CRN), where I show how to account for CRN in simplepairwise comparisons. I think CRN is a practically useful variance-reduction technique.

I welcome comments or arguments. Are there more fundamental practical design and analysis principles? Am I expecting too much or too little from practitioners? Nelson, B. L. (1992) "Statistical Analysis of Simulation Results," Chapter 102 in _Handbook of Industrial Engineering_ (2nd edition), G. Salvendy, ed., 2567—2593, Wiley, NY.

BEFORE PROOF ANIMATION, THE WOLVERINE HAD A BIT OF TROUBLE TRYING TO SHOW HOW THINGS REALLY WORKED.

...THEN THE TRUCK LEAVES THE PLANT HEADING NORTH ON STATE STREET. THE FREIGHT TRAIN IS ARRIVING TO GET THE NEXT LOAD WHEN... WHOOPS... JUST IGNORE THAT... HEH, HEH

DISTINGUISHED SERVICE AWARD

College Honors Alan Pritsker

A. Alan B. Pritsker has received the Distinguished Service Award from the TIMS College on Simulation. The award recognizes long standing and exceptional service to the simulation community.

The award plaque was presented in Phoenix at the plenary session of the 1991 Winter Simulation Conference, which TIMS co-sponsors with ORSA and seven other professional societies. The 1991 Distinguished Service Award Committee was composed of George S. Fishman, Robert G. Sargent, and Thomas J. Schriber (chairman).

In presenting the award, Tom Schriber made the following statement about Alan Pritsker's contributions to simulation and about the award itself:

"It is a pleasure for the TIMS College of Simulation to give a Distinguished Service Award this year. The award, which is given at most once a year, was established in 1986 to recognize service to the simulation community (and has been awarded in past years to John McLeod, Dick Nance, Bob Sargent, Harold Highland, and George Fishman). For purposes of this award, service is deliberately defined in a very narrow sense. By service, we do not mean research contributions. (There is after all a TIMS/CS Best Paper of the Year Award for that.) Nor do we mean excellence in teaching. (Excellent teaching is recognized in other ways.) Nor do we mean such things as developing simulation software or writing simulation textbooks. Instead, we mean service as characterized by such activities as being simulation area editor for a journal; helping establish a simulation department in a journal; being a member of the Board of Directors of the Winter Simulation Conference; playing a leading role in the Winter Simulation Conferences; serving actively in positions of leadership in various simulation societies, and so on. And by service we do not mean one-time or short-term service - we mean cumulative service spanning many years, such as 10 or 15 or even 20 years.

"The recipient of the Distinguished Service Award on this occasion is a person whose name is in many respects synonymous with simulation. The recipient served on the Board of Directors of the Winter Simulation Conference for multiyear periods on two different occasions, and chaired that board for two years. He

A. Alan B. Pritsker (right) accepts Distinguished Service Award from Tom Schriber.

served as area editor for combined discrete-continuous simulation for the Simulation journal for seven years. And he has been an active participant in the technical program of the Winter Simulation Conference each year for the past twenty-four years, delivering the WSC keynote address in one of those years. But quite apart from easily identified activities such as these, the recipient has worked quietly and often behind the scenes in a personal crusade to spread the good word about simulation. By his leadership in various professional societies over the past 30 years, he has contributed significantly to the dramatic growth of simulation (and to the larger fields of Industrial Engineering and Operations Research, although this is incidental for our purposes). By virtue of his membership in such distinguished groups as the National Academy of Engineering, coupled with his name recognition as an outstanding simulation professional, he has on many occasions been both a formal and an informal spokesperson for simulation in high circles of influence at the national and international levels and at various regional levels.

As a member of the committee for The Foundations of Manufacturing Systems within the National Academy of Engineering, for example, he has worked to convey to executives and others in high positions the meaning and importance of simulation. His contributions include furthering the cause of simulation as an invited speaker at such places as Stanford University, where he has been several times during the past several years to espouse simulation for the benefit of combined Operations Research, Industrial Engineering and Business audiences; Georgia Tech, where he gave a series of lectures on the powerful capability of simulation to solve engineering-type problems; Bulgaria, where he spoke last summer at the Technical University of Sofia with industrial leaders, faculty and students about the potential uses of simulation to help bolster that country's economy; and at the Fraunhofer Institute in Dortmund, where last summer he gave seminars on simulation. And on and on, going back over a long and distinguished career that has spanned over three decades. Whereas these contributions are often subtle and do not always have high or widespread visibility, their cumulative effect has been, in our opinion, to serve

simulation in ways that have substantially benefited all members of the simulation community as well as the simulation profession itself.

"It is in a sense appropriate and indicative, in fact, that although he will be at this conference later, Alan Pritsker cannot be here this morning to accept the Distinguished Service Award because his presence is needed instead at an important meeting of the National Academy of Engineering which is taking place right now in California. Here this morning to accept the award on Dr. Pritsker's behalf is his daughter, Pamela.

"Pamela, it is a pleasure to present you with the TIMS College of Simulation Distinguished Service Award for your father. Our most sincere congratulations, thanks, and best wishes to him."

Dr. Pritsker is Chairman and CEO of Pritsker Corporation.

Outstanding Publication Award Goes to Ward Whitt

The TIMS College on Simulation presented its 1991 Outstanding Publication Award to Ward Whitt for his paper "Planning Queueing Simulations." Ward accepted the award at the 1991 Winter Simulation Conference in Phoenix. The award committee cited the paper for its contribution to the simulation literature:

"In the paper 'Planning Queueing Simulations' (Management Science, Volume 35, 1989, pp. 1341-1366), Ward Whitt develops formulae for estimating the run length in a single-replication queueing simulation that is sufficiently long to yield a confidence-interval estimator of the steady-state mean response with prespecified levels of the coverage probability as well as the absolute or relative half-length. The main results of this paper provide a clear-cut, readily accessible characterization of the way in which the required run length depends on the traffic intensity and on the variability of the arrival and service processes. Moreover, these results can be used in all aspects of the design of a queueing simulation experiment,

Ward Whitt (right) accepts Outstanding Simulation Publication Award from Doug Miller.

such as selecting the system configurations to simulate, specifying a feasible level of statistical precision for each run, and allocating an appropriate computational budget to the overall experiment.

Based on heavy-traffic limit theorems for a large class of queueing processes, this paper develops diffusion approximations for these processes using the corresponding results for reflected Brownian motion. The paper provides remarkably lucid descriptions of how these approximations work and of the class of queueing systems to which these approximations can be applied.

In addition, the paper provides specific guidance on tactical issues that arise in practical applications of the methodology to complex queueing simulations. This paper makes a significant contribution to the practice and theory of large-scale system simulation."

The 1991 award committee consisted of Peter Welch, Jim Wilson and Doug Miller. Jim Wilson will chair the 1992 award committee.

President's Message
[continued from p. 1]

very well indeed by Departmental Editor Jim Wilson.

Finally, thanks go out to the many individuals who volunteered to serve on several ad-hoc committees to look into specific issues; these people include Jorge Haddock, Dean Hartley, Jeff Tew, Bob Sargent, George Fishman, Andy Seila, and Thanos Avramidis. I'd also like to express my appreciation to John Llewellyn for his analysis and presentation concerning our discussions on a monograph series.

The future for the College, and for simulation in

general, looks bright. Barry has many exciting ideas for new activities. Our financial situation is sound. The two awards are by now institutions in their own right. We are looking at options for participation in and support of electronic bulletin boards. We have expanded our activities in the areas of Ph.D. student support for the Sunday-night student colloquium at WSC, ably run by Jorge Haddock and Dave Goldsman in recent years. And the *Newsletter* continues to provide the single best source of information for what's going on in simulation.

Again, thanks to you all.

—*David Kelton*
President, TIMS College on Simulation

Call for Nominations
1992 Outstanding Simulation Publication Award

To recognize outstanding contributions to the simulation literature, TIMS/College on Simulation annually sponsors an Outstanding Simulation Publication Award. Nominations for the 1992 Award should be sent by May 31, 1992, to the Awards Committee Chair:

James R. Wilson
Department of Industrial Engineering
North Carolina State University
Box 7906
Raleigh, North Carolina 27695-7906
(919) 515-2362
FAX: (919) 515-5281
INTERNET: jwilson@eos.ncsu.edu

The complete set of rules governing the Award appeared in Vol. 9, No. 2 of TIMS/College on Simulation *Newsletter* (Fall 1985). The following summary includes an amendment to these rules that was passed by the College at its December 1991 Business Meeting. Anyone is eligible to win the Award. Journal articles, proceedings articles, books, and monographs copyrighted in 1988, 1989, 1990, and 1991 are eligible for the Award to be presented in 1992. Technical reports, research memoranda, working papers, theses, and dissertations are not eligible.

Nominations for the Award 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.

TIMS/CS *Newsletter* Advertising Information

TIMS/CS Newsletter, a publication of TIMS College on Simulation, is produced by and for those involved in the academic and industrial use of simulation products worldwide. The *Newsletter* is distributed to the more than 270 members of the College, at the Summer and Winter Simulation Conferences (500-650 attendees each), and at the Spring and Fall TIMS/ORSA Joint National Meetings (between 1,800 and 2,500 attendees each).

This publication offers an excellent opportunity to advertise products and services, or for recruitment purposes, to this well-informed group at significantly lower prices than other publications dealing with this subject. Rates, deadlines and dimensions follow. If you have other questions, please contact:

John Llewellyn
TIMS/CS Newsletter Advertising
2555 Cumberland Parkway, Suite 299
Atlanta, GA 30339

Tel: (404) 431-0867 • Fax: (404) 432-6969

Deadlines

Issue	Copy/Order Due	Publ. Date	Print Run
Fall 1992	September 20	October 1	1,100
Spring 1993	April 1	April 16	1,100

Display Advertising Rates

Size	Full	Half	Third	Quarter	Eighth
One-time	$200	$140	$120	$80	$55
Two-time	$180	$126	$108	$72	$50

(Rates are subject to change)

Display Advertising Dimensions

	Full	Half	Third	Quarter	Eighth
Inches	7x10	$7x4^7/_8$	$3^3/_8x7$	$3^3/_8x4^7/_8$	$3^3/_8x2^3/_8$
(Width x height)		$3^3/_8x10$			

Classified Advertising: $3.00 per line.

• All verbal orders are binding unless canceled in writing prior to the booking date.
• No agency discounts for Classified advertising
• Typesetting for Display Advertising will be billed at 10 percent of the gross cost of the ad.
• Payment upon receipt of invoice.

WSC Golfers Compete for $1M Stakes!!

On Sunday, December 8, the first WSC Golf Tournament was held on the Adobe Course at the Arizona Biltmore Country Club. The weather was perfect, and the course was in excellent shape. Twelve golfers competed for gift certificates and $1,000,000 in Monopoly money. The gift certificates were awarded to Eric Nordstrom for low score (78), to Dan Berning for the longest drive on the 469-yard, par-5 6th hole (WOW!), and to Don Byrkett for the tee shot closest to the pin on the 157-yard, par-3 12th hole (not quite in birdie range). But, as you can see below, all of these golfers are winners. Thanks to all who participated in the tournament. We'll have to do it again sometime!

WSC '91 GOLF TOURNAMENT RESULTS

GOLFER	AVG. SCORE	STD. DEV.	PRIZE MONEY	AWARD
Eric Nordstrom	4.333	0.686	145,732	Low Gross Score
Paul Lundegard	4.500	0.857	131,159	Father/Son Champ
Dan Berning	4.666	1.029	118,043	Longest Drive
Don Byrkett	4.722	1.227	100,927	Closest-to-the-Pin
Ray Hill	4.722	1.179	100,927	Armed Services Champ
Dennis Price	5.333	1.138	86,053	Southeast Region Champ
Rich Kilgore	5.388	1.378	73,576	Most Sand Traps (N-1) - Tied Course Record
Chuck Reilly	5.388	1.335	73,576	Most Golf Balls Lost IN Date Trees (1)
Chris Funke	5.611	1.037	62,733	Ironman - Participated in 5K Race and Golf
Tom Schuppe	5.833	1.465	56,460	Most Near Misses by a Military Officer
Bob Lundegard	6.055	1.392	50,814	WSC Board Champ
Gordon Clark	6.111	1.453	0*	Gross Score

* Withdrew after nine holes; no Monopoly money.

For WSC race results, see page 15.
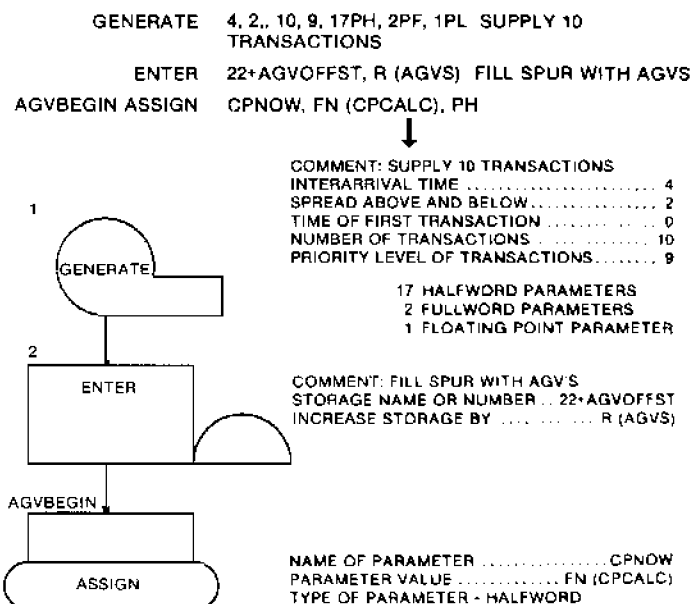
Bulletin Board for OR/CS Researchers Goes Online

We are pleased to announce the formation of ORCS-L, a new list to discuss the topics at the interface of Operations Research/Management Science and Computer Science. This list will serve as a "bulletin board" for researchers, practitioners, and graduate students working in OR/CS interface. This list may be used to ask specific questions for references, or to initiate discussion on a topic. Other appropriate uses may include announcements of conferences, software, special issues of journals, books, availability of technical reports/working papers, etc. Please subscribe to this list to keep current with the topics in this area. Also, the level of activity is totally dependent on the list members' contributions. You are invited to post relevant messages to the list.

To subscribe to ORCS-L, send the following command to LISTSERV@OSUVM1 via mail text or interactive message: SUBSCRIBE ORCS-L Your_full_name

To post a message to the list, send the message to: ORCS-L@OSUVM1. Please note that (at least initially) this is not a moderated list. Anything you send ORCS-L@OSUVM1 will be broadcast (unedited) to subscribers.

List Owner: Ramesh Sharda
(MGMTRSH@OSUVM1)
Graduate Assistant: Darren Parsons
(MGMTDRP@OSUVM1)

WSC Simulation Race Results

At 7 am on Tuesday, December 10, 1991, seventeen people in skimpy shorts dashed from the front of the Arizona Biltmore Hotel in Phoenix, Arizona. They were not your usual sun worshiping fanatics, but rather participants in the first Winter Simulation Conference 5k Race.

In a photographic-memory finish, Ray Davis (17:20) edged out Stephen Buckley ($17:20 + \epsilon$) for first place; the race director declared the difference not statistically significant. First female finisher was Jean Steppe in 18:49, followed closely by Joan Donohue. The other finishers were Torben Holck, Joseph Kent, John Fowler, Matt Rohrer, Chris Funke, Roger Phillips, Susumu Morito, Jim Wilson, Tom Schriber, Jon Hill and Jerry Banks.

In addition, race starters Keebom Kang and Dave Goldsman ambled in in a virtual tie; unfortunately, they were running a virtual course, and were disqualified.

Event Calendar

1992 Summer Computer Simulation Conference, July 27-30. Sparks, Nevada. For further information contact Brian O'Neill, SCS, P.O. Box 17900, San Diego, CA 92177. Phone: (619) 277-3888. FAX: (619) 277-3930.

Pacific-Rim International Conference on Modelling, Simulation and Identification, August 4-7. Vancouver, Canada. Sponsored by IASTED and ISMM. For further information contact MSI'92, P.O. Box 25, Stn. G, Calgary, Alberta, Canada T3A 2G1. Phone: (403) 288-1195. FAX: (403) 247-6851. E-mail: 75500,1264 Compuserve.

Joint Statistical Meetings, August 9-13. Boston Marriott Copley Place and Sheraton Boston Hotel and Towers. Boston, MA. Sponsored by ASA, ENAR, WNAR, and IMS. For further information contact ASA, 1429 Duke St. Alexandria, VA 22314-3402. Phone: (703) 684-1221.

EUROSIM 92: '92 Eurosim Simulation Congress, Spetember 29 to October 1. Capri, Italy. Sponsored by SCS, CASS, CSSC, CNR Italy. For further information contact Mrs. A. DiChiara, Department of Civil Engineering, University of Rome "Tor Vergata", via della Ricerca Scientifica, I-00173 Roma, Italy. Phone: +39 6 7259457S. FAX: +39 6 72594586.

2nd Beijing International Conference on System Simulation and Scientific Computing, October. Beijing, China. Sponsored by The Chinese Association for System Simulation. Contact Professor Chen, Zong Ji, Department of Control Engineering, Beijing University of Aeronautics and Astronautics, Beijing 100083, P. R. China.

TIMS/ORSA Joint National Meeting, November 1-4, Hilton Hotel, San Francisco, CA. For further information, contact Chaiho Kim, The Leavey School of Business, University of Santa Clara, CA. 95053.

SIMTEC 92: Simulation Technology Conference International 1992, November 4-6, Houston, TX. Sponsored by SCS and NASA/JSC. For further information contact Mary Lou Padgett, Auburn University, 1165 Owens Road, Auburn, AL 36830. Phone: (205) 821-2472. FAX: (619) 277-3039.

1992 European Simulation Symposium, November 6-8. Dresden, Federal Republic of Germany. Sponsored by The Society for Computer Simulation International. For further information contact The Society for Computer Simulation International, European Simulation Office, c/o Philippe Geril, University of Ghent, Coupure Links 653. B-9000 Ghent, Belgium. Phone: 0032.91.234941. E-mail: scsi@biomath.rug.ac.be.

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. 32816.

23rd Annual Pittsburgh Conference on Modeling and Simulation, April 30 to May 1, Pittsburgh, PA. For further information contact William G. Vogt or Marlin H. Mickle, 348 Benedum Engineering Hall, University of Pittsburgh, Pittsburgh, PA 15261.

ICOOMAS 92, International Conference on Object-Oriented Manufacturing Systems, May 4-6. Calgary, Canada. For further information contact Douglas Norrie, Division of Manufacturing Engineering, University of Calgary, 2500 University Drive N.W., Calgary, T2N 1N4, Alberta, Canada. Phone: (403) 220-5787. FAX: (403) 282-8406.

IIE Industrial Engineering Research Conference, May 20-21. Hyatt Regency O-Hare, Chicago, Illinois. For further information, contact Ed Unger, 207 Dunstan Hall, Auburn University, AL. 36849-5346. Phone: (205) 844-1400.

1992 European Simulation Multiconference, June 1-3, York, United Kingdom. For further information contact The Society for Computer Simulation International, European Simulation Office c/o Philippe Geril, University of Ghent, Coupure Links 653. B-9000 Ghent, Belgium. Phone: 0032.91.234941. E-mail: scsi@biomath.rug.ac.be.

RSP-3rd International Workshop on Rapid System Prototyping, June 23-25. Research Triangle Park, North Carolina. IEEE International Workshop cosponsored by IEEE Computer Society Technical Committees on Design Automation, Simulation, and Test Technology. For further information contact Nick Kanaopoulos, Center for Systems Engineering, Research TZriangle Institute, 3040 Cornwallis Road, Research Triangle Park, NC 27709. Phone: (919) 541-7341. FAX: (919) 541-6515. E mail: rsp@rti.rti.org.

EURO XII/TIMS XXXI Joint International Conference, June 29 to July 1, Helsinki, Finland. For further information contact Helsinki School of Economics and Business Administration, Department of Management Sciences, Runebergerginkatu 14016, SF-00100 Helsinki, Finland. Phone: +358 (0) 431-3745. FAX: +358 (0) 431-3217. E-mail: eurotims@finfun.bitnet.

ICS'92: ACM SIGARCH International Conference on Supercomputing, July 19-24. Hyatt Crystal City, Washington, D.C. Sponsored by ACM Special Interest Group ARCH. For further information contact Ken Kennedy, CITI Rice University, P.O. Box 1892, Houston, Texas 77251. Phone: (713) 527-6009. E-mail: ken@rice.edu.

Minutes of the 11/5/91 TIMS/CS
Meeting at Los Angeles ORSA/TIMS

Members present: Wheyming Tina Song, Dean Hartley, James Lin, Mike Bailey, Gary Kochman, Jim Swain, Peter Glynn, Dave Kelton, Bruce Schmeiser.

Nonmembers Present: G. Arthur Mihram, Doug Smith, Ali Gunal, Chien-Chou Su.

- Dave Kelton called the meeting to order at 5:50 p.m.
- Attendees introduced themselves.
- Dave Goldsman read the Minutes from the TIMS/CS meeting at the Spring 1991 Nashville ORSA/TIMS Conference, and they were approved.
- Dave Goldsman read the Treasurer's Report.
- Dave Kelton reported on the sponsored sessions (in place of Barry Nelson). All 4 of the Monday (11/4/91) sessions went well. The WSC'91 Doctoral Colloquium will be held at 7:00 p.m. on Sunday night, 12/8/91. There will be 7 sessions at the Spring 1992 ORSA/TIMS Conference in Orlando. The Fall 1992 ORSA/TIMS Conference will be held in San Francisco, 11/1/92-11/4/92. Contact Barry Nelson about organizing/chairing sessions.
- Dave Kelton announced that elections for new TIMS/CS officers will take place in the Spring 1992 *Newsletter*.
- Jim Swain reported on the *Newsletter*. The mass mailings to WSC attendees will continue. Dave Kelton thanked Jim for a job well done.
- Dave Kelton read the report from the WSC Board representative (Steve Roberts). WSC'91 looked to be in excellent shape. The WSC Board now owns the Proceedings copyright.
- Dave Kelton read the reports from the Publication Award Committee (in place of Doug Miller) and the Distinguished Service Award Committee (in place of Tom Schriber). Both committees are active.
- Peter Glynn (in place of Jim Wilson) reported that the Simulation Department at Management Science is in good hands.
- Dave Kelton (in place of Jorge Haddock) led a short discussion on the possible Monograph series. Additional discussion was deferred to WSC'91.
- Dave Kelton (in place of Jeff Tew) discussed the creation of an electronic bulletin board and an expanded e-mail list of TIMS/CS members.
- Dave Kelton reported on the TIMS College officers' breakfast. Nothing much happened there.
- Peter Glynn stated that the SIAM-sponsored simulation conference will probably take place around August 1993.
- We decided to reimburse TIMS for a mass mailing for the Simulation Department at Management Science, if necessary.
- The meeting was adjourned at 6:20 p.m., and attendees enjoyed refreshments and informal conversation.

Respectfully submitted,

David Goldsman, Secretary-Treasurer December 18, 1991

Minutes of the 12/10/91 TIMS/CS
Meeting at Phoenix WSC

Members Present: Bridget Moore, Lynne Goldsman, Neal Bengston, David Diener, Pandu Tadikamalla, Enio Velazco, Robert Klein, Steve Roberts, Jim Wang, Halim Damerdji, Thanos Avramidis, Dave Withers, Chuck White, T. J. White, Michael Fu, Doug Miller, Ward Whitt, Voratas Kachitvichyanukul, Jerry Evans, Lee Schruben, Bob Sargent, Mingliang Yuan, Jim Wilson, Jeff Tew, Douglas Morrice, John Charnes, Gordon Clark, Bor-Ruey Fu, Michael Ketcham, Richard Kilgore, Yun Bae Kim, Enver Yucesan, Barry Nelson, Ed Mykytka, John Fowler, Sheldon Jacobson, Jim Swain, Ferry Winiadharta, Sigrun Andradottir, Bruce Schmeiser, Pierre L'Ecuyer, Ed MacNair, Frank Chance, Russell Barton, Susumu Morito, Jorge Haddock, Chuck Reilly, Osman Balci, Diane Bischak, Mary Ann Flanigan, Andy Seila, Antonio Pedrosa, Mike Taaffe, Kim Ong, Tom Schriber, Dave Kelton, Deb Davis, Alan Pritsker, Bill Biles, Paul Sanchez, Laurel Travis, Keebom Kang, Peter Welch, Ken Musselman, George Fishman, Dave Goldsman.

Nonmembers Present: Natalie Giroux, Felisa Vazquez-Abad, Carl Crosswhite, Ricki Ingalls, Wafik Iskander, Keith Aklalelu, Christine Gallagher, Darrell Donahue, Raj Vecramani, Joan Donohue, George Donovan, Robert Kittell, Doug Smith, Ali Gunal, Paul Audair.

- Dave Kelton called the meeting to order at 5:20 p.m.
- Dave Goldsman read the Minutes from the TIMS/CS meeting at the Fall 1991 Los Angeles ORSA/TIMS Conference, and they were approved.
- Dave Goldsman read the Treasurer's Report.
- Barry Nelson read the Vice President's report on the sponsored sessions. There will be 7 sessions at the Spring 1992 ORSA/TIMS Conference in Orlando. The Fall 1992 ORSA/TIMS Conference in San Francisco will have 6 sessions. Contact Barry about organizing/chairing sessions.
- Jim Swain reported on the *Newsletter*. Jeff Tew will take over as Editor next Fall. Dave Kelton thanked Jim for a job well done.
- Jorge Haddock reported on the Doctoral Colloquium. There were 10 student speakers and 70 attendees. Each student will be reimbursed $100 to help cover travel expenses.
- Steve Roberts, the WSC Board Representative, announced that WSC'91 had 533 fully-paying attendees (as well as about 100 other attendees). Steve will be the Board's Chairman for two years. He stated that Jim Wilson will be the Program Chair of WSC'92 (which will be held in Washington, D.C.), and Bill Biles will be the Program Chair of WSC'93 (in Los Angeles).
- Doug Miller, Chair of the Outstanding Publication Award Committee, announced that Ward Whitt had won this year's prize. Peter Welch goes off the Committee, and Jim Wilson becomes Chair next year. Doug made the following motion.
- The eligibility period for the TIMS/CS annual Outstanding Publication Award shall be the four preceding years. For example, papers and books copyrighted in 1988, 1989, 1990, and 1991 will be eligible for the 1992 award.

The motion passed unanimously.

- Tom Schriber, Chair of the Distinguished Service Award Committee, announced that Alan Pritsker had won this year's prize. Alan was given a standing ovation. Bob Sargent goes off the Committee, and George Fishman becomes Chair next year. Tom stated that a call for nominations for next year's award will appear in the next Newsletter and in OR/MS Today.
- Jim Wilson reported that the Simulation Department at Management Science is doing very well in terms of number and quality of papers processed. He announced that Paul Glasserman has been named an Associate Editor.
- Jorge Haddock introduced a motion to terminate investigation of the Monograph series. The motion passed. Dave Kelton thanked Jorge for all of his hard work, and Jorge received a round of applause.
- The meeting was adjourned at 6:05 p.m., and the attendees enjoyed refreshments and informal conversation.

Respectfully submitted,

David Goldsman, Secretary-Treasurer December 18, 1991

Treasurer's Report

For the period 9/1/91 — 3/15/92, the TIMS College on Simulation had the following transactions at the Wachovia Bank of Georgia, Atlanta, GA.

Balance Forward		$29148.48
Revenues		
Checking account interest	$623.74	
Member dues	$27.00	
Total Revenues		$650.74
Disbursements		
Bank service charges	$81.95	
S/91 and F/91 *Newsletters*	$2129.00	
Bulk mail permit	$75.00	
Meetings at S/91 and F/91 ORSA/TIMS and 1991 WSC		
(including Doctoral Colloquium)	$1264.19	
Outstanding Publication Award	$500.00	
Books for Outstanding Publication Award	$174.90	
Distinguished Service Award	$250.00	
Plaques	$130.97	
Management Science Simulation Dept. mass mailing		
(sent by TIMS)	$604.58	
Photography	$205.48	
Doctoral Colloquium student reimbursements	$1000.00	
1992 WSC seed money	$2000.00	
Total Disbursements	$8416.07	
Net (revenues - disbursements)	-$7765.33	
Balance Forward		$21383.15

In addition to the above funds, the College has on account at TIMS Headquarters $1700.00, bringing the TIMS/CS net worth to $23083.15.

Respectfully submitted, David Goldsman, Secretary-Treasurer, March 18, 1992

SNET Simulation Network
Mailer, Digest, and More

SNET is a recently activated facility operated by the Department of Operations Research at Stanford University. The intent is to provide a means of linking the widespread stochastic simulation community and to facilitate the exchange of scientific and technical information within the community. We would like to take this opportunity to invite you to join this network.

SNET Features

The following items are currently operational at SNET.

(1) **Central Mailer:** This is a central mailing system, modelled on the highly successful central mailer used by NA-NET. In particular, to communicate via e-mail with another member of simulation community who is enrolled on SNET, only their last name need be remembered. For example, suppose that one wishes to send a message to John Doe. One simply mails the message to Doe@or.stanford.edu ; the mailing system then automatically forwards the mail to whatever current address John Doe has supplied to SNET.

(2) **News Digest:** SNET will issue, on a regular basis, a news digest to its membership. This will consist of items sent by members for inclusion in the digest, as well as information gathered independently that is considered to be of general interest to the stochastic simulation community. Among the items that may appear in the news digest are :
(a) meeting announcements
(b) abstracts of new papers
(c) book reviews
(d) requests for mathematical results, models or software
(e) open problems looking for a solution
(f) calls for papers

(3) **White Pages:** This is a directory service that permits members to list pertinent professional information about themselves that can then be accessed by the rest of the SNET community. (SNET takes no responsibility for the accuracy of the listings.)

The following items will be implemented within SNET in the near future.

(4) **Software Library:** SNET will offer a centralized library for accessing stochastic simulation software. A special emphasis will be placed on acquiring software that implements complex variate generation schemes, output analysis algorithms, and variance reduction methodologies. This can potentially play an important role in offering simulation methodology to a broad user community and allowing developers of new techniques an enhanced ability to directly compare their results with those obtained via competing algorithms.

(5) **Research Paper Library:** SNET will offer electronically stored versions of recently completed research papers. Based on a maintained list of abstracts, users will then be able to select and obtain copies of the corresponding papers from this electronic library. It is hoped that this can have a positive impact on fostering rapid dissemination of research results throughout the community.

Joining The SNET

To join the SNET, send mail to: "snet.join@or.Stanford.Edu". In the message body specify fields for your firstname, lastname and e-mail address. For example, message body for John Doe would be:
Lastname: Doe
Firstname: John
E-mail: Doe@...
The values can be specified in any order. The subject line of your message is ignored. If there is a member of SNET with the same last name, then a message will be sent back to you. In that case refer to the help manual for instructions to become a member.

To receive the help manual for SNET, you simply need to send e-mail at :
snet.help@or.stanford.edu
This message can be sent with a blank subject field and blank message field. This help manual will then automatically be sent to you.

Additional information on SNET

SNET resides on a DEC Station 5000/200 and is maintained by Sandeep Juneja, a Ph.D. student associated with Department of Operations Research at Stanford University, under the supervision of Professors Peter W. Glynn and Donald L. Iglehart.

SNET takes advantage of software originally developed for NA-NET. This activity is currently supported by the Army Research Office under Contract No. DAAL03-91-G-0319.

SNET is a facility that is intended to be of value to academic, industrial, military, and governmental users of stochastic simulation models and methodologies. (Please note, however, that all information carried by SNET is unclassified.)

DON'T FORGET TO VOTE
See page 24 ★ ★ ★ ★
for your ballot ★ ★
and voting instructions

Call for Papers

Variance Reduction Techniques:
Theory and Practice

A Special Issue of

ACM Transactions on Modeling and Computer Simulation (TOMACS)

Papers are solicited for a special issue of *ACM TOMACS* on variance reduction techniques in discrete event simulations. The special issue will appear in October 1993. Its purpose is to highlight significant, recent advances in this area. All areas of variance reduction are welcome. Specific topics of interest for this special issue include, but are not limited to:

- Efficient rare event simulation
- Variance reduction for sensitivity estimates
- Theoretical properties of efficient sampling schemes and variance reduction techniques such as common random numbers, conditional Monte Carlo, control variates, importance sampling, splitting, stratification, etc.
- Case studies illustrating the effectiveness of variance reduction techniques in simulation models of real manufacturing, transportation, computer, and communications systems
- Analysis of other simulation methods (e.g., metamodeling, ranking and selection, stochastic optimization) in the presence of variance reduction techniques

Details concerning preparation of manuscripts are given in the January 1991 issue of TOMACS. Please submit five copies of the complete manuscript, not to exceed 35 double-spaced pages, by September 1, 1992, to one of the following guest editors:

Prof. Paul Glasserman
403 Uris Hall
Graduate School of Business
Columbia University
New York, New York 10027

pg@cugsbvm.columbia.edu
(212) 854-4102
Fax: (212) 864-4857

Dr. Philip Heidelberger
IBM T.J. Watson Research Center
P.O. Box 704
Yorktown Heights, New York 10598

berger@watson.ibm.com
(914) 784-7156
Fax: (914) 784-7455

Abstracts

"**The Autocovariance Structure of TES Processes**," **David L. Jagerman and Benjamin Melamed, NEC Research Institute, Princeton, NJ.**

A modular stochastic sequence is obtained by applying modulo arithmetic, as the final operation. In this pare we study a class of modular sequences with modulo-1 arithmetic where the next variate is obtained recursively by taking the fractional part of a linear autoregressive scheme. We show how this class gives rise to uniform sequences in a general and natural way, by observing that marginal uniformity is closed under modulo-1 addition of an innovation with arbitrary distribution. We derive the autocovariance function of transformed modular sequences using Fourier and Laplace Transform methods. The results have applications to the modeling of correlated sequences, particularly in a Monte Carlo simulation context.

"**An Extended Sweep Operator for the Cross Validation of Variable Selection in Linear Regression**," **David Alan Grier, Department of Statistics, Computer and Information Systems, The George Washington University, Washington, D.C. 20052.**

The mathematical properties of variable selection techniques in linear regression are only discovered with large scale Monte Carlo Simulation. Recent work cross-validation has suggested that a cross-validated version of traditional variable selection techniques could easily output perform the traditional methods. A Monte Carlo examination of such a computationally intensive algorithm is expensive and requires an efficient algorithm. This paper explores such an algorithm based on the sweep operator.

In its application to variable selection in the linear model, cross-validation is traditionally applied to an individual models contained in a set of potential models. Each model in the set is cross-validated independently of the rest and the model with the smallest cross-validated sum of squares is selected. In such settings, an efficient algorithm for cross-validation must be able to add and to delete single points quickly from a fixed model. Recent work in variable selection has applied cross-validation to an entire process of variable selection, such as Backward Elimination or Stepwise regression. The cross-validated version of Backward Elimination, for example, divides the data into an estimation and validation set and performs a complete Backward Elimination on the estimation set, while computing the cross-validated sum of squares at each step with the validation set. After doing this process once, a different validation set is selected and the process is repeated. The final model selection is based on the cross-validated sum of squares for all Backward Eliminations.

An optimal algorithm for this application of cross-validation need not be efficient in adding and deleting observations from a single model but must be efficient in computing the cross-validation sum of squares from a series of models using a common validation set. This paper explores such an algorithm based on the sweep operator.

"**Retrospective Optimization of Some Simulated Systems**," **Lee Schruben, Technical Report 9119, Department of Operations Research, Naval Postgraduate School, Monterey, CA 93943.**

For some simulation response optimization problems a retrospective experimental approach can be used where optimal decisions are made after a simulation run is completed. Once the stochastic sample path has been generated, it is sometimes possible to solve the resulting deterministic optimization problem or a closely related problem. When this is possible the simulation model then generates samples of (path-wise) optimal solutions. Relationships between retrospective optimization and more traditional approaches to simulation experimentation are explored. In particular, trace driven simulations and the variance reduction technique of common random numbers are shown to have some of the properties of the ad-hoc experimental approach presented in this paper.

"**Massively Parallel and Distributed Simulation of a Class of Discrete Event Systems: A Different Perspective**," **Pirooz Vakili, Department of Manufacturing Engineering, Boston University, August 1991.**

In this paper we propose a new approach to parallel and distributed simulation of discrete event systems. Most parallel and distributed discrete event simulation algorithms are concerned with the simulation of one "large" discrete event systems. In this case computational intensity is due to the size and complexity of the simulated system. In contrast, we are interested in simulating a "large" number of "medium sized" systems. These are variants of a "nominal system" with different system parameter values or operation policies. The computational intensity in our case is due to the "large" number of simulated variants. Many simulation projects such as factor screening, performance modeling and optimization require system performance evaluations at many parameter values; and others, we believe, could significantly benefit from it.

There is considerable work in the literature on stochastic coupling of trajectories of parametric families of stochastic processes. Our approach can be viewed as the simulation of the coupled trajectories. We use a single clock mechanism that drives all trajectories simultaneously, hence the approach is called Single Clock Multiple System (SCMS) simu-

Abstracts?

...lation. The single clock synchronizes all trajectories such that the "same" event occurs at the "same" time at all systems. This synchronization is the basis of our parallel and distributed algorithms.

We focus on a particular implementation of the SCMS simulation using the so-called Standard Clock (SC) technique and also on the massively parallel implementation of the SC algorithm on the SIMD Connection Machine. Orders of magnitude of speedup is possible. Furthermore, the possibility of concurrent performance evaluation and comparison at many system parameter values offers new and significant opportunities for performance optimization.

"Using Distributed-Event Parallel Simulation to Study Departures from many Queues in Series," Albert G. Greenberg, Otmar Schlunk, and Ward Whitt, AT&T Bell Labs, Murray Hill, NJ 07974-0636, February 1992.

Exciting new opportunities for efficient simulation of complex stochastic systems are emerging with the development of parallel computers with many processors. In this paper we describe an application of a new distributed-event approach for speeding up a single long simulation run to study the transient behavior of a large non-Markovian network of queues. In particular, we implemented the parallel-prefix-based algorithm of Greenberg, Lubachevsky and Mitrani (1990, 1991) on the 8,192-processor CM-2 Connection machine and the 16,384-processor MasPar computer to simulate the departure time $D(k,n)$ of the kth customer from the nth queue in a long series of single-server queues. Each queue has unlimited waiting space and the first-in first-out discipline; the service times of all the customers at all the queues are i.i.d. with a general distribution; the system starts out with k customers in the first queue and all other queues empty. Gynn and Whitt (1991) established limit theorems for this model, but very little could be said about the limits themselves. The simulation results here describe the limits and the quality of the approximations resulting from using the limits for finite k and n. Indeed, the simulations suggest some very interesting conjectures. For this model, speeding up a single long run is far superior to independent replications, because very long runs are required to obtain unbiased estimates of the desired quantities and the variance of the estimator at the end of the run is small. The achieved simulation rate was about seventeen billion service completions per hour, which is a speedup by about a factor of 100 compared to simulation on a conventional single-processor machine. This speedup contributed greatly to performing the desired experiments.

Status Report on the Simulation Department of Management Science

For the calendar year 1991, a total of 19 new papers were submitted to the Department; and editorial work was completed on 19 papers, with 11 papers accepted, 5 papers rejected, and 3 papers withdrawn. During the first quarter of 1992, 4 new papers have been submitted; and editorial work has been completed on 6 papers with 2 rejected and 4 papers accepted. Currently 20 papers are in process.

We are pleased to announce that Halim Damerdji of Purdue University and Paul Glasserman of Columbia University have agreed to serve as Associate Editors of the Simulation Department. The other Associate Editors are Russell Cheng of the University of Wales, Peter Glynn of Stanford University, Dave Goldsman of Georgia Tech, Pierre L'Ecuyer of Universite de Montreal, and Steve Roberts of North Carolina State University.

Jim Wilson, the current Departmental Editor, will step down at the end of 1992. Nominations for a new Departmental Editor should be submitted to:

Comments?

E-Mail Directory

Please send updates to Jeff Tew, IEIE9S@VTVM2

NAME	AFFILIATION	E-MAIL ADDRESS
Christos Alexopoulos	Georgia Tech	calexopo@gtri01.bitnet
Sigrun Andradottir	U. Wisconsin	sa@engr.wisc.edu
Mike Bailey	Naval Postgraduate School	502&@navpgs.bitnet
Osman Balci	Virginia Tech	balci@vtopus.cs.vt.edu
Richard Barr	SMU	barr@csvax.seas.smu.edu
Russell Barton	Penn State U.	barton@simplex.psu.edu
Ken Bauer	AFIT	kbauer@galaxy.afit.af.mil
Bill Biles	U. Louisville	webile01@ulkvrm
Diane Bischak	NC State	bischak@ncsuie.bitnet
Ted Brown	Queens College	brown@gvax.bitnet
Martha Centeno	FSU	centeno@evax0.eng.fsu.edu
Frank Chance	Cornell	chance@orie.cornell.edu
John Charnes	U. Miami	charnes@umiami.miami.edu
Russell Cheng	U. Wales (UK)	cheng@cardiff.ac.uk
Gordon Clark	Ohio State	clark-g@eng.ohio-state.edu
Tom Clark	Florida State	tclark@fsuavm.bitnet
John Comfort	Forida International	comfort@servax.bitnet
Halim Damerdji	Purdue	damerdji@ecn.purdue.edu
Ron Dattero	Florida Atlantic U.	dattero@fauvax.bitnet
Luc Devroye	McGill	luc@mujunior.cs.mcgill.ca
Joan Donohue	U. South Carolina	fsu0002S@bagamcok
Remko Dur	Delft Tech	windur@hdetud1.tudelft.nl
George Fishman	U. North Carolina	uncgsf@unc.bitnet
Paul Fishwick	Florida	fishwick@fish.cis.ufl.edu
Bob Foley	Georgia Tech	rfoley@gtri01.bitnet
Ben Fox	U. Col.-Denver	bfox@cudenver.bitnet
Mark Fox	U. Toronto	msf@ie.utoronto.ca
Michael C Fu	U of Maryland	mfu@umd5.umd.edu
Masanori Fushimi	U. Tokyo	fushimi@misojiro.t.u-tokyo.ac.jp
James Gentle	IMSL	uunetlimsl!gentle
Paul Glasserman	Columbia University	fapglass@cugsbvm.columbia.edu
Peter Glynn	Stanford	glynn@leland.stanford.edu
Dave Goldsman	Georgia Tech	sman@isye.gatech.edu
David Grier	George Washington	dagrier@gwuvm.bitnet
Jorge Haddock	RPI	frye@rpitsmts.bitnet
Kevin Healy	Cornell	healy@orie.cornell.edu
Phil Heidelberger	IBM	berger@ibm.com
Rong-Yau Huang	Purdue	rong@cn.ecn.purdue.edu
Sheldon Jacobson	Case Western	jacobson@pyrite.som.cwru.edu
Mary Johnson	U. Illinois	maryjohn@ux1.uiuc.edu
Keebom Kang	Naval Postgraduate School	5030p@navpgs.bitnet
Dave Kelton	Minnesota	dkelton@vx.acs.umn.edu
Jack Kleijnen	Tilburg (Netherlands)	kleijnen@kub.nl.bitnet
Robert Klein	Regenstrief Institute	icjd100@indyvax.bitnet
Murat Koksalan	Purdue	koksalan@puccusm
Pierre Lecuyer	U. Monteal	lecuyer@iro.umontreal.edu
Peter Lewis	Naval Postgraduate School	1526p@navpgs.bitnet
J Jung Lyu	Iowa	aeglynpa@uiamvs.bitnet
D.C. McNickle	U. Canterbury (NZ)	opre001%canterbury.ac.nz@relay.cs.net
Doug Miller	George Mason U.	drmiller@gmuvax
Susumu Morito	Waseda (Japan)	opremori@punwas00
Edward Mykytka	AFIT	emyKytka@galaxy.afit.af.mil

Richard Nance	Virginia Tech	nance@vtopus.cs.vt.edu
Barry Nelson	Ohio State	nelsonb@random.eng.ohio-state.edu
Harald Niederreiter	U. Vienna	nied@qinfo.oeaw.ac.at
Norman Nielsen	SRI International	nielsen@sri.com
Ashvin Radiya	Wichita State U	radiya@sulu.cs.twsu.edu
R. Joel Rahn	Laval	rahn@vm1.ulaval.ca
Roderick Reasor	Virginia Tech	reasor@vtvm1.bitnet
Charles Reilly	Ohio State	reilly-c@eng.ohio-state.edu
Steve Roberts	NC State	sroberts@ncsuie.bitnet
Paul Sanchez	Arizona	paul@tucson.sie.arizona.edu
Bob Sargent	Syracuse University	rsargent@top.cis.syr.edu
Bruce Schmeiser	Purdue	schmeise@ecn.purdue.edu
Tom Schriber	Michigan	userk2bu@umichub.bitnet
Lee Schruben	Cornell	lee@orie.cornell.edu
Andy Seila	U. Georgia	aseila@uscn.bitnet
Robert Shannon	Texas A&M	res2568@tamsigma.bitnet
Henk G. Sol	Delft Tech (NL)	winfsol@hdetud1.tudelft.nl
Wheyming Tina Song	Natl. Tsing Hua U. (ROC)	wsong@twnctu01.bitnet
Ernst Stadlober	TU-Graz, (Austria)	statistik@rech.tu-graz.ada.at
John D. Sterman	MIT	jsterman@mit.edu
Bob Storer	Lehigh	rhs2@lehigh.bitnet
Steve Strickland	U. of Virginia	sgs8r@kelvin.edu
Jim Swain	Lionheart Pub.	jefacdg@gitvm1.bitnet
Mike Taaffe	U. Minnesota	taaffe@ux.acs.umn.edu
Pandu R. Tadikamalla	U. of Pittsburgh	pandu@pittvms.bitnet
Jeffrey D. Tew	Virginia Tech	jele95@vtvm2.bitnet
Laurel Travis	University of Alberta	usertras@ualtamts
Pirooz Vakili	Boston U.	vakili@buenga.bu.edu
Enio Velazco	Worcester Poly.	evelazco@wpi.wpi.edu
Alexaner Verbraeck	Delft Tech (NL)	winfave@hdetud1.tudelft.nl
Peter Welch	IBM	welch@ibm.com
Folkert W. Wierda	Delft Tech (NL)	winfiww@hdetud1.tudelft.nl
Ward Whitt	AT&T Bell Labs	wow@research.att.com
Rosemary Wild	U. Hawaii	wild@uhccvx.uhcc.hawaii.edu
Jim Wilson	NC State	jwilson@eos.ncsu.edu
Dave Withers	Mead Data Control	davew@meaddata.com
Jeff Wright	Purdue	wrightje@simplex.ecn.purdue.edu
Helio Yang	San Diego State	hyang@sciences.sdsu.edu
Enver Yucesan	INSEAD	yucesan@freiba51.bitnet
George Zobrist	U. Missouri-Rolla	c2816@umrvmb.umr.edu

••••••••••• 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, fill out this form and send it, along with a check for the appropriate amount, to: **David Goldsman, School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0205.** 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.

Ballot for New Officers

To vote for officers of the College, return the ballot below to:

W. David Kelton
Dept. of Operations and Management Science
University of Minnesota
Minneapolis, MN 55455

Ballots must be received by June 1, 1992. The mailing label on the *Newsletter* certifies your vote; however, your vote will be kept confidential.

Vote for at most one candidate for each office. As specified in the College bylaws, candidates' names are listed in alphabetical order, and a space is provided for write-in candidates. Officers serve a two-year term, and the Vice-President/President-Elect becomes the President of the College for the next term. *Newsletter* Editors are appointed by the President. Barry Nelson is the new President of the College.

Vice President-President Elect	Secretary-Treasurer
David Goldsman	Sheldon Jacobson
Dean Hartley	James J. Swain
_____ (write-in)	_____ (write-in)

T.I.M.S
College on
Simulation

290 Westminster St.
Providence, RI 02903