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T·I·M·S
College on
Simulation

THE INSTITUTE OF MANAGEMENT SCIENCES

NEWSLETTER

President's Message

To coincide with the formal introduction of the new College logo that was selected in the voting last Spring, I asked James McCammack, the designer of the new logo, to suggest a complementary format for this *Newsletter*. This is the first issue in the new format. Any suggestions for further improvements to the format or content of the *Newsletter* would be greatly appreciated. In producing the *Newsletter*, our main objective is to provide an effective means of communicating news about College activities and developments in the field of simulation to College members and other interested individuals.

As a follow-up to the President's Message in the last issue of the *Newsletter*, I am pleased to report substantially increased activity in the Simulation Department of *Management Science*. For the year to date, twenty-one new papers have been submitted, four papers have been accepted, and eleven have been rejected. Eighteen papers are currently in process. According to Professor Donald G. Morrison, the Editor-in-Chief, this conforms to the acceptance rate that has been maintained across all Departments of *Management Science* for many years. Although editorial response times have been improving, we have not yet been able to achieve four-month turnaround times on a consistent basis. In an attempt to further reduce response times, I have enlisted Dave Goldsman as another Associate Editor. As with the *Newsletter*, we welcome suggestions for ways to improve the Simulation Department of *Management Science*.

I remind all College members about the 1989 Winter Simulation Conference to be held December 4–6 in Washington, D.C. There is a final announcement about this conference in this *Newsletter*.

One of the most important functions of the College is its sponsorship of the Outstanding Simulation Publication Award. To provide College members with an additional opportunity to make nominations for the 1990 Award, we have extended the deadline for nominations to January 31, 1990. There is an announcement about the 1989 and 1990 Awards in this *Newsletter*.

In closing, I urge everyone to think about and suggest ways that the College can better serve the needs of its members. For some of us with ongoing administrative responsibilities, there is a tendency to focus on immediate requirements at the expense of larger issues facing the College. A continuing dialogue between College officers and members is required to ensure that the activities of the College are relevant to the members.

Respectfully submitted,
James R. Wilson

Minutes of College Meeting at CORS/TIMS/ORSA in Vancouver

TIMS/CS members attending: Barry Nelson, Bruce Schmeiser, David Kelton, Ted Brown, Ben Fox, Ronald Dattero, Peter Glynn, Diane Bischak, Dave Goldsman, Sheldon Jacobson, Dave Withers, Keebom Kang, Joseph Murray.
Nonmembers attending: Douglas Morrice, Dean Hartley.

1. The meeting was called to order by President Wilson at 5:20 PM on May 9, 1989.

2. The Treasurer's report, showing the net worth of the College to be $20,623.12, was approved. The minutes of the business meeting at WSC '88 were read and approved.

3. Vice-President David Kelton reported that the College will sponsor four invited-paper sessions at the ORSA/TIMS meeting in New York in Autumn 1989 and six to eight sessions at the TIMS/ORSA meeting in Las Vegas in Spring 1990. In addition, the College will sponsor four sessions at the International TIMS meeting in Osaka, Japan in July.

4. Wilson announced the winner of the 1989 Outstanding Publication Award by reading the following announcement:

   > The Institute of Management Sciences College on Simulation presents its 1989 Outstanding Publication Award to Luc Devroye for his book, *Non-Uniform Random Variate Generation*, Springer-Verlag, 1986. This book provides an encyclopedic guide to non-uniform random variate generation and is a seminal contribution to the literature on stochastic simulation. Much of stochastic simulation owes its existence to the availability of algorithms for obtaining non-uniform random variates, and the Devroye book carefully details all the important methodologies. It should become a classic reference, and we are proud to announce its selection.

   The Award will be presented at the Opening Session of WSC '89, when Luc Devroye will be present. There will be a reception after the College business meeting at WSC '89. Wilson suggested using WSC as the forum for future award presentations.

5. The committee to investigate attracting women and minorities to the field of simulation has been formed: Jorge Haddock (Chair), F. Javier Gurrola-Gal, Nelson Pacheco, Diane Bischak, and Whey-Ming (Tina) Song. The committee will give its initial report at the ORSA/TIMS New York business meeting.

6. College member Peter Glynn will chair a SIAM-sponsored conference on "Simulation in the 1990s," which will probably be held during the summer of 1991. Glynn stated that this conference will present an opportunity to interact with simulators in other areas of mathematics and science. The role of the College was discussed, and a committee consisting of Bruce Schmeiser (Chair), Glynn, David Withers and Jim Wilson was appointed to coordinate our participation.

7. Kelton reported on his investigation into producing a College-sponsored monograph series. It appears that publication by TIMS is unlikely. In a lengthy discussion the following key points emerged:

   (a) Even if TIMS does not publish the monographs, we should have TIMS approval for the series.

   (b) We need a professional publisher to handle distribution.

   (c) We will act as editors for the series.

   (d) The purpose of the series is to publish important works that are not suitable for the usual outlets of journal articles and books.

A committee was formed consisting of Kelton, Pandu Tadikamalla, Steve Roberts, and Wilson to investigate options. They will report either at ORSA/TIMS New York or WSC '89.

8. The proposed College logos were discussed. Wilson described the intended significance of the symbols used in the designs: a diamond representing decision making, circuit traces representing the use of computers, and an elongated "S" representing both simulation and integration. Returns from the *Newsletter* ballots showed design B winning by a substantial margin. A motion was made to adopt design B, and the motion passed.

9. A motion was introduced by Kelton to discontinue the student presentation award. Reasons given included the small number of participants, the difficulty in restricting participation to "simulation" topics, the difficulty of administering the process, and the undue pressure put on students often giving their first talk. After considerable discussion Withers moved to table the motion until ORSA/TIMS New York; the motion to table passed. It was suggested that an item be placed in the Fall *Newsletter* to solicit feedback from the membership.

10. Withers moved that wine, beer, soft drinks, and appropriate snacks be served after all College business meetings. The motion passed.

11. The meeting was adjourned.

Respectfully submitted,
Barry L. Nelson
Secretary-Treasurer

Treasurer's Report

For the period 3/8/89 through 10/3/89 the College had the following transactions at BancOhio National Bank, Columbus, Ohio.

Balance forward:			$22,510.20
Revenues:			
Interest earned	599.35		
Dues	27.00		
WSC '88 share	7798.54		
Total revenues		8424.89	
Disbursements:			
College logo	289.00		
Book for Publication Award	52.47		
Publication Award Plaque	72.52		
Newsletters	823.41		
Travel for WSC Board Rep	253.00		
Dues to TIMS	7.50		
Total disbursements		1498.90	
Net (revenues - disbursements)			6925.99
Balance Forward (previous balance + net)			$27734.73

All funds are in a money market checking account at BancOhio National Bank. In addition to these funds, the College has on account at TIMS Headquarters the sum of $963.58 (as of 6/30/89), bringing the College's net worth to $28698.31.

Respectfully submitted,
Barry L. Nelson, Secretary-Treasurer
October 3, 1989

Abstracts of Papers

Kenneth W. Bauer, Jr. and James R. Wilson (1989), "Control-Variate Selection Criteria," Technical Report No. SMS 89-13, School of Industrial Engineering, Purdue University, West Lafayette, Indiana 47907.

Often simulation practitioners seeking to use the control-variate technique are confronted with numerous candidate controls. In this paper we develop control-variate selection criteria for two cases: (a) the covariance matrix of the controls is unknown and is estimated from simulation-generated data; and (b) the covariance matrix of the controls is known and is incorporated into new estimators of the target mean response.

Maged M. Dessouky and James R. Wilson (1989), "Minimizing Production Costs for a Robotic Assembly System," School of Industrial Engineering, Purdue University, West Lafayette, Indiana 47907.

The objective of this study is to minimize the expected present worth of the production costs incurred over the operational life of a robotic assembly system that is integrated with an Automatic Storage/Retrieval System (AS/RS). Production costs include inventory cost and capital cost of equipment. Inventory cost depends on the scheduling policy for the assembly robots as well as the inventory policy for the AS/RS. Capital cost of equipment depends on the number of depalletizer robots and the number of assembly robots. To identify the minimum-cost design for a certain automotive assembly operation from a given set of alternative system configurations, we present a simulation experiment in which independent replications of each alternative are controlled by a statistical ranking-and-selection procedure that has been adapted to simulation.

George S. Fishman (1989), "Confidence Intervals for the Mean in the Bounded Case," Technical Report No. 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 which avoids the error of approximation that assuming normality induces and which is shorter than the interval that Chebyshev's inequality induces for small α.

Bennett L. Fox, David Goldsman, and James J. Swain (1989), "Spaced Batch Means," School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332-0205.

We examine a variant of the familiar batch means (BM) method for analysis of a stationary (simulation) process. Our *spaced batch means* (SBM) method attempts to reduce the bad effects of inter-batch correlation by inserting *spacers* between the batches of observations. We present analytical examples in which SBM yields an estimator for the variance parameter that is less biased than the corresponding BM estimator. We also give analytical examples in which SBM improves coverage of confidence intervals for the mean of the response. Under positive serial correlation, SBM fares only slightly better than BM.

Ambuj Goyal, Perwez Shahabuddin, Philip Heidelberger, Vitor F. Nicola, and Peter W. Glynn (1989), "A Unified Framework for Simulating Markovian Models of Highly Dependable Systems," IBM Thomas J. Watson Research Center, Yorktown Heights, New York.

In this paper we present a unified framework for simulating Markovian models of highly dependable systems. Since the failure event is a rare event, the estimation of system dependability measures using standard simulation requires very long simulation runs. We show that a variance reduction technique called Importance Sampling can be used to speed up the simulation by many orders of magnitude over standard simulation. This technique can be combined very effectively with regenerative simulation to estimate measures such as steady-state availability and mean time to failure. Moreover, it can be combined with conditional Monte Carlo methods to quickly estimate transient measures such as reliability, expected interval availability,

and the distribution of interval availability. We show the effectiveness of these methods by using them to simulate large dependability models. We also discuss how these methods can be implemented in a software package to compute both transient and steady-state measures simultaneously from the same sample run.

Jack P. C. Kleijnen and Nabil Adam (1989), "Pseudorandom Number Generation on Supercomputers," School of Business and Economics, Tilburg University, The Netherlands.

Pseudorandom number generators are essential in Monte Carlo simulation. On supercomputers these numbers should be generated in parallel. Several procedures are evaluated, and one practical procedure is developed.

Jack P. C. Kleijnen and Ben Annink (1989), "Pseudorandom Number Generators Revisited," School of Business and Economics, Tilburg University, The Netherlands.

When splitting the cycle (of length h) of a multiplicative generator into two parts, the pseudorandom numbers across parts (x_i and $x_{i+h/2}$ with $i = 1, \ldots, h/2-1$) turn out to lie on only two parallel lines. These "long range" correlations have consequences for classic and for parallel computers. For supercomputers simple alternative generators are presented. These generators are more efficient than the standard subroutines (RANF and VRANF) available on the CYBER 205.

Jack P. C. Kleijnen and Ben Annink (1989), "Supercomputers, Monte Carlo Simulation, and Regression Analysis," School of Business and Economics, Tilburg University, The Netherlands.

Supercomputers provide a new tool for management scientists. The application of this tool requires thinking in parallel or vector mode. This mode is examined in the context of Monte Carlo simulation experiments with multivariate regression models. The parallel mode needs to exploit a specific dimension of the Monte Carlo experiment (namely the replicates of that experiment). Then Ordinary Least Squares on a CYBER 205 takes only 1.4% of the time needed on a VAX 8700. Estimated Generalized Least Squares, however, is slower on the CYBER 205 because it requires matrix inversion.

Sanghoon Lee, Melba M. Crawford, and James R. Wilson (1989), "Modelling and Simulation of a Nonhomogeneous Poisson Process with Cyclic Features," Technical Report No. SMS 89-19, School of Industrial Engineering, Purdue University, West Lafayette, Indiana 47907.

In this paper we develop an integrated approach to modelling and simulating a nonhomogeneous Poisson process with periodic characteristics. To represent the oscillating behavior of such a time-varying process, we use an exponential rate function in which the exponent includes both a polynomial and a trigonometric component. Maximum likelihood estimates of the parameters are determined numerically, where initial estimates of the trigonometric parameters are derived from a preliminary spectral analysis of the process. To simulate the fitted process by the method of thinning, we develop a procedure for constructing a piecewise linear majorizing rate function. We also present a new implementation of the inverse transform method for simulating a nonhomogeneous Poisson process with a piecewise linear rate function. The procedure is faster and numerically more stable than previously published implementations.

Bruce Schmeiser (1989), "Simulation Experiments," Technical Report No. SMS 89-23, School of Industrial Engineering, Purdue University, West Lafayette, Indiana 47907.

To appear as a Chapter in *Handbook of Operations Research and Management Science*, edited by George Nemhauser, Volume on Stochastic Models, edited by Dan Heyman and Matt Sobel, North-Holland.

Bruce Schmeiser and Voratas Kachitvichyanukul, "Non-inverse Correlation Induction: Guidelines for Algorithm Development," Technical Report SMS 89-15, School of Industrial Engineering, Purdue University, West Lafayette, Indiana 47907.

To appear in *Proceedings of the Conference on Random Numbers and Simulation*, November 1988, Lambrecht, West Germany, edited by Jurgen Lehn.

We propose guidelines for future development of random-variate generators that are capable of inducing statistical dependence between simulation replications without incurring the computational burden of numerically inverting the distribution function. Two examples are given: an exponential generator using the inverse transformation and a generic acceptance-rejection generator based on an existing beta generator. A driver program and illustrative Monte Carlo results are discussed.

J. D. Tew and James R. Wilson (1989), "Estimating Simulation Metamodels Using Integrated Variance Reduction Techniques," Technical Report No. SMS 89-16, School of Industrial Engineering, Purdue University, West Lafayette, Indiana 47907.

This paper develops a procedure for jointly applying the variance reduction techniques of antithetic variates, common random number streams, and control variates in a simulation experiment. The objective is to estimate a linear model for a given simulation output variable expressed in terms of an input vector of decision variables for the target system. The proposed procedure is an adaptation of the Schruben-Margolin correlation induction strategy that integrates the method of control variates. Under specified conditions and with respect to a variety of optimality criteria, the procedure is shown to be superior to each of the following conventional correlation-based variance reduction techniques: independent random number streams, common random number streams, control variates, and the original Schruben-Margolin strategy.

J. D. Tew and James R. Wilson (1989), "Validation of Statistical Analysis Methods for the Schruben-Margolin Correlation-Induction Strategy," Technical Report No. SMS 89-18, School of Industrial Engineering, Purdue University, West Lafayette, Indiana 47907.

This paper develops a three-stage procedure to validate the use of a statistical analysis technique proposed by Nozari, Arnold, and Pegden in simulation experiments conducted under the Schruben-Margolin correlation induction strategy. The objective of such experiments is to estimate a general linear metamodel (that is, a regression model) for a selected simulation response variable expressed in terms of decision variables (regressors) that are relevant to the target system. Each stage of the validation procedure tests a key assumption about the behavior of the response variable across all points in the experimental design. The first stage tests for multivariate normality in the overall set of responses, the second stage tests for the Schruben-Margolin covariance structure among those responses, and the third stage tests for the adequacy of the user-specified metamodel. To handle simulation experiments that display significant departures from the Schruben-Margolin covariance structure, we present a lack-of-fit test and a follow-up analysis for the proposed metamodel that are based only on the assumption of jointly normal responses. A numerical example illustrates the steps of this validation procedure.

Wei-Ning Yang and Barry L. Nelson (1989), "Using Common Random Numbers and Control Variates in Multiple-Comparison Procedures," Working Paper Series No. 1989-001, Department of Industrial and Systems Engineering, The Ohio State University, Columbus, Ohio 43210.

This paper considers determining the relative merits of two or more system designs via stochastic simulation experiments by constructing simultaneous interval estimates of certain differences in expected performance. Tukey's all-pairwise-comparisons procedure, Hsu's multiple-comparisons-with-the-best procedure, and Dunnett's multiple-comparisons-with-a-control procedure are standard methods for making such comparisons. We propose refinements for all three procedures through the use of two variance reduction techniques: common random numbers and control variates. We show that the proposed procedures are better than the standard multiple-comparison procedures in the sense that they have a larger probability of containing the true difference and, at the same time, not containing zero when a difference exists.

Event Calendar

Southeastern Simulation Conference 1989, October 16-17, 1989, Pensicola, Florida. Contact Mary Lou Padgett, 1165 Owens Rd., Auburn, Alabama 36830 or Joe Gauthier, 919B Willowbrook Dr., Huntsville, Alabama. Phone (205) 881-0947.

TIMS/ORSA Joint National Meeting, October 16-18, 1989, Marriott Marquis Hotel, New York City. For further information, contact Sunil Chopra, Stern School of Business, New York University, 90 Trinity Place, New York, New York 10006. Phone (212) 285-6180.

Workshop on Conducting Large-Scale Simulation Experiments, December 3-4, 1989, Washington, D.C. Russell Barton, School of OR & IE, Upson Hall, Cornell University, Ithaca, New York 14853. Phone (607) 255-9133.

1989 Winter Simulation Conference, December 4-6, 1989, The Capital Hilton, Washington, D.C. Contact Kenneth Musselman, Pritsker Corporation, Box 2413, West Lafayette, Indiana 47906. Phone (317) 463-5557.

TIMS/ORSA Joint National Meeting, May 7-9, 1990, Caesar's Palace, Las Vegas, Nevada. For further information, contact Asim Roy, Dept. of Decision and Information Systems, College of Business, Arizona State University, Tempe, Arizona 85287. Phone: (602) 965-6324.

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

Announcements

Joining the College on Simulation: It is still possible to be a member of the TIMS College on Simulation without being a member of TIMS. Annual membership dues for non-TIMS members of the College are $3, compared to $2 for TIMS members. To join, send name, address, e-mail address (if applicable), and $3 to Barry L. Nelson, Dept. of Industrial and Systems Engineering, The Ohio State University, Columbus, OH 43210. Make checks payable to "TIMS College on Simulation." If you know people who might be interested in joining, please pass along this announcement.

Outstanding Simulation Publication Awards for 1989 and 1990

To recognize outstanding contributions to the simulation literature, the College on Simulation annually sponsors an Outstanding Simulation Publication Award. The 1989 Award will be presented to Luc Devroye for his book *Non-Uniform Random Variate Generation*, which was published by Springer-Verlag in 1986. Stephen D. Roberts, the outgoing Chairperson of the Awards Committee, will make the formal presentation at the Opening Session of the 1989 Winter Simulation Conference.

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

Dr. Peter D. Welch
IBM Corporation
Thomas J. Watson Research Center
P.O. Box 704
Yorktown Heights, NY 10598
(914) 789-7560
welch@yktvmh.bitnet

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 1986, 1987, and 1988 are eligible for the Award to be presented in 1990. 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.

Outstanding Service Award for 1990

To recognize outstanding service contributions to the field of simulation, the College on Simulation annually sponsors an Outstanding Service Award. Nominations for the 1990 Award will accepted until September 1, 1990. The Outstanding Service Award committee consists of Robert Sargent, Bruce Schmeiser, and Lee Schruben. Send nominations to:

Professor Lee Schruben
School of OR & IE
Upson Hall
Cornell University
Ithaca, NY 14853
(607) 255-9133
lee@orie.cornell.edu

Editors' Corner

Below is the latest update of the e-mail directory. If you would like to have your address included, please send it to one of the *Newsletter* Editors.

Name	Affiliation	e-mail address
Christos Alexopoulos	Georgia Tech	calexopo@gtri01.bitnet
Gerald Brosnan	AT&T Bell Labs	gab@hound.att.com (arpa)
		att!hound!gab (usenet)
Russell Barton	Cornell	barton@gvax.cs.cornell.edu
Ted Brown	Queens College	brownt@qcvax.bitnet
David Briskman	General Foods	brisk@crnlimap.cornell.edu
Tom Clark	Florida St.	tclark@fsu.bitnet
John Comfort	Fla. Intl.	comfort@servax.bitnet
Luc Devroye	McGill U.	luc@mujunior.ce.mcgill.ca
Paul Fishwick	Florida	fishwick@fish.cis.ufl.edu
Bob Foley	Georgia Tech	rfoley@gtri01.bitnet
Ben Fox	Col.-Denver	bfox@cudenver.bitnet
Peter Glynn	Stanford	glynn@sierra.stanford.edu
Dave Goldsman	Georgia Tech	dgoldsma@gtri01.bitnet
David Grier	George Wash.	dagrier@gwuvm.bitnet
Jorge Haddock	RPI	ffye@rpitsmts.bitnet
Phil Heidelberger	IBM	berger@yktwnh.bitnet
Sheldon Jacobson	Case Western	jacobson@cwru.bitnet
		jacobson@cwru.cwru.edu
Mark Johnson	Georgia Tech	mjohnson@gtri01.bitnet
V Kachitvichyanukul	Iowa	aegvorwy@uiamvs.bitnet
Keebom Kang	Naval Postgrad	5030p@navpgs.bitnet
Dave Kelton	Minnesota	dkelton@umnacvx.bitnet
Jack Kleijnen	Tilburg U.	t435kleijnen@htikub5
Peter Lewis	Naval Postgrad	1526p@navpgs.bitnet
J Jung Lyu	U of Iowa	aeglynpa@uiamvs.bitnet
Susumu Morito	Waseda U/Japan	opremori@jpnwas00
Barry Nelson	Ohio State	nelson-b@eng.ohio-state.edu
Norman Nielsen	SRI Internat'l	nielsen@kl.sri.com

E. Joel Rahn	U. Laval	rahnj@lavalvm2.netnorth
Steve Roberts	Purdue	steverob@gb.ecn.purdue.edu
Paul Sanchez	U. of Arizona	sie!paul@arizona.edu
Bob Sargent	Syracuse	rsargent@top.cis.syr.edu
Bruce Schmeiser	Purdue	schmeise@pink.ecn.purdue.edu
Tom Schriber	Michigan	userk2bu@michub.bitnet
Lee Schruben	Cornell	lee@orie.cornell.edu
Andy Seila	U. Georgia	aseila@uscn.bitnet
Wheyming Tina Song	Purdue	wheyming@pink.ecn.purdue.edu
Bob Storer	Lehigh	rhs2@lehigh.bitnet
Jim Swain	Georgia Tech	jswain@gtri01.bitnet
Mike Taaffe	Rhode Island	taaffe@gb.ecn.purdue.edu
Peter Welch	IBM	welch@yktvmh.bitnet
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 SU	q200250@calstate
Enver Yücesan	Cornell U.	vohy@cornella.bitnet

As usual, please send any announcements, abstracts, or other material which you may wish to contribute to the *Newsletter*. – DG,JJS

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Volume 13, Number 2, Fall 1989

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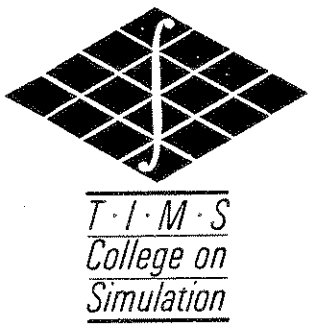

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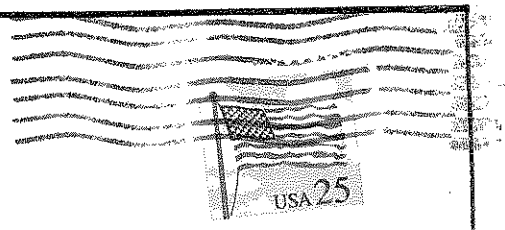

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BARRY NELSON
OHIO STATE UNIV - I S E
1971 NEIL AVENUE
COLUMBUS, OH 43210