Orthogonal Polynomials and Special Functions

SIAM Activity Group on Orthogonal Polynomials and Special Functions

★ ★ ★ ★ **Newsletter** ★ ★ ★ ★

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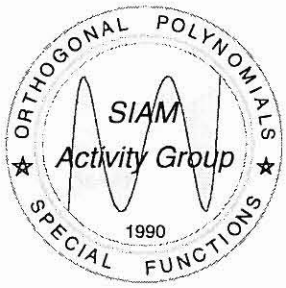

The News

In this issue we announce the startup of the OP-SF Net, our own electronic news network. Then we also begin a Letters section for the Newsletter, in which you can write down your thoughts in a letter to the Editor. And there is a meeting or two which may interest you. The one thing missing seems to be an editorial column but we are not yet organized for that.

George Gasper informs us that the latest list of errata for the Gasper and Rahman "Basic Hypergeometric Series" book is available by ftp from Waleed Al-Salam's anonymous ftp site "ftp euler.math.ualberta.ca" in the "pub" directory. He also mentions that a Special Issue of the SIAM Journal on Mathematical Analysis, dedicated to Richard Askey and Frank Olver, will be scheduled for publication in the Spring of 1994. It will consist of papers from about 50 authors, amounting to something like 450 pages.

Charles Dunkl has just accepted an appointment to the Editorial Board of the SIAM Journal on Mathematical Analysis, and this comes on top of being named an Associate Editor of a new journal called Integral Equations and Special Functions.

You may recall that Doron Zeilberger's Maple package was described in the Fall issue of the Newsletter. Now an alternative implementation has been produced by Tom Koornwinder, using Zeilberger's original algorithm on hypergeometric and q-hypergeometric function identities. It may be interesting to compare Doron's program with Tom's alternative in practical calculations. Tom's code is also available by anonymous ftp from the site "euler.math.ualberta.ca" in the directory: pub/koornwinder (files zeilb and qzeilb, with the help files help_zeilb and help_qzeilb). It runs under Maple V, Release 2.

Eugene Tomer has been serving unofficially for about a year and a half as the Editor of this Newsletter. His work originally amounted to a volunteer effort for the purpose of establishing the current LaTeX format. Now that it has been established, he has been officially appointed as Editor of the Newsletter by the four elected officers, and he will serve through the end of December 1995, the same term as the other officers. No dramatic changes are planned for the Newsletter and it will continue on its present course. Your Editor welcomes all suggestions and criticism, as well as contributions from all the members.

SIAM Activity Group
on
Orthogonal Polynomials and Special Functions

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Elected Officers
CHARLES DUNKL, *Chair*
GEORGE GASPER, *Vice Chair*
MARTIN E. MULDOON, *Program Director*
TOM H. KOORNWINDER, *Secretary*

Appointed Officer
EUGENE TOMER, *Editor of the Newsletter*

◇

THE PURPOSE *of the Activity Group is*

—to promote basic research in orthogonal polynomials and special functions; to further the application of this subject in other parts of mathematics, and in science and industry; and to encourage and support the exchange of information, ideas, and techniques between workers in this field, and other mathematicians and scientists.

Announcing The OP-SF Net

As a complement to the Newsletter we are beginning an electronic news net, called OP-SF Net, in line with the other SIAM nets. This will allow rapid distribution of important news items to those members on the Internet. Tom Koornwinder will act as Editor (and moderator) of the OP-SF Net, and our Activity Group will henceforth utilize both media. All members are urged to contribute to the OP-SF Net as well as the Newsletter.

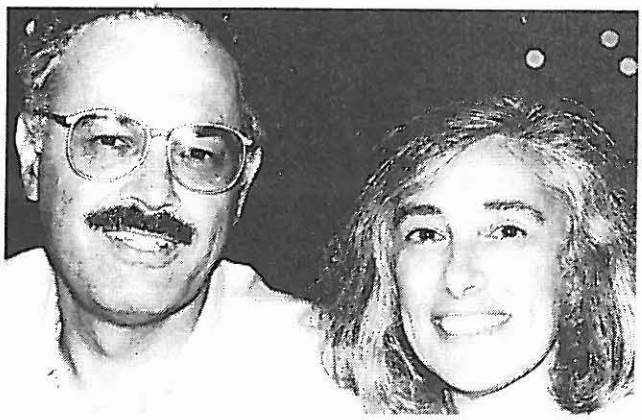
All items in the OP-SF Net will appear in the next edition of the Newsletter (except when the activity has already occurred), while many items appearing in the Newsletter will be included in the Net transmission.

The first transmission will be around December 15 and it will contain information on the yearly schedule. Members will not receive the OP-SF Net automatically, however. To receive the transmissions, send your name and e-mail address to poly-request@siam.org. As with other nets, *nonmembers* may also receive the transmissions after first filling out the informal application which will be sent following their request.

You should send all your OP-SF Net contributions to poly@siam.org. Please tell your friends and colleagues about the OP-SF Net.

The Philadelphia Minisymposium (continued)

We were unable to get hold of Haubold's abstract in time for this edition but his papers are available at Waleed Al-Salam's ftp site and you can look them up if you have access to the Internet. Otherwise maybe you can get a friend to download them for you. Directions to the site are given in an article below.



Charles Dunkl and wife Phil enjoy some pasta after sessions

In spite of the huge number of parallel sessions in Philadelphia last July, many people found time to relax at the end of the day.

Letters

In this issue we begin a Letters section, in which you are encouraged to write down your thoughts about our field, any special requests, and so on, in a letter to the Editor. Occasionally a letter may be edited slightly to conform with standard English usage but it will otherwise be printed as received.

Dear Editor–I am a mathematician, and a lecturer, at the University of Oradea, Romania. I am interested in orthogonal polynomials of two, or of many, variables, and I am also interested in orthogonal polynomials associated with singular integrals, for example singular integrals of the Poisson type. I would greatly appreciate receiving reprints of papers on these subjects from the members. Thank you very much.

Yours sincerely,

Dr. Sorin Gh. Gal
Department of Mathematics
University of Oradea
Str. Armatei Române 5
3700 Oradea, Romania

Nov. 3, 1993

Tel: 40 99 145 831
Fax: 40 99 156 313

Meetings and Conferences

Some of these items have appeared in previous editions.

1. North Carolina State University will host a conference in Raleigh from December 12–17, 1993 to celebrate the 100th anniversary of Cornelius Lanczos (1893-1974). The conference will reflect the wide interests of Lanczos—in computational mathematics, theoretical physics, and in astrophysics. The program will include 25 invited plenary speakers and 25 minisymposia, approximately. Contact

Lanczos International Centenary Conference
Attn: Sheehan/Heggie
NCSU/OCE&PD, Box 7401
Raleigh, NC 27695 lanczos@math.ncsu.edu

2. A session on the topic of special functions will be held during the March 25-26, 1994 meeting of the AMS in Manhattan, Kansas. Anyone who might be interested in presenting a paper at this meeting should please contact

Robert Gustafson
Department of Mathematics
Texas A&M University
College Station, TX 77843,
Tel: (409) 764-8933 and (409) 845-3950
Fax: (409) 845-6028 rgustaf@math.tamu.edu

3. The 100th anniversary of T.J. Stieltjes' premature death will be commemorated in 1994-95. A number of activities are planned in Leiden, and also in Toulouse.

First of all, in April 1994 the Congress of Wiskundig Genootschap (The Dutch Mathematical Society) will be held in Leiden, where Richard Askey will give the Stieltjes Lecture. Contact:

Prof. Gerrit van Dijk
Rijksuniversiteit Leiden
Afdeling Wiskunde en Informatica
P.O. Box 9512
2300 RA Leiden, The Netherlands

Then in Toulouse there will be a colloquium in the Spring of 1995. The focus will be on continued fractions and moment problems, orthogonal polynomials, Laplace transforms, the Riemann hypothesis, and other topics. This will have a somewhat historical character. Contact:

Prof. J.-B. Hiriart-Urruty
Groupe d'Histoire des Mathématiques
de l'Université Paul Sabatier
118, Route de Narbonne
31062 Toulouse, France

4. The Thomas Jan Stieltjes Research Institute is a newly-organized inter-university mathematical research center located in the western part of The Netherlands. Within the framework of the Institute's program there will now be a period of concentration on representation theory and q-special functions.

Thus, between April and June, 1994, a number of guests are expected, for a longer or shorter time, and regular seminars will be held. The focus will be on Heckman-Opdam hypergeometric functions associated with root systems, and interpretations of Macdonald's orthogonal q-polynomials on quantum groups. The activity will take place both at the Universities of Leiden and Amsterdam.

The following have agreed to come for a period of two to eight weeks: Ivan V. Cherednik (Chapel Hill), Charles F. Dunkl (Charlottesville), Ian G. Macdonald (London), Masatoshi Noumi (Tokyo), Grigori I. Olshanski (Moscow). Further information can be obtained from Tom Koornwinder (thk@fwi.uva.nl) or from Eric Opdam (opdam@rulcri.leidenuniv.nl).

5. Also in commemoration of Stieltjes there will be a conference with the title "Orthogonality, Moment Problems, and Continued Fractions" to be held at Delft University of Technology, October 31–November 4, 1994. Each of four days will feature a different aspect of Stieltjes' work, ranging from continued fractions, rational approximation, moment problems, orthogonal polynomials, and asymptotics, to the properties of zeros and Gaussian quadrature. The format will consist of an invited lecture in the morning followed by the (short) communications.

The exceptional day is Wednesday which will feature an invited lecture in the morning about the life and work of Stieltjes, followed by a sightseeing tour after lunch.

No parallel sessions are planned and therefore the number of communications is limited. Selection of invited lectures as well as communications will be supervised by a scientific committee whose members are

Walter J.Van Assche
Gerrit van Dijk
J.-B. Hiriart-Urruty
Francisco Marcellan
Paul Nevai
Marcel G. de Bruin

If you would like to participate, you are invited to inquire before January 10, 1994 by sending an e-mail to tjs94@twi.tudelft.nl or a letter to

TJS94, Mekelweg 4, kr. H4.11
Department of Pure Mathematics
Delft University of Technology
P.O. Box 5031
2600 GA Delft
The Netherlands

whereupon you will receive a second announcement which describes the registration procedures and submission of manuscripts.

More on Waleed's ftp Site

We give directions once again to Waleed Al-Salam's anonymous ftp site, in case you may have missed it earlier, and we also reproduce the list of papers contained therein. The list has not been verified (it is printed here more or less as received) but you should have no trouble navigating around it.

The procedure for downloading files from Waleed's machine is as follows:

1. Type "ftp euler.math.ualberta.ca" (but without the quotation marks).
2. When prompted for your Name, type "anonymous".
3. When prompted for your Password, type your e-mail address or anything else.
4. When the ftp> prompt appears, type "cd pub" to switch to the /pub directory.
5. Examine the /pub directory by typing "ls" or "ls -l".
6. After the ftp> prompt you may move to any subdirectory by typing "cd dirname" where "dirname" is the name of the subdirectory. To return to the previous directory, type "cd ..".
7. To download a file, type "get filename" where "filename" is the name of the file.
8. To exit, type "quit" after the ftp> prompt.

If you wish to make your unpublished manuscripts available to the Orthogonal Polynomials and Special Functions community, they should first of all be written in TEX, LATEX, AMS-TEX or AMS-LATEX. Then they can be submitted to Waleed's FTP site by one of these two methods:

- Via e-mail to waleed@euler.math.ualberta.ca
- Via FTP by doing steps 1, 2, 3 above and then, after the ftp> prompt appears, type "cd submissions" to change to the submissions directory, and finally type "put filename" where "filename" is the name of the file you wish to submit.

Large files and manuscripts with one or more related macro/style files will be tarred and compressed to create a single *.tar.Z file for UNIX machines and a *.zip file for DOS machines. These can be untarred and uncompressed, using a standard UNIX facility, or unzipped using any one of many unzipping programs available for DOS machines. If you wish to receive periodic information regarding recent additions to this electronic depository, just send a message to waleed@euler.math.ualberta.ca and remember to give your e-mail address.

Current List of Papers in euler.math.ualberta.ca

o G. Gasper and W. Trebels. On necessary multiplier conditions for Laguerre expansions II.
/pub/gasper/gasper.tar.Z or gasper.zip

o G. Gasper. Using sums of squares to prove that certain entire functions have only real zeros.
/pub/gasper/sums.tex

o W. Gautschi. Algorithm xxx–Orthpol: A package ...
/pub/gautschi/gautschi1.tex

o W. Gautschi. Gauss-type quadrature rules for rational functions. /pub/gautschi/gautschi2.tex

o M. L. Glasser and E. Montaldi. Some Integrals Involving Bessel Functions. /pub/glasser/glasser1.tex + glasser2.tex (references file for glasser1.tex)

o R. Askey and S.K. Suslov. The q-Harmonic Oscillator and an Analog of the Charlier polynomials.
/pub/askey_suslov.tex

o R. Askey, N.M. Atakishiyev and S.K. Suslov. An Analog of the Fourier Transformation for a q-Harmonic Oscillator. /pub/askey_atak_suslov.tex

o A. P. Magnus. Painlevé-type differential equations for the recurrence coefficients of semi-classical orthogonal polynomials. /pub/painlevemagnus.tex

o W. Van Assche and I. Vanherwegen. Quadrature formulas based on rational interpolation.
/pub/vanassche2.tex

o W. Van Assche. The impact of Stieltjes' work on continued fractions and orthogonal polynomials.
/pub/vanassche3.tex

o A. Sinap and W. Van Assche. Polynomial interpolation and Gaussian quadrature for matrix-valued functions.
/pub/vanassche1.tex

o G. Valent. Associated Stieltjes-Carlitz polynomials and a generalization of Heun's differential equation.
/pub/valent.tex

o T. Koornwinder. Jacobi polynomials of type BC, Jack polynomials, limit transitions and $O(\infty)$.
/pub/koornwinder1.tex

o J. Letessier. Some results on co-recursive associated Laguerre and Jacobi polynomials. /pub/jletessier.tex

o Al-Salam and M. Ismail. A q-beta integral on the unit circle and some biorthogonal functions. /pub/WA-IS.tex

o S. Ekhad and D. Zeilberger. A high-school algebra, wallet-sized proof, of the Bieberbach conjecture,
(after L. Weinstein). /pub/bieberbach.tex

o A. de Medicis, D. Stanton, and D. White. The combinatorics of the q-Charlier polynomials.
/pub/stanton/demed_stan_white.tex

o R. Simion and D. Stanton. Specializations of generalized Laguerre polynomials. /pub/stanton/sim_stan.tex

o K. Stempak and W. Trebels. On weighted transplantation and multipliers for the Laguerre expansions.
/pub/trebels.tex

- R. Askey and S. K. Suslov. The q-harmonic oscillator and the Al-Salam and Carlitz polynomials. /pub/ask-sus.tex
- H.T. Koelink and R.F. Swarttouw. On the zeros of the Hahn-Exton q-Bessel function and associated q-Lommel polynomials. /pub/koelink_swarttouw/qbessel.zip or qbessel. tar
- H.J. Haubold and A. M. Mathai. Computational aspects of the gravitational instability problem for a multicomponent cosmological medium. /pub/haubold_mathai.tex
- H. J Haubold and A. M. Mathai. Applications of generalized special functions in stellar astrophysics. /pub/haubold-mathai2.tex
- M. Rosenblum. Generalized Hermite polynomials and the Bose-like oscillator calculus. /pub/boselike.tex
- M. Ismail and D. Masson. q-Hermite polynomials, biorthogonal rational functions and q-beta integrals. /pub/biorthog.tex
- M. Ismail and R. Zhang. Diagonalization of certain integral operators. /pub/integral-operators.tex
- M. Ismail and M. Rahman. Some basic bilateral sums and integrals. /pub/sums-and-integrals.tex
- W. J. Anderson, H. J. Haubold, and A. M. Mathai. Astrophysical thermonuclear functions. /pub/anderson_haubold_mathai.tex
- M. L. Glasser and E. Montaldi. Staircase polynomials and recurrent lattice walks. /pub/glasser/glasser3.tex
- T. Koornwinder. Uniform multi-parameter limit transitions in the Askey tableau. /pub/koornwinder2.tex
- T. Koornwinder. On Zeilberger's algorithm and its q-analogue: a rigorous description. /pub/koorwinder/koornwinder3.tex and related Maple V procedures in that subdirectory
- G. Gasper and M. Rahman. Errata and updates of the references, etc., for "Basic Hypergeometric Series". /pub/gasper-rahman.tex
- B. M. Brown and M. Ismail. A right inverse of the Askey-Wilson operator. /pub/inverse-operator.tex
- M. Ismail, M. Rahman and R. Zhang. Diagonalization of certain integral operators II. /pub/diagonal-2.tex
- A. J. Duran and W. Van Assche. Orthogonal matrix polynomials and higher order recurrence relations. duran_vanassche.tex
- E. Neuman and P. J. Van Fleet. Moments of Dirichlet splines and their applications to hypergeometric functions. neuman_v_fleet.tex
- B. C. Carlson and J. L. Gustafson. Asymptotic approximations for symmetric elliptic integrals. /pub/carlson.tex
- W. Al-Salam. A characterization of the Rogers q-Hermite polynomials. /pub/qhermite.tex

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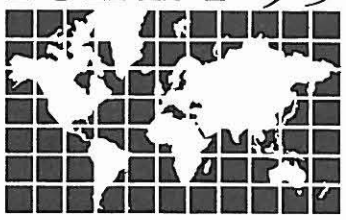
ICIAM 95



Third International Congress on Industrial and Applied Mathematics

July 3-7, 1995
Congress Centrum
Hamburg, Germany

For further information, contact:

GAMM - Office
Univ. Regensburg
NWFI - Mathematik
D-93053 Regensburg
Germany
Fax: +49-941-943-4005

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Société de Mathématiques Appliquées et Industrielles (SMAI)
Society for Industrial and Applied Mathematics (SIAM)

Problems

Another problem has been added to the list, bringing the total to eight. A printout of all the problems and the solutions is available from the Editor. If the problem has been solved, the printout will include any solution(s) suggested by the proposer.

2. Is it true that

$$x^2 t^x \, {}_2F_1(x+1,\, x+1;\, 2;\, 1-t)$$

is a convex function of x whenever $-\infty < x < \infty$ and $0 < t < 1$?

Submitted by George Gasper, August 19, 1992.
(g-gasper@nwu.edu)

3. The following Toeplitz matrix arises in several applications. Define for $i \neq j$

$$A_{ij}(\alpha) = \frac{\sin \alpha\pi(i-j)}{\pi(i-j)},$$

and set $A_{ii} = \alpha$. Conjecture: the matrix

$$M = (I - A)^{-1}$$

has positive entries. A proof is known for $0 < \alpha \leq 1/2$. Can one extend this to $0 < \alpha < 1$?

Submitted by Alberto Grünbaum, November 3, 1992.
(grunbaum@math.berkeley.edu)

5. The result of Problem #4 can be generalized to

$$\begin{aligned} S_m &= \sum_{n=0}^{\infty} \frac{(-1)^n (mn + 1/2)!}{\sqrt{\pi}\,(mn+1)!} \\ &= \frac{1}{m} \sum_{k=0}^{m-1} \frac{\sin\left(5(2k+1)\pi/(4m) + \pi/4\right)}{[2\sin\left((2k+1)\pi/(2m)\right)]^{1/2}} \end{aligned}$$

valid for integral $m \geq 2$.

Submitted by J. Boersma and P.J. de Doelder, July 12, 1993.
(wstanal@win.tue.nl)

6. For nonnegative integral n, let

$$\phi_n(x) = P_n(1-2x) = {}_2F_1(-n, n+1; 1; x).$$

Evaluate the integral

$$\Delta_{m,n}(\alpha) = \int_0^1 \phi_n(x) \int_0^1 \frac{\phi_m(t)}{|x-t|^\alpha}\, dt\, dx, \quad (\alpha < 1)$$

as a rational function of α.

Submitted by Barbara S. Bertram and Otto G. Ruehr, August 3, 1993.
(bertram@math.mtu.edu otto@math.mtu.edu)

7. The incomplete Airy integral given by [1]

$$I_0(\sigma, \gamma; k) = \int_\gamma^\infty e^{jk(\sigma z + z^3/3)}\, dz \tag{1}$$

serves as a canonical integral for some sparsely explored diffraction phenomena involving the evaluation of high frequency EM fields [2] near terminated caustics and composite shadow boundaries. In equation (1), k is the wavenumber of the propagation medium and is assumed to be the large parameter. Both the parameters σ and γ are real.

The desired task is to derive a complete asymptotic expansion for I_0 in inverse powers of $k \to \infty$ for the case when the saddle points of the integrand satisfying

$$z^2 + \sigma = 0 \tag{2}$$

$$z_{1,2} = \pm(-\sigma)^{1/2} \tag{3}$$

are real and widely separated ($\sigma \ll -1$). The asymptotic expansion should be of the form

$$I_0(\sigma, \gamma; k) \sim \sum_{n=0}^{\infty} k^{-n} f(\sigma, \gamma, n) \tag{4}$$

in which $f(\sigma, \gamma, n)$ is expressed in terms of known and easily computed functions. The asymptotic expansion in (4) should also hold uniformly as the endpoint γ approaches, or coincides with, one of the saddle points.

Submitted by E.D. Constantinides and R.J. Marhefka, August 11, 1993.
(evagoras@tiger.eng.ohio-state.edu)
(rjm@tiger.eng.ohio-state.edu)

8. Can the real and imaginary parts of a hypergeometric series of type ${}_pF_q$ with one complex parameter (either in the numerator or the denominator) be expressed by means of multiple hypergeometric series?

Submitted by Ernst D. Krupnikov, July 25, 1993.
(ernst@net.neic.nsk.su)

Address: P.O. Box 300, Novosibirsk State University, Novosibirsk 90, 630090 Russian Federation.

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[1] Electrical engineers use j for $\sqrt{-1}$, reserving $i = v/r$ for current.

[2] See their brief article on electromagnetic (EM) diffraction in the previous issue of the Newsletter.

On Material for the Newsletter

Like most newsletters, this one relies on input from the members it is supposed to serve.

Here is the publication schedule. Material received on or before a *Draft* #1 date can be included in that particular edition. Material received after such a date will have to be considered for a later edition.

Edition	*Draft* #1	*Mailing* $\approx$
Fall	August 10	September 1
Winter	November 10	December 1
Spring	February 10	March 1
Summer	May 10	June 1

Please send your Newsletter contributions to the Editor

Eugene Tomer
Applied Mathematics & Computing
150 Hernandez Avenue
San Francisco, CA 94127
Tel: (415) 665-9555 Fax: (415) 731-3551
etomer@netcom.com

The preferred mode is a LaTeX file sent by e-mail. This should be followed by a hard copy which is necessary if you have graphs or drawings. Note that the column width is exactly 3.5 inches while the font is the default `\normalsize (cmr10)`; also these constraints may tax your patience when typesetting the longer formulas. Here is the LaTeX *preamble* you will need when setting up your manuscript.

```
\documentstyle[twocolumn]{article}
\topmargin -0.5in
\oddsidemargin -0.375in
\evensidemargin -0.375in
\textheight 9.2in
\textwidth 7.25in
\columnsep 0.25in
\parskip 0.02in
\begin{document}
\title{Draft}
\author{Name of Author(s)}
\date{\today}
\maketitle
% Your text input goes here * *
\vfill
\end{document}
```

If e-mail and LaTeX are not suitable for you, then almost any other mode will do—provided the result is readable. A typewritten Fax is fine.

With last minute items turnaround time can be short. Please check over your material for accuracy and completeness before submitting it.

Since the membership embraces many languages, errors in an ümlaut, çedilla, or háček may be conspicuous if they occur in a name. Also, first names rather than first initials are preferred, in view of the wide geographical dispersion. For given only a first initial (with no address or affiliation), you cannot always prove the uniqueness of an individual even if you have every memberlist.

You may also send your contributions to the Chair of the Activity Group

Charles Dunkl
Department of Mathematics
University of Virginia
Charlottesville, VA 22903
Tel: (804) 924-4939 Fax: (804) 982-3084
cfd5z@virginia.edu

The **Newsletter** is a quarterly publication of the *SIAM Activity Group on Orthogonal Polynomials and Special Functions*. The Editorial Committee consists of Charles Dunkl, George Gasper, and Eugene Tomer.

To join the group and thereby receive the Newsletter, please contact

Society for Industrial and Applied Mathematics
3600 University City Science Center
Philadelphia, PA 19104-2688
Tel: (215) 382-9800 service@siam.org

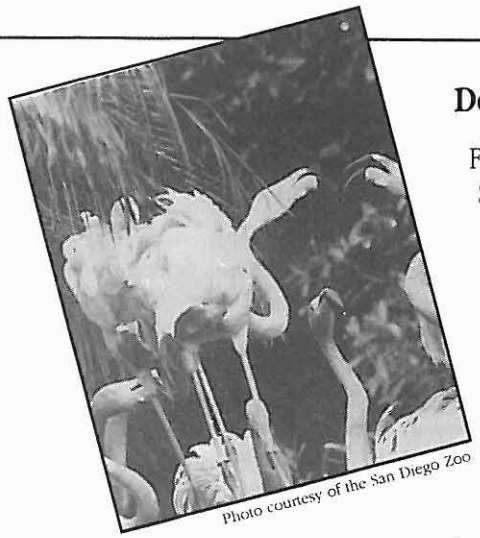

Photo courtesy of the San Diego Zoo

Deadline for Submission of Abstracts: January 24, 1994

For more information, contact:
SIAM, 3600 University City Science Center
Philadelphia, PA 19104-2688
Telephone: 215-382-9800
Fax: 215-386-7999
E-mail: meetings@siam.org

1994 SIAM Annual Meeting

San diego

CALIFORNIA

July 25 - 29, 1994
Sheraton Harbor Island East

Themes

Applications of Dynamical Systems

Applied Probability and Statistics

Control Theory, Optimization and Applications

Economics and Financial Modeling

Environmental and Geophysical Modeling

Large-Scale and Scientific Computing

Manufacturing and Design

Molecular Dynamics and Biological Modeling

Partial Differential Equations

Wave Propagation

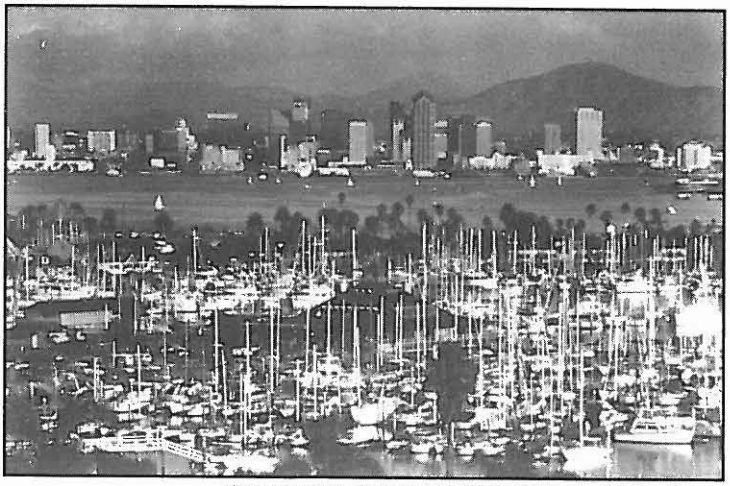

Photo courtesy of James Blank, San Diego Convention & Visitors Bureau

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