

NEWSLETTER

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(ANOTHER) NEW ADDRESS FOR NEWSLETTER EDITOR

I have moved again, this time due to a job change. I am now at ARCO Power Technologies, Inc. where I continue to do EM modeling. Mail sent to my old address should get forwarded. Please send new mail to:

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ACES NEWSLETTER COPY INFORMATION

<u>Issue</u>	<u>Copy Deadline</u>
March	January 25
July	May 25
November	September 25

Send copy to Paul Elliot, ARCO, 1250 24th St. NW, Suite 850, Washington, DC 20037 in the following formats:

1. A hardcopy.
2. Camera ready hardcopy of any figures.
3. If possible send text on a floppy disk. We can read MICROSOFT WORD and ASCII files on both IBM and Apple disks. On IBM disks we can also read WORDPERFECT and WORDSTAR files. If it's not possible to send a disk then the hardcopy should be in Courier font only for scanning purposes.

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The opinions, statements and facts contained in this Newsletter are solely the opinions of the authors and/or sources identified with each article. Articles with no author can be attributed to the editor, or to the committee head in the case of committee reports. The United States recently became part of the Berne Copyright Convention. Under the Berne Convention, the copyright for an article in this newsletter is legally held by the author(s) of the article since no explicit copyright notice appears in the newsletter.

NEWSLETTER EDITORS AND WRITERS NEEDED

The ACES Newsletter could use the following:

- * Acquisitions Editor - to locate articles for newsletter
- * Advertising Editor - to solicit and coordinate ads
- * Writers - to write occasional articles

Volunteers should contact Paul Elliot, Newsletter Editor.

OFFICERS' REPORTS

PRESIDENT'S REPORT

It was an awesome feeling at the end of last year, when facing tenure as President of ACES, I thought of the handover of responsibility from Jim Logan. In retrospect, he made it as smooth as possible by keeping me informed on major issues throughout the past year and by exceptional measures to make me aware of the administrative details prior to our meeting in Monterey. Jim arranged to visit me in Montreal during one of his trips to Washington. But this turned out to be the coldest day of the winter on February 24th! This is a measure of his dedication to ACES' success. To him, Dave Stein, Dick Adler and the other members of our ADCOM, I wish to express my gratitude for their help and understanding.

Jim kept ACES business matters well organized in a red filing case which he carried with him on business trips and also on his trip to Montreal. In the photographs from our banquet in Monterey you will see him handing over to me, this symbol of ACES presidency - the worries and deliberations.

Jim worked hard with the Financial Committee to expose the state of our finances and to identify the alternatives for a 5 year budget together with the operational consequences in terms of publications and fees. You will find this detail in the past issue of the Newsletter. For ACES to continue to be a viable society we must build up a reasonable financial reserve. The 5-year budget is designed to gradually build up a reserve of 100% of the current year's expenses over the 5-year period. It assumes a modest increase in fees each year and a reduction of publications to 3 Newsletters and one Journal per year. At the ADCOM meeting in Monterey this proposal and its realities were accepted in principle, but no formal vote was taken. Clearly, the reduction to one Journal per year was difficult to accept. ADCOM decided to review the proposal for next year at the forthcoming meeting in Dallas when the finances from the March conference would be available.

Difficult decisions to reduce services are best made when ADCOM can be aware of the importance of these services to our members. Therefore at the 6th Annual Review a questionnaire was circulated to attendees asking them for their opinion on the relative value of ACES publications and on their willingness to support these by an increase in fees, should this prove necessary. Because of the importance of knowing the wishes of the membership, this questionnaire is enclosed in this Newsletter. Please take the time to fill it out and mail it in! Also enclosed is a membership renewal form. If you have not already paid your membership, please do so and ask others to join. At the 6th Annual Review, Dick Adler notified ADCOM and the membership that incorporation of ACES as a non-profit organization in the State of California was imminent. It was anticipated that the first official meeting of the Board of Directors of the incorporated society would take place during the AP-S Symposium in Dallas.

Indeed the Applied Computational Electromagnetics Society was officially incorporated on the 26th of March 1990. It was incumbent upon us in Dallas, to complete the formality of approving the By-Laws, electing the officers, establishing the terms of office of the directors, establishing committees and transferring the assets into the new corporation. The By-Laws are included in this newsletter. Let me comment briefly on some of their consequences.

The ADCOM of ACES met for a luncheon meeting at the Dallas Convention Center on Thursday, the 10th of May 1990. A quorum was present and proxies were available for absent members. ADCOM agreed to transfer the assets and liabilities of the current ACES to the incorporated society (see the treasurer's report) and to conduct other business in consonance with the known wishes of the ACES membership. ADCOM then adjourned to sit as the interim Board Directors of the incorporated Applied Computational Electromagnetics Society. With the concurrence of the members, I chaired both meetings. The following terms of office were approved and officers were elected as noted. The results of the recent ACES mail-in vote are shown in brackets.

ADCOM**BOARD OF DIRECTORS (New)**

Pres. Stan Kubina (Just elected for 2 yrs + 4 ADCOM)	—>	1. 3 year term - Pres.
V. Pres. Hal Sabbagh (Just elected for 2 yrs)	—>	2. 3 year term - V.P.
Sec. Dick Adler (Just elected for 2 yrs)	—>	3. 2 year term - Sec.
Treas. Jim Breakall (Just elected for 2 yrs)	—>	4. 2 year term - Treas.
Members at Large:		
#1. Ray Luebbers (Just elected for 3 yrs - 1993)	—>	5. 3 year term
#2. Scott Ray (Completes term in 1992)	—>	6. 2 year term
#3. Pete Cunningham (Completes term in 1991)	—>	7. 1 year term
Past Pres. #1 Ed Miller (Has 2 more yr. on ADCOM)	—>	8. 1 year term
Past Pres. #2 Jim Logan (Has 4 more yrs. on ADCOM)	—>	9. 1 year term

Some of the commitments remain the same, others are different and staggered to satisfy the requirements to have three directors stand for election at each annual meeting.

The Board of Directors (BOG) agreed to receive the assets and liabilities of the former ACES.

Committees of ACES, Inc. can be Committees of the Board and Committees of the Corporation. The BOG approved as Committees of the Board, the Executive Committee, (Pres., Logan, Adler), the Financial Committee, (Logan, Pres., Sabbagh, Adler (NV), Breakall (NV), Stein (NV)) and the Nomination Committee, (Cunningham, Sabbagh, Logan). The NV means non-voting. The present committees of ACES were approved as Committees of the Corporation.

The BOG then formally brought in as members, the paid-up members of the current ACES. At this point the formal process of the By-Laws takes effect. If you scan the By-Laws you will note that an annual report will be prepared, and annual meeting will take place during our Annual Review for the election of new directors and to transact other business, and meetings of the BOG will be convened. Thus you can expect to receive the ballots for the election and the yearly report, as enclosures with the appropriate Newsletters where possible. I will be urging you to participate fully in our new process.

With the completion of the formalities associated with the By-Laws, the BOG re-examined the question of the budget and the restriction on the number of publications. Working with Dick Adler and Frank Walker, Jim Logan had been able to establish the cost and revenue for the past Annual Review, and in consultation with Frank was able to establish a proposed budget for the 1991 Annual Review. On this basis he presented the BOG with three options for the 5-year budgetary projection - one with a single Journal per year and a \$10 annual dues increase, and two others with two Journals and a \$10 or \$15 dollar increase in dues per year. The former option was approved. It represents a slower buildup of the reserve to an estimated 70% in 1994 versus approximately 90% for the two other options. The BOG will continue to monitor our finances to assure that we continue to operate as a viable society. From these considerations you can sense the importance of the questionnaire, the growth of our membership and the maintenance of services to the membership in an effective manner.

The success of the 6th Annual Review was an important factor in arriving at the decision on the budget and the number of publications. Scott Ray and his team and Dick Adler and his support staff must be congratulated for their extraordinary efforts.

It was most satisfying to distribute the Call for Papers for our 7th Annual Review at the AP-S Symposium. Frank Walker was able to have the announcement completed on time, even though he was on an assignment away from his home office. I admire and thank Frank for his expert use of modern communications.

The "raison d'être" of our society continues to be emphasized by the escalation of interest in computational electromagnetics by other technical societies. Through the financial planning described above, we now know how we can continue to have a sound fiscal base while serving our technical community. It is important for us to forge constructive links with other societies and to publicize our goals and services in order to attract new members. I call upon your help and participation in this effort and in our various committees. Do not hesitate to call any one of the officers or chairmen. They will welcome your ideas and your assistance.

Stanley J. Kubina
ACES President

TREASURER'S REPORT

At the 10 May 1990 ADCOM Meeting, the financial status of ACES was as follows:

Account	Amount
Main Savings	2,097.03
Main Checking	21,070.03
Main CD # 1	11,102.06
Main CD # 2	11,102.06
Editor Savings	25.00
Editor Checking	1,964.74
Secretary Savings	25.00
Secretary Checking	1,063.88
Total	\$48,449.80

This total amount was transferred to ACES, Inc. and was accepted by the Board of Directors.

Jim Breakall
Treasurer

COMMITTEE REPORTS

PUBLICATIONS COMMITTEE

During recent months, the payoffs for our efforts have exceeded all expectations. INSPEC, the data base for physics, electronics, and computing, will be including *ACES Journal* papers in their abstracting services. INSPEC made this decision after reviewing recent *ACES Journal* issues. Our authors and editors can take pride in a job well done!

In addition, ACES has been accepted for membership in the United Kingdom - Based Association of Learned and Professional Society Publishers. Meanwhile, our canonical problem solution project, which originated under the *ACES Journal* Special Issue program, has itself launched the ACES Workshop Program — one purpose of which is to provide ACES activities in parts of the world other than Monterey. Furthermore, it has paved the way for cooperative activities with TEAM, an informal group with its own impressive series of canonical problem solution workshops. We are fortunate to be sponsoring our first workshop jointly with TEAM. (See Announcements)

During these same recent months, however, we have had to make difficult decisions regarding the ACES budget. As former ACES President Jim Logan stated in the previous *ACES Newsletter* (Vol. 5, No. 1, March 1990), ACES had been functioning for more than four years without fiscal planning. In late 1989, the need for a dues increase (to become effective in January 1990) was identified, primarily to offset the effects of inflation and the costs of a separate *ACES Journal* and *ACES Newsletter*. (The imperative for separate publications was discussed at length in Vol. 4, No. 1 of the *ACES Newsletter*). Then, between December 1989 and April 1990, we incurred additional expenses: the loss of free postage, support to CAEME, a shortfall in short course income, and incorporation expenses. Even prior to April 1990, an impact on the ACES publications became imminent.

To maintain financial reserves in the face of these recent developments, cost-savings measures were imposed. These measures included an *ACES Journal* publication cutback (from 2 issues to 1 issue/year, but with the same total number of pages), an *ACES Newsletter* publication cutback (from 4 to 3 issues/year), and new restrictions regarding *ACES Journal* Special Issues. It was found that reducing the number of publications issues would have the desired cost-saving effect, even if the total number of published pages remained constant.

In spite of these developments, the ACES Board of Directors (formerly, the ACES ADCOM) determined at its 10 May meeting that we can maintain two *ACES Journal* issues for 1990. For several reasons, I am pleased to report this decision. First, with the *ACES Journal* moving into pre-eminence, a cutback to 1 issue/year can only be counterproductive. Moreover, a cutback would perturb our publishing schedule, which is only now approaching regularity. Notwithstanding our recent arrangements with INSPEC, some of the abstracting services do not look favorably upon deviations or irregularities in publishing schedules. Of even greater significance is the need to maintain "rapid turnaround" of papers from initial submission to final publication. No *ACES Journal* author has ever waited 12 months or longer for an acceptable paper to be published. If we are to continue attracting quality papers, it is necessary that we remain responsive to the needs of authors.

Equally pleased with the recent decisions will be many of our 1990 ACES Symposium attendees, who — in response to a questionnaire — selected the *ACES Journal* publication cutback as the least-desirable cost-saving measure. The *ACES Journal* authors and editors are honored by this vote of confidence, but indirectly, the vote also demonstrates a need for additional activities and services. (If an *ACES Journal* publication cutback is ever re-imposed, we need activities and services, other than our publications and symposia, which we can offer to members and to prospective members. Even in the absence of such a cutback, there are other advantages to "flying on all engines").

The remaining publications-related cost-savings provisions remain in effect and have my full support. In the immediate future, we shall publish three *ACES Newsletter* issues/year, and

each *ACES Journal* special issue will be published in one of three ways: as a special section of a regular issue, in place of a regular issue, or as an optional purchase publication not included in the membership dues. In each case, the mode of publication will be determined by a number of factors, to include the preferences of the respective Guest Editor.

As we seek a balance between cost-savings measure and the maintenance of essential activities and services, we face another challenge of a very different nature. Applied Computational Electromagnetics is not a sub-discipline with long-established standards of publication, and with ACES rests the responsibility to establish and maintain such standards. Therefore, in the near future your Editors will be re-examining and refining the standards of publication for the *ACES Journal*. Inasmuch as our existing standards have served us well — and also because of our highly thorough review process (in which each paper is reviewed in depth by three Editors, representing at least two nations, and also by the Editor in Chief) — we do not anticipate major changes in the types of papers which we publish. Instead, the primary impacts of our efforts will be a more simplified (but nonetheless thorough) review process, fewer needed revisions in papers, and an improved general understanding of our editorial policies. A well-defined set of standards available not only to Editors but also to authors and readers will make these things possible.

Not yet defined, however, are the standards for selecting Best (*ACES Journal*) Paper Award recipients. In the absence of such standards, a fair selection procedure cannot be guaranteed. For this reason, I cancelled our recent plans to present Best Paper Awards, including retroactive awards for previous years. Later this year, we plan to re-examine the viability of Best Paper Awards and formulate the necessary standards; however, we shall defer these actions until we complete the re-examination/refinement of our standards of publication. At that time, we shall also consider establishing a similar award for authors of *ACES Newsletter* articles.

The *ACES Newsletter* is launching its own ambitious projects. One of these projects, a code-indexing service for *ACES Journal* papers and *ACES Newsletter* articles, begins with the present issue. In addition, the *ACES Newsletter* will compile a running bibliography of measured data appropriate for code validation. Details are found elsewhere in this issue, and the success of this effort depends on ACES member support.

Projects such as these help guarantee that the ACES publications meet tomorrow's needs — today.

David E. Stein
Editor-in-Chief

COMMITTEE ON ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

The committee held its first meeting during the 6th Annual Review of Progress of ACES. Ten hardy souls met for about two hours. Those attending brought to the party a broad spectrum of experiences and interests. Present were EM and AI "Experts" as well as developers and users. It shouldn't be surprising to find out that there was no consensus of opinion of how this committee should be functioning nor what it should be doing. It is clear that the committee should continue to exist. There are some real needs and possibly even some solutions that should be addressed.

The specific committee activities now underway include collection and publishing a list of activities where "intelligence" is being added to EM codes. Let me know of your activities and I will publish them here.

A list of those expressing interest in this subject is included below. Let me know if you want your name added to the list.

It appears the best we can do now is to encourage work in this area of adding intelligence to EM codes.

ACES Committee on Artificial Intelligence and Expert Systems
(Names from the 6th Annual Review at Monterey, CA)

NAME	ADDRESS, ORGANIZATION, ETC.
1. Wayne Harader	Ball Comm. Broomfield, CO. 303-460-2289
2. Joan Dornfest	LMSC, San Jose, CA.
3. Oxena Turetsky	Locus/NRL, Washington, DC. 703-960-1000
4. S. T. Li	NOSC, San Diego, CA. 619-553-5089
5. J. W. Rockway	NOSC, San Diego, CA 619 553-5688.
6. Jim Logan	NOSC, San Diego, CA. 619-553-3780
7. J. Holtzman	Univ. of Kansas, Lawrence, KS. 913-864-7759
8. C. Tsatsoulis	Univ, of Kansas, Lawrence, KS. 913-864-7749
9. E. K. Miller	LANL, Los Alamos, NM. 505-667-4316
10. Kenn Atkinson	Locus/NRL, Warrenton, VA. 703-347-5716
11. Lt. J. M. Jorgensen	Naval Postgraduate School, Monterey, CA.
12. Andy Jansons	P.Q. Research, Los Gatos, CA. 408-354-9645
13. Frank E. Walker	Boeing, Seattle, WA. 206-564-3840
14. Christopher Smith	Kaman Sciences Corp. Colorado Springs, CO.
15. Mark Gross	Kaman Sciences Corp. Utica, N.Y.

Wayne Harader
Chairman, AI and Expert System Committee

OTHER COMMITTEE REPORTS

Next issue we hope to include reports from the following committees:

Software Exchange	European Committee
Constitution and Bylaws	Meetings Committee
Awards	Long Range Planning (Technical Activities)
Historical	Software Performance Standards

BIBLIOGRAPHY OF MEASURED ELECTROMAGNETICS DATA

In support of present code validation efforts and requirements, the ACES Newsletter is compiling a bibliography of measured electromagnetics data. For an example of what we need, see Jim Logan's contribution to Ed Miller's recent committee report (ACES Newsletter, vol. 5, no. 1, March 1990, pp. 14-15).

Only with your support can this bibliography be compiled. Therefore, if you know of any measured data which would be useful to other ACES members, please send the appropriate bibliographic information to:

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Editor, *ACES Newsletter*
ARCO Power Technologies, Inc.
1250 24th St. NW, Suite 850
Washington, D.C. 20037, USA

Our interests include all areas of electromagnetics and are not limited to radiation, propagation, and scattering, propopagation, and scattering.

USER'S GROUPS

The process of forming code users groups for ACES members has been underway since December of last year. It began with a mailing to all members requesting the return of a form indicating response. Since then, 40 members have returned those forms, and a database of all responses has been created.

The diversity of responses was seen at a meeting of interested members held during the recent 6th Annual Review held in Monterey last March. Though originally intended as separate users groups for each code, one group formed spontaneously and elected to become the Moment Method Code Users Group. At least initially, this group will support NEC 2 and 3 (and variants), MININEC3, and even GEMACS (though this code implements other methods as well). If the group grows in membership, it may split into smaller groups.

A volunteer was solicited to chair the group, and Russ Taylor (c/o McDonnell Douglas Helicopters 530/B335, 5000 E. McDowell, Mesa, AZ 80205, tel. 602-891-5539) agreed to the task. A copy of the database will soon be sent to him to assist his efforts.

A second group also formed with interests in high frequency methods such as GTD. Indeed, Ron Marhefka was present and offered his cooperation as the code developer of NEC-BSC. In the interim, Chris Smith (c/o Kaman Sciences Corp., P.O. Box 7463, Colorado Springs, Co. 80933, tel. 719-599-1406 will chair the group.

The respondents mentioned a wide range of codes and techniques, and all will be retained for consideration as member response dictates. For the time, getting the two groups which formed at the *Review* on a sound footing is top priority. All respondents should receive a letter describing the next steps which will be undertaken in the next month.

If either of the two users groups mentioned above would serve your interest and you haven't yet responded, please get in touch with the chairman. Of course, help with the work load will always be appreciated.

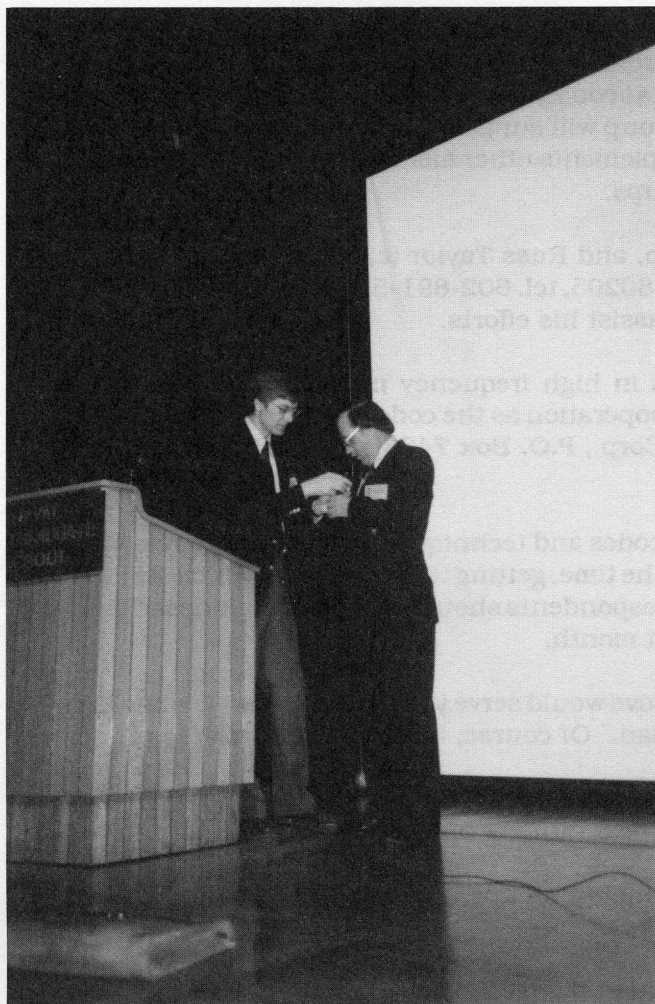
We anticipate that such code user groups will provide a number of benefits to the user:

- * Communications from the code developers (including upgrades, updates, and bug reports) will be sent to all user group members.
- * Bug reports (and "work-arounds"), as submitted by user group members, will be verified. A concise description of verified bugs will be sent to other user group members. Also, code developers will be notified of bugs, so that they can solicit fixes.
- * Users can share their code applications experiences. Typical problems with solutions will be solicited, collected, and published.
- * Beginner's tutorials will be offered as needed. Users with limited experience will have access to experienced users when they need help.
- * User-developed code modifications will be published when sent in. In addition, they will be provided to the developer, who may choose to incorporate them or at least comment on them. (Neither ACES nor the developers will be obligated to support user modifications).

Some of these benefits are contingent upon the cooperation of the respective code developers (and will vary from code to code), whereas other benefits can be provided independently. We shall seek full cooperation between the developers and ACES, so that we can serve developers and users alike.

Chris Smith
Chairman, Users Groups

SCENES FROM 6TH ANNUAL REVIEW



(1) SCOTT RAY PREPARES

JIM LOGAN FOR
"STATE OF UNION" ADDRESS



(2) MAGDY ISKANDER

DESCRIBES

"CAEME" PROGRESS

(Photos by Chris Trueman)



(3) ED MILLER EXPOUNDS TO CAPTIVE AUDIENCE

(STAN KUBINA, BILL STUART, ED MILLER)

(8) JIM LOGAN RECEIVES ACEES AWARD FOR LEADERSHIP IN
COMPUTATIONAL ELECTROMAGNETICS FROM ED MILLER

(Photos by Chris Treiman)



(4) JIM LOGAN HANDS OVER "RED FILE" TO STAN KUBINA; HAL SABBAGH APPLAUDS



(5) JIM LOGAN RECEIVES ACES AWARD FOR LEADERSHIP IN COMPUTATIONAL ELECTROMAGNETICS FROM ED MILLER

(Photos by Chris Trueman)

ELECTROMAGNETICS CODE CONSORTIUM RCS CODE SURVEY

The Electromagnetics Code Consortium was formed in 1987 to consolidate and minimize duplication of effort in radar cross section (RCS) computer code development by the U.S. Government and to ensure that results are commensurate with expenditures. An exhaustive survey of existing RCS codes in use in industry and academia was conducted in late 1989 and a detailed report written. The report is available through WRDC/SNA, Wright-Patterson AFB, OH, 45433 Attn: Mr. Joseph C. Faison. The two tables below are a replication of the summary chart of the government report. The tables are a "quick-look" reference of the state-of-the-art in RCS computational capabilities. The tables also appear in an article by Mr. Faison in the February IEEE Antennas and Propagation Magazine and are republished with permission.

In addition to completing the survey mentioned above the Electromagnetics Code Consortium has also acquired a geometry input code for use with RCS codes, and has selected a support contractor to provide documentation, validation, and user assistance. Currently the Consortium activities include establishing canonical benchmarking criteria for code validation, determining standards for programming and documentation, defining a technology roadmap for future RCS code requirements, and obtaining long-term funding.

Table 1a - Code Summary

Technique PEC ⁽¹⁾	Materials	Geometry	Large Surfaces	Internal	Waves	Irregularities
(Y=yes)	Bulk		B N	Inlets	Surface	Cracks
(N=no)	Layered		O A	Ducts	Traveling	Gaps
	Anisotrop		R S	Cavities	Creeping	Discont.
1D 2D 3D	1D 2D 3D		(2) (3)			
Low Freq.						
MoM Y Y Y	L L N	Facets & Surfaces	Y N	I	S,T,C	C,G,D
K-Space Y Y Y	B B N	Facets	Y Y	N	S,T,C	C,G,D
FDTD/ Y Y N	L L N	Facets & Surf.(?)	Y Y	I	S,T,C	C,G,D
FDTD						
High Frequency						
GO/GTD Y Y Y	L L N	Surf(GTD)	Y Y	I	S,T,C	C,G,D
PO/PTD Y Y Y	L L L	Facets	Y Y	I, C	N	N
MISC.						
Hybrid Y Y Y	L L N	Facets	Y N	I	S,T,C	C,G,D
HF & LF						
FEFD Y Y Y	L L N	Facets	Y Y	I, C	S,T,C	C,G,D
CEM Y Y Y	L L N	Surfaces	Y Y	I	S,T,C	C,G,D

Notes: 1. PEC = Perfect Electrical Conductor; 2. BOR = Body of Revolution; 3. NAS = Non-Axisymmetric Body.

Table 1b - Code Summary (cont.)

Technique	State of the Art	Limitations	Needed Advances
Method of Moments	Theory (both LF & HF) mature, hardware is limiting factor, 2D & 3D codes exist which can calculate both monostatic & bistatic RCS of large coated bodies for a variety of polarizations (V,H, XPOL)	Ducts & cavities require higher processing speeds & more memory. 10 sq wavelengths for PEC, 1-2 sq wavelengths for coated bodies require supercomputers.	Higher computer speeds & more memory. T-matrix, CGM & LU decomposition schemes need to be implemented.
K-Space	Technique & theory well developed. Application to special problems only.	Accuracy & speed of FFT calculation. No general 3D geometry solutions.	Higher computer speeds. Validation of codes.
FDTD/FDFD	Theory mature, implementation for realistic problems is lacking. Far field dependent upon target volume.	Computer word size & speed (accuracy vs. speed tradeoff). Definition of useful far field criteria.	Higher computer speeds & longer word lengths.
GO/GTD	Well-developed surface normals & tangents not incorporated into geometry. Used for diagnostic tool, e.g., ray tracing through ducts for location of RCS hot spots.	Wavelengths much less than target size, calculations around boundaries (shadow & diffraction), materials off normal incidence, surface geometry description.	More realistic shapes & use of realistic materials. Applications to full -size vehicles.
PO/PTD	C,G,D & I,C can be handled using special software codes.	Wavelengths much less than target size, limited ability to handle treated surfaces. Does not account for shadowing, diffraction, multiple interactions between surfaces & creeping/traveling waves.	Use of realistic materials, better use of surface features & near-field calculations.
Hybrid (HF & LF)	Theory integrating HF & LF methods not well developed & verified.	Development of boundary between HF & LF needs more study.	Surface described by structures between HF & LF regions, unstructured grid geometry to have ability to provide better details of sharper edges and corners & also provide a broader bandwidth matrix for models. Code Validation
FEFD	Theory mature but implementation is functional & needs to be optimized. Little validation of codes.	1000-3000 cubic wavelength body sizes on CRAY XMP/11. Limited validation.	Optimization algorithms, local vs. global body-fitted geometry system. Validation of codes.
CEM	Development of algorithm & implementation are immature. Geometry definition for general 3D case not implemented.	Full 3D development & validation.	Full development of algorithms & geometry. Validation of code.

PORTING NEC-2 TO 386 PCs

Tom Wallace
ARCO Power Technologies, Inc.
Washington, D.C. 20037

The low cost and high numeric performance of 386 PCs make them an attractive platform for applications which formerly required minis or mainframes, including NEC. Recently, NEC-2 has been ported to 386 PCs using a Phar-Lap DOS extender. This DOS extender allows the use of the full 32-bit 386 instruction set, up to 16 megabytes of physical (core) memory, and provides virtual memory if more memory is needed. The execution speed of the 386 NEC-2, running on a 20 MHz 386 with a Weitek 1167 numeric coprocessor, is roughly triple that of the Macintosh II version of NEC-2, and about twice that of a VAX 11/780.

The porting process began with the Macintosh II version of the NEC-2 double precision source code obtained from Gerry Burke of Lawrence Livermore Labs. Gerry's Mac II version had already been cleaned of many of the VAX-specific features as described by him in the June 1989 Newsletter. The source was transferred to the PC and compiled using MicroWay NDP Fortran. The process was straightforward, although several additional VAXisms had to be changed before the code would compile properly, including the removal of the Q-edit descriptor and rewriting of the timing functions. In addition, the assignment of Hollerith character constants to numeric variables (a Fortran 66 practice which generates warning messages on Fortran 77 compilers) was modified to use character variables instead.

The completed NEC-2D double precision port can run problems of up to 400 segments in core on a PC with 4 megabytes, and over 900 segments in core on a 16 megabyte machine. A 400 segment problem with no symmetry requires 15 minutes, and a 900 segment problem without symmetry takes roughly 2.5 hours. For more than 900 segments the DOS extender used by NDP Fortran, Phar-Lap's RUN386, has a virtual memory option which can provide additional memory by paging to disk, at the cost of execution speed. However, we have not investigated whether the use of the hardware virtual memory of the 386 is more efficient than NEC's own out-of-core solution method. Since PC memory costs roughly \$100 per megabyte, it is more cost effective to install more memory than to tolerate several hours of additional runtime.

The NDP Fortran compiler was chosen because it had been used for several other large programs with good results. There are several other 32-bit Fortran compilers for the PC, and the porting process should be similar for all of them. We highly recommend those compilers which support the Weitek coprocessors, which provide a factor of 2-3 increase in numeric speed over the 387. For problems which are still too large to run on a 386 with 16 megabytes, there are several new 486 machines available which have core memory capacities of 32-64 megabytes. The 486 with its companion Weitek coprocessor, the 4167, should also provide a factor of 2-4 speed increase over the current 386 version.

RENDEZVOUS WITH A COMPUTER SCIENTIST

Methods of Software Validation

Virginia Stover

In the last issue I discussed some of the problems with testing software. Many tests are needed to adequately "cover" the code. It is not easy to choose input values that will cause selected paths to be executed and that will reveal faults along these paths. It can be difficult to measure the effectiveness of the testing effort. Testing alone cannot determine when all the errors have been found.

Yet, testing remains the primary means for validating software. The time programmers spend detecting and correcting errors can exceed the time they spend writing the program in the first place. Programs are released, not when they are known to be correct, but when the rate of error-detection falls below some predetermined level. Unlike most products, software rarely comes with a warranty. We expect programs to contain errors.

Surely there is a better approach. After all, a computer program is fundamentally a mathematical object. It is a formal representation of a mathematical algorithm, subject to logic and calculation. It should be possible to prove the correctness of a program in the same sense that we prove the correctness of a mathematical theorem, that is, through the application of logical rules of inference to a valid set of axioms.

Computer programming is an exact science in that all the properties of a program and all the consequences of executing it can, in principle, be found out from the text of the program itself by means of deductive reasoning.

C.A.R. Hoare

Proofs of Correctness

One system for proving the correctness of programs was introduced by Floyd in 1967 and later refined by Hoare. Hoare's system is based on input and output assertions. An assertion is a statement describing the properties of and relationships between program variables. An input assertion describes the relationships that are assumed to be true at the beginning of a group of statements. An output assertion describes the conditions that should be satisfied after those statements are executed. Hoare's system includes a set of programming axioms, one for each type of programming construct. Axioms are expressed in the form

$$\{P\} \text{ statement - list } \{Q\}$$

which states that if assertion P is true, and the statements in the list are executed, then assertion Q will be true when execution terminates.

For example, the axiom for an assignment statement of the form $V = E$ is

$$\{P [E/V]\} \quad V=E \quad \{P\}$$

where $P[E/V]$ stands for a version of the assertion P in which each occurrence of the variable V is replaced by the expression E . To illustrate this axiom, apply it to the following formula

$$\{B+C+D=5\} \quad A=B+C \quad \{A+D=5\}.$$

which states that if $\{B+C+D=5\}$ is true, and the assignment statement $A=B+C$ is executed, then $\{A+D=5\}$ should be true. Notice that if each occurrence of A in the output assertion is replaced by $B+C$, the input assertion is obtained. Thus, the correctness of the formula follows directly from the axiom.

In addition to a set of axioms, Hoare defined a set of inference rules. An example is the composition rule

$$\begin{array}{l} \text{if } \{P\} S_1 \{Q\} \\ \text{and } \{Q\} S_2 \{R\}, \\ \text{then } \{P\} S_1; S_2 \{R\} \end{array}$$

which says that input and output assertions for a sequence of statements can be derived from a series of input and output assertions for each separate statement.

To illustrate how assertions and axioms are used to prove the correctness of a program, consider a program for performing integer division by repeated subtraction.

```

q = 0;
r = x;
while (r >= y) loop
    r = r - y;
    q = q + 1;
end loop;

```

This program fragment computes the quotient q and remainder r when a non-negative integer x is divided by a positive integer y . That is, it computes integers q and r such that $x = q*y + r$ where $0 \leq r < y$.

The input assertion for this program is

$$\{x \geq 0 \text{ and } y > 0\}.$$

We wish to prove the following output assertion

$$\{x = q*y + r \text{ and } (0 \leq r \text{ and } r < y)\}.$$

The output assertion is proved by interleaving the programming statements with intermediate assertions as shown below.

```

{ (x >= 0) and (y > 0) } (input assertion)
q = 0;
{ (x >= 0) and (y > 0) and (q = 0) }
r = x;
{ (x >= 0) and (y > 0) and (q = 0) and (r = x) } =>
{ (x = q*y + r) and (r >= 0) }
while (r >= y) loop
    { (x = q*y + r) and (r >= 0) and (r >= y) } =>
    { (x = (q+1)*y + (r-y)) and (r-y >= 0) }
    r = r - y;
    { (x = (q+1)*y + r) and (r >= 0) } =>
    q = q + 1;
    { (x = q*y + r) and (r >= 0) } =>
end;
{ (x = q*y + r) and (r >= 0) and (r < y) } (output assertion)

```

Most of the intermediate assertions are derivable from the previous assertion and the assignment axiom. Reasoning about the while loop is a little harder since we don't know how many times the loop will be iterated. However, by using the assignment axiom twice we can show that if $\{(x = q*y + r) \text{ and } (r >= 0) \text{ and } (r >= y)\}$ is true, and the two statements inside the loop are executed, then $\{(x = q*y + r) \text{ and } (r >= 0)\}$ will still be true. Thus, the assertion $\{(x = q*y + r) \text{ and } (r >= 0)\}$ is true before every iteration of the loop and when the loop terminates *no matter how many times the loop is executed*. Such an assertion is called a "loop invariant". Since the loop continues as long as $r \geq y$, we can also assert that $r < y$ is true if and when the loop terminates.

This argument about the while loop is reflected in the axiom for a loop of the form **while (B) loop S end loop** which is as follows:

if {P and B} S {P},
then {P} **while (B) loop S end loop** {P and not B}.

The first part of this axiom establishes that P is an invariant for this loop. The second part states that if {P} is true before the loop is executed, then {P and not B} will be true if and when the loop terminates. This completes that proof of the correctness of the program.

When the correctness of a program, its compiler, and the hardware of the computer have all been established with mathematical certainty, it will be possible to place great reliance on the results of the program, and predict their properties with a confidence limited only by the reliability of the electronics.

C.A.R. Hoare

Hoare's system provides a logical foundation for proving certain properties of computer programs. Yet, even if a program has been proved to be "correct", it can still fail for several reasons:

1. Proving the correctness of a program is difficult and tedious. The proof is usually longer than the program itself. It is not unusual for a single program assertion to span a page or more in length. The mathematical expressions in program assertions can be even harder to understand than the program itself. Proofs of correctness are, therefore, prone to human errors in deriving the proof and in checking its correctness. Errors, of course, also occur in mathematics, even in papers published in refereed journals. The most reliable proofs, however, are small and simple, whereas program proofs tend to be long and complex.
2. Even if the program is formally verified, it may not perform correctly because of errors in the compiler, operating system, firmware, or hardware.
3. The proof given above does not prove that the program ever halts. It also does not address such machine-dependent issues as overflow, underflow, round-off error, and finite memory size. These important issues can be addressed in proofs of correctness, but, except for program termination, they are typically omitted because of the added complexity.
4. Actually such a proof does not really prove the *correctness* of a program. It proves the *equivalence* of the program with some other formal representation of the program (its specifications). If the specifications are incorrect or incomplete, then the program may not do what we want it to do.

Logic is the art of going wrong with confidence.

Joseph Wood Krutch

Some of these difficulties can be met by automated verification tools. Automated program provers, for example, mechanically generate assertions and verify the consistency between the code and the assertions. They help to reduce the errors and tedium that arise from manual methods. Unfortunately, they will never be able to completely automate the verification of programs. In fact, it is theoretically impossible to build any general-purpose verification procedure using testing or other methods to prove the correctness of a program. This follows from the impossibility of constructing a general method for determining whether two programs are equivalent (i.e., they produce the same output given the same input).

(Caution! This paragraph contains a proof. Those with an allergy to proofs may want to skip to the following paragraph.) To understand why no procedure can, in general, decide if two

programs are equivalent, suppose there were a program E which, given two programs p_1 and p_2 , $E(p_1, p_2) = \text{true}$ if and only if p_1 is equivalent to p_2 . If E exists, then we can construct another program H as follows:

$H(p_1, p_2)$:

if $E(E, H) = \text{true}$ then return $\text{not}(E(p_1, p_2))$ else return $E(p_1, p_2)$

A little analysis shows that H cannot exist. Consider whether E is equivalent to H. If E and H are equivalent, then $E(E, H) = \text{true}$, so, for any two programs p_1 and p_2 , $H(p_1, p_2)$ returns the *opposite* of $E(p_1, p_2)$. But if E and H are equivalent, they should return the *same value*. Therefore, E and H cannot be equivalent. Thus, $E(E, H) = \text{false}$, and $H(p_1, p_2)$ returns the *same value* as $E(p_1, p_2)$. Since E and H always return the same value, they are equivalent. This is a contradiction, proving that H, and hence E, cannot exist.

Despite their complexity, formal methods of verification do play an important role. The methodology forces programmers to think in more precise terms. This results in more reliable software. Formal proofs of correctness have been used to verify highly critical parts of some software systems such as the life-support system aboard a spacecraft or the security kernel of an operating system. Formal proofs of correctness will probably play an increasing role as we rely more on software in high-risk areas.

Dynamic Assertions

It may not be cost-effective to construct proofs of correctness for every software application. A much easier, but related method is that of "dynamic assertions". Dynamic assertions are assertions that are embedded in the program to be evaluated at *run-time*. If the assertion is evaluated as false during execution, an error message alerts the programmer that there is a fault in the program. In the example above, the expression

$$\{(x=q*y+r) \text{ and } (r \geq 0) \text{ and } (r < y)\}$$

should be evaluated at the end of the program to check that the quotient and remainder were computed correctly. Dynamic assertions are either executable statements embedded in the source code or are statements that are translatable through a pre-processor into executable statements. They should be inserted at critical places in a program, such as the beginning and end of embedded functions and inside loops. The goal is to provide a sufficient set of assertions, so that if no error messages are encountered, we can assume that the program is functioning properly.

Dynamic assertions have several advantages over normal testing techniques. Dynamic assertions describe states of the program that are invariant with respect to the program's input. They can test values of variables at intermediate stages of program execution. They are tested every time the code is run. They help to ensure that code updates do not introduce new errors. And they provide precise program documentation.

Symbolic Execution

Whereas testing examines the effect of one input sequence at a time, a proof of correctness considers all program inputs at once. This is the motivation for the method of symbolic execution. In symbolic execution, the program is tested over symbolic, rather than actual values thus producing algebraic expressions as output. For example, an assignment statement is "executed" by assigning the symbolic value of the expression on the right hand side of the assignment operator to the variable on the left hand side. Of course, the actual output may depend on the particular path traversed through the program. Therefore, boolean expressions called "path predicates" are constructed from the decisions taken along each path. An expression simplifier simplifies the intermediate algebraic expressions corresponding to symbolic output and path predicates. Finally, symbolic output values for each path are compared directly to the program specifications to verify their correctness.

For example, consider the following program fragment.

```

read (A, B);
C = A + B;
D = C + 1;
if (A > 0) then
    E = D + A
elseif (A < 0) then
    E = D - B
else
    E = D
end if;

```

If we give the variables A and B the symbolic values A and B, respectively, then the computed symbolic values and path predicates (after simplification) are as shown below.

	path predicates	symbolic values
read (A, B);	true	C = A + B
C = A + B;	true	D = A + B + 1
D = C + 1;		
if (A > 0) then	A > 0	E = 2 * A + B + 1
E = D + A		
elseif (A < 0) then	A < 0	E = A + 1
E = D - B		
else	A = 0	E = B + 1
E = D		
end if;		

Notice that the path predicate for the else clause, not (A>0) and not (A<0), simplifies to A = 0, and the symbolic value of E corresponding to this path, A + B + 1, simplifies to B + 1.

Consider the following program fragment that finds the sum of the first N elements of array A.

```

S = 0;
I = 1;
while (I <= N) loop
    S = S + A[I];
    I = I + 1;
end loop;
return (S);

```

The number of loop iterations depends on the value of N. Thus, there is a separate path for each value of N. The table below shows the symbolic values of I and S for the path predicates N = 1, N = 2, and N = 3.

	symbolic values		
	N = 1	N = 2	N = 3
S = 0;	S=0		
I = 1;	I=1		
while (I <= N) loop		I=2, S=A ₁	I=3, S=A ₁ +A ₂
S = S + A[I];	S=A ₁	S=A ₁ +A ₂	S=A ₁ +A ₂ +A ₃
I = I + 1;	I=2	I=3	I=4
end loop;			
return (S);	ret A ₁	ret A ₁ +A ₂	ret A ₁ +A ₂ +A ₃

Notice that at the beginning of each iteration of the loop and when the loop terminates, S can be described in symbolic form as $A_1 + A_2 + \dots + A_{I-1}$, which is a loop invariant. When the loop terminates, I has the value $N+1$, so $S = A_1 + A_2 + \dots + A_N$, as desired.

Symbolic execution can be performed using automated tools. A necessary capability of such a tool is the ability to simplify the intermediate algebraic and boolean expressions. This may involve solving systems of equations and inequalities. No automated tool will ever be able to completely simplify all expressions, even with a complete knowledge of mathematics, since in general, non-linear equations and inequalities cannot be solved algebraically. There are also more practical limitations. One limitation is the symbolic execution of loops. Another involves the evaluation of dynamic array subscripts and pointer variables, as in the following example.

```
for I = 1, 10 loop
  A[I] = 0;
end loop;
read (J);
A[J] = 2;
return (A[1]);
```

What is the value of $A[1]$ after these statements are executed? Is its value 0 or 2? The memory reference, $A[J]$, cannot be evaluated symbolically since the value of J will be unknown until run-time.

Symbolic execution can be used as a tool in other types of testing and analysis. Path predicates can be used to describe the conditions that must be met to force the execution of a particular path in control-flow or data-flow testing. Likewise, path predicates that evaluate to false indicate infeasible paths. Symbolic expressions can be used to derive invariant assertions used in proofs of correctness. By combining symbolic and actual data, the effect of changing the values of selected variables can be analyzed.

Code Reading

A much simpler verification method, requiring no automated tools, is code reading. Code reading is an in-depth examination of a small piece of code. It can take the form of a formal "inspection" or an informal "walkthrough". Usually one person steps through the code for one or more reviewers. The reviewers look for such errors as uninitialized or unused variables, unreachable code, infinite loops, array subscripts out of bounds, mismatches between formal and actual parameters, improper type conversions, improperly handled exception conditions, and departures from coding or documentation standards.

The purpose of code reading is to increase reliability and reduce testing time. Unlike testing, which corrects errors one by one, code reading can correct many defects at one reading. Studies show that code reading can be from 2 to 10 times more efficient at removing errors than testing. Typically, walkthroughs and inspections reveal 70 percent or more of all errors and require less effort to discover each error. Moreover, code reading can be done at an early stage of software development. That is, it can be applied to requirements, specifications, designs, and test plans as well as to actual code. This is important since defects discovered earlier in the software life cycle cost significantly less to fix.

Automated "static analysis" tools, including compilers and linkers, can check for many of the errors listed above. Yet, they have some of the same practical and theoretical limitations as other automated verification tools. For example, it is impossible to construct a general-purpose procedure that will determine, given an arbitrary program P , whether P will halt for all input (i.e., does not get caught in an infinite loop).

Implications

Matsch's Law:

It is better to have a horrible ending
than have horrors without end.

Proofs of correctness, dynamic assertions, symbolic execution, and code reading can all be used to increase software reliability. Yet we are a long way from knowing how to build reliable software. This is an argument against the Strategic Defense Initiative (SDI) or "Star Wars". SDI is a ballistic defense system intended to make nuclear weapons "impotent and obsolete". A 1985 DoD-sponsored report from the Eastport Study Group states that the major problem in implementing SDI will be the software.

The SDI software will be the largest, most complex system ever built - an estimated *6-10 million lines of code* running over a distributed network with hard real-time constraints. A good example of the problems with large, complex systems is provided by the space shuttle. The shuttle attempts to achieve reliability through redundancy. It uses four redundant avionics computers running the same software, and a fifth back-up computer running different software. Despite this redundancy, there was a software failure during the shuttle's first launch. A software modification to correct a timing problem caused the computers to become unsynchronized. Notice that this problem arose during maintenance to fix an existing problem. Furthermore, this problem arose because of the complexity introduced by redundant systems *designed specifically to enhance reliability*.

Besides the size and complexity of SDI, it has other serious problems. The software must be written from incomplete specifications since we have no complete knowledge of the characteristics of enemy weapons, delivery vehicles, targets, tactics, and countermeasures. Constant updates in response to new Soviet threats must be made to a space-based system in operation. It will be impossible to conduct extensive testing under realistic battle conditions. The time between detecting a launch and responding with an attack will be too short (about 90 seconds) to allow for more than minimal human intervention. Yet, this system must work reliably in the hostile environment of a limited or protracted nuclear war *the very first time*. In addition, any accidental activation of the system during a time of crisis could be disastrous.

David Parnas, a prominent software engineer, was a member of the Panel on Computing in Support of Battle Management convened by the SDI Organization. He resigned in 1985 because he believed that the Star Wars effort would not achieve its stated goals. He argues that even if such a system could be built, our confidence in it would be so low, that we could not afford to abandon our nuclear deterrent. The same arguments can be applied to many other large, complex, life-critical software systems that allow little opportunity for human intervention.

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UPDATE ON PLOTTING SOFTWARE PACKAGES

Paul Elliot

The last issue of the ACES Newsletter included a list of Plotting Software Packages with a few comments on some of them. Recently I somewhat randomly chose EasyPlot from the list to purchase (\$299 from Spiral Software, 6 Perry St., Suite 2, Brookline, MA 02146). I have personally found it much more useful than Graphic C or Harvard Graphics. It is a menu-driven stand-alone plotting package (no programming required), as opposed to Graphic C and some other plotting packages which consist of FORTRAN or C-callable subroutines which you use to program your plotting software. I prefer the stand alone plotting packages since they require no programming. It was easy to get started with since I was plotting useful data within about 1/2 hour. Some of the extra features take longer to learn. The technical support was excellent both times I called (with questions that were actually answered in the manual had I read more of it). Multiple data files and/or multiple columns of data can be input. Short equations can be typed in and will appear plotted on the screen. Data may also be graphically analyzed (FFT, curve fit, etc). Plots are drawn to the screen almost instantly (on a 386) but to print a hardcopy of the plot ties up the computer for about a minute or longer. Contour and 3D mesh plots of xyz data can be made but the x and y increments between data points must be equal. The next release may allow unevenly spaced x and y data points for the contour and 3D plots. If anyone has used any other plotting software feel free to send in your impressions.

Prof. Duncan Baker of the University of Pretoria, South Africa wrote and informed me of some PC plotting packages which I was not aware of and therefore were not included in last Newsletter's list:

1. PLOTS88 (Plotworks Inc., 16440 Eagles Crest Rd, Ramona, CA. 92065-9674. Cost is \$299 to \$399 depending on compiler you use it with). Prof. Baker has tried PLOT88 and found it quite useful. PLOT88 consists of FORTRAN or C callable plotting routines. It provides contour and 3D mesh capabilities and some beautiful sample plots are available from the vendor. Screen plots and a host of output devices are supported as well as several compilers. According to Plotworks the American Institute of Physics Manual (\$7.) has some interesting information on plotting.
2. TempleGraph (\$395, Mihalisin Assoc., 600 Honey Run Rd., Amber, PA 19002 (215)646-3814). TempleGraph was reviewed in the Jan. 1989 IEEE Spectrum magazine. 2D linear xy, semilog, log-log, polar, and bar graphs are available. 3D or contour plots are not mentioned in the ad or review. Technical help was good. The reviewer recommends it strongly over Graph or Sigma-Plot. It will graphically analyze your data and graph math functions.
3. PLOTZ Graphics (\$350 from Curtis Technical Software Corp., PO Box 178, Pennington, NJ 08534 (609)737-8844). Also does data analysis. An unusual capability offered is digitizer input which uses plotter as an XY digitizer. No mention of or pictures of 3D or contour plots in ad.
4. Sigma-Plot (Jandel Scientific, Sausalito, CA). Offers Greek and math symbols, curve-fitting.

INDEX OF COMPUTER CODES FOR VOLUMES 1-4 OF THE ACES JOURNAL AND THE ACES NEWSLETTER

A comprehensive index, to include computational electromagnetics techniques and applications, is planned for the *ACES Journal* and the *ACES Newsletter*. As a first step in compiling this comprehensive index, we offer the following index of computer codes as discussed in *ACES Journal* papers and in *ACES Newsletter* articles. This computer code index will be updated annually.

Computer Codes

Legend:

AJ	<i>ACES Journal</i>
AN	<i>ACES Newsletter</i>
AJN	<i>ACES Journal and Newsletter</i> (a combined publication for volumes 1, 2, and 3)
SI-ECCV	<i>Aces Journal Special Issue on Electromagnetics Computer Code Validation</i> (published in 1989)
*	Pre- or post-processor for another computational electromagnetics code
page #	The <u>first page of each paper or article</u> in which the indicated code is discussed.

NOTE: The inclusion of any computer code in this index does not guarantee that the code is available to the general ACES membership.

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* NECPLOT	AN Vol. 4, No. 1	p. 18
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ADVERTISEMENTS

THE APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY

is currently accepting

ADVERTISEMENTS FOR THE ACES NEWSLETTER

Paid advertisements that may be of interest to the ACES membership are:

Computer Software	Publications
Employment Opportunities	Short Courses

The rates are:	Full page	\$200.	7.5" x 10.0"
	1/2 page	\$100.	7.5" x 4.7" or
			3.5" x 10.0"
	1/4 page	\$ 50.	3.5" x 4.7"

All ads must be camera ready copy.

Ad deadlines are same as Newsletter copy deadlines.

To place an ad, contact Paul Elliot, Newsletter Editor, ARCO, 1250 24th St. NW, Suite 850, Washington, D.C. 20037 USA. (202)223-8808. The editor reserves the right to reject ads.

BYLAWS OF THE
APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY

a California Nonprofit Public Benefit Corporation

ARTICLE 1. OFFICES

SECTION 1. PRINCIPAL OFFICE

The principal office of the corporation for the transaction of its business is located in Monterey County, California.

SECTION 2. CHANGE OF ADDRESS

The county of the corporation's principal office can be changed only by amendment of these Bylaws and not otherwise. The Board of Directors may, however, change the principal office from one location to another within the named county by noting the changed address and effective date below, and such changes of address shall not be deemed an amendment of these Bylaws:

_____ Dated: _____, 19__
_____ Dated: _____, 19__
_____ Dated: _____, 19__

SECTION 3. OTHER OFFICES

The corporation may also have offices at such other places, within or without the State of California, where it is qualified to do business, as its business may require and as the Board of Directors may, from time to time, designate.

ARTICLE 2. PURPOSES

SECTION 1. OBJECTIVES AND PURPOSES

The primary objectives and purposes of this corporation shall be scientific and educational. Specific purposes are to advance the theory and practice of electrical and electronics engineering and the allied arts and sciences by promoting close cooperation and the exchange of technical information among its members, affiliates, and the public.

ARTICLE 3. MEMBERS

SECTION 1. DETERMINATION AND RIGHTS OF MEMBERS

The corporation shall have three classes of members: industrial; individual; and student. No member may hold more than one membership in the corporation. Industrial members shall have only one vote and shall designate a named individual to cast their ballot. Except as expressly provided in or authorized by the Articles of Incorporation or Bylaws of this corporation, all memberships shall have the same rights, privileges, restrictions and conditions.

SECTION 2. QUALIFICATIONS OF MEMBERS

Membership in the Society shall be available to all persons or entities practicing in the field of electromagnetics.

SECTION 3. ADMISSION OF MEMBERS

Qualified applicants shall be admitted to membership upon making application therefor in writing and payment of the first annual dues as specified in the following sections of this Bylaw.

SECTION 4. FEES, DUES AND ASSESSMENTS

- (a) No fee shall be charged for making application for membership in the corporation.
- (b) The annual dues payable to the corporation by members shall be in such amount as may be determined from time to time by resolution of the Board of Directors.
- (c) Memberships shall be nonassessable.

SECTION 5. NUMBER OF MEMBERS

There is no limit on the number of members the corporation may admit.

SECTION 6. MEMBERSHIP BOOK

The corporation shall keep a membership book containing the name and address of each member. Termination of the membership of any member shall be recorded in the book, together with the date of termination of such membership. Such book shall be kept at the corporation's principal office and shall be available for inspection by any Director or member of the corporation during regular business hours.

The record of names and addresses of the members of this corporation shall constitute the membership list of this corporation and shall not be used, in whole or part, by any person for any purpose not reasonably related to a member's interest as a member.

SECTION 7. NONLIABILITY OF MEMBERS

A member of this corporation is not, as such, personally liable for the debts, liabilities, or obligations of the corporation.

SECTION 8. NONTRANSFERABILITY OF MEMBERSHIPS

No member may transfer for value a membership or any right arising therefrom. All rights of membership cease upon the member's death.

SECTION 9. TERMINATION OF MEMBERSHIP

(a) Grounds for Termination. The membership of a member shall terminate upon the occurrence of any of the following events:

- (1) Upon his or her notice of such termination delivered to the President or Secretary of the corporation personally or by mail, such membership to terminate upon the date of delivery of the notice or date of deposit in the mail.

(2) Upon a determination by the Board of Directors that the member has engaged in conduct materially and seriously prejudicial to the interest or purposes of the corporation.

(3) Upon a failure to renew his or her membership by paying dues on or before their due date, such termination to be effective thirty (30) days after a written notification of delinquency is given personally or mailed to such member by the Secretary of the corporation. A member may avoid such termination by paying the amount of delinquent dues within a thirty (30)-day period following the member's receipt of the written notification of delinquency.

(b) Procedure for Expulsion. Following the determination that a member should be expelled under subparagraph (a)(2) of this section, the following procedure shall be implemented:

(1) A notice shall be sent by first-class or registered mail to the last address of the member as shown on the corporation's records, setting forth the expulsion and the reasons therefor. Such notice shall be sent at least fifteen (15) days before the proposed effective date of the expulsion.

(2) The member being expelled shall be given an opportunity to be heard, either orally or in writing, at a hearing to be held not less than five (5) days before the effective date of the proposed expulsion. The hearing will be held by the Board of Directors in accordance with the quorum and voting rules set forth in these Bylaws applicable to the meetings of the Board. The notice to the member of his or her proposed expulsion shall state the date, time, and place of the hearing on his or her proposed expulsion.

(3) Following the hearing, the Board of Directors shall decide whether or not the member should in fact be expelled, suspended, or sanctioned in some other way. The decision of the Board shall be final.

(4) Any person expelled from the corporation shall receive a refund of dues already paid. The refund shall be prorated to return only the unaccrued balance remaining for the period of the dues payment.

SECTION 10. RIGHTS ON TERMINATION OF MEMBERSHIP

All rights of a member in the corporation shall cease on termination of membership as herein provided.

SECTION 11. AMENDMENTS RESULTING IN THE TERMINATION OF MEMBERSHIPS

Notwithstanding any other provision of these Bylaws, if any amendment of the Articles of Incorporation or of the Bylaws of this corporation would result in the termination of all memberships or any class of memberships, then such amendment or amendments shall be effected only in accordance with the provisions of Section 5342 of the California Nonprofit Public Benefit Corporation Law.

ARTICLE 4. MEETINGS OF MEMBERS

SECTION 1. PLACE OF MEETINGS

Meetings of members shall be held at the principal office of the corporation or at such other place or places within or without the State of California as may be designated from time to time by resolution of the Board of Directors.

SECTION 2. ANNUAL MEETINGS

The members shall meet annually during the first four months of the calendar year at a date and time designated by resolution of the Board of Directors for the purpose of electing Directors and transacting other business as may come before the meeting. Cumulative voting for the election of Directors shall not be permitted. The candidates receiving the highest number of votes up to the number of Directors to be elected shall be elected. Each voting member shall cast one vote, with voting being by ballot only. The annual meeting of members for the purpose of electing Directors shall be deemed a regular meeting and any reference in these Bylaws to regular meetings of members refers to this annual meeting.

One additional regular meeting of the members may be held during the remainder of the calendar year on such date and at such time and place as may be designated from time to time by resolution of the Board of Directors.

SECTION 3. SPECIAL MEETINGS OF MEMBERS

(a) Persons Who May Call Special Meetings of Members. Special meetings of the members shall be called by the Board of Directors or the President of the corporation. In addition, special meetings of the members for any lawful purpose may be called by five percent (5%) or more of the members.

SECTION 4. NOTICE OF MEETINGS

(a) Time of Notice. Whenever members are required or permitted to take action at a meeting, a written notice of the meeting shall be given by the Secretary of the corporation not less than ten (10) nor more than ninety (90) days before the date of the meeting to each member who, on the record date for the notice of the meeting, is entitled to vote thereat; provided, however, that if notice is given by mail, and the notice is not mailed by first-class, registered, or certified mail, that notice shall be given twenty (20) days before the meeting.

(b) Manner of Giving Notice. Notice of a members' meeting or any report shall be given either personally or by mail or other means of written communication, addressed to the member at the address of such member appearing on the books of the corporation or given by the member to the corporation for the purpose of notice; or if no address appears or is given, at the place where the principal office of the corporation is located or by publication of notice of the meeting at least once in a newspaper of general circulation in the county in which the principal office is located. Notice shall be deemed to have been given at the time when delivered personally or deposited in the mail or sent by telegram or other means of written communication.

(c) Contents of Notice. Notice of a membership meeting shall state the place, date, and time of the meeting and (1) in the case of a special meeting, the general nature of the business to be transacted, and no other business may be transacted, or (2) in the case of a regular meeting, those matters which the Board, at the time notice is given, intends to present for action by the members. Subject to any provision to the contrary contained in these Bylaws, however, any proper matter may be presented at a regular meeting for such action. The notice of any meeting of members at which Directors are to be elected shall include the names of all those who are nominees at the time notice is given to members.

(d) Notice of Meetings Called by Members. If a special meeting is called by members as authorized by these Bylaws, the request for the meeting shall be submitted in writing, specifying the general nature of the business proposed to be transacted and shall be delivered personally or sent by registered mail or by telegraph to the Chairman of the Board, President, Vice-President or Secretary of

the corporation. The officer receiving the request shall promptly cause notice to be given to the members entitled to vote that a meeting will be held, stating the date of the meeting. The date for such meeting shall be fixed by the Board and shall not be less than thirty-five (35) nor more than ninety (90) days after the receipt of the request for the meeting by the officer. If the notice is not given within twenty (20) days after the receipt of the request, persons calling the meeting may give the notice themselves.

(e) Waiver of Notice of Meetings. The transactions of any meeting of members, however called and noticed, and wherever held, shall be as valid as though taken at a meeting duly held after regular call and notice, if a quorum is present either in person or by proxy, and if, either before or after the meeting, each of the persons entitled to vote, not present in person or by proxy, signs a written waiver of notice or a consent to the holding of the meeting or an approval of the minutes thereof. All such waivers, consents and approvals shall be filed with the corporate records or made a part of the minutes of the meeting. Waiver of notices or consents need not specify either the business to be transacted or the purpose of any regular or special meeting of members, except that if action is taken or proposed to be taken for approval of any of the matters specified in subparagraph (f) of this section, the waiver of notice or consent shall state the general nature of the proposal.

(f) Special Notice Rules for Approving Certain Proposals. If action is proposed to be taken or is taken with respect to the following proposals, such action shall be invalid unless unanimously approved by those entitled to vote or unless the general nature of the proposal is stated in the notice of meeting or in any written waiver of notice:

- (1) Removal of directors without cause;
- (2) Filling of vacancies on the Board by members;
- (3) Amending the Articles of Incorporation; and
- (4) An election to voluntarily wind up and dissolve the corporation.

SECTION 5. QUORUM FOR MEETINGS

A quorum shall consist of one third of the voting members of the corporation.

The members present at a duly called and held meeting at which a quorum is initially present may continue to do business notwithstanding the loss of a quorum at the meeting due to a withdrawal of members from the meeting provided that any action taken after the loss of a quorum must be approved by at least a majority of the members required to constitute a quorum.

In the absence of a quorum, any meeting of the members may be adjourned from time to time by the vote of a majority of the votes represented in person or by proxy at the meeting, but no other business shall be transacted at such meeting.

When a meeting is adjourned for lack of a sufficient number of members at the meeting or otherwise, it shall not be necessary to give any notice of the time and place of the adjourned meeting or of the business to be transacted at such meeting other than by announcement at the meeting at which the adjournment is taken of the time and place of the adjourned meeting. However, if after the adjournment a new record date is fixed for notice or voting, a notice of the adjourned meeting shall be given to each member who, on the record date for notice of the meeting, is entitled to vote at the meeting. A meeting shall not be adjourned for more than forty-five (45) days.

Notwithstanding any other provision of this Article, if this corporation authorizes members to conduct a meeting with a quorum of less than one-third (1/3) of the voting power, then, if less than one-third (1/3) of the voting power actually attends a regular meeting, in person or by proxy, then no action may be taken on a matter unless the general nature of the matter was stated in the notice of the regular meeting.

SECTION 6. MAJORITY ACTION AS MEMBERSHIP ACTION

Every act or decision done or made by a majority of voting members present in person or by proxy at a duly held meeting at which a quorum is present is the act of the members, unless the law, the Articles of Incorporation of this corporation, or these Bylaws require a greater number.

SECTION 7. VOTING RIGHTS

Each member is entitled to one vote on each matter submitted to a vote by the members. Voting at duly held meetings shall be by voice vote. Election of Directors, however, shall be by ballot.

SECTION 8. PROXY VOTING

Members entitled to vote shall have the right to vote either in person or by a written proxy executed by such person or by his or her duly authorized agent and filed with the Secretary of the corporation, provided, however, that no proxy shall be valid after eleven (11) months from the date of its execution unless otherwise provided in the proxy. In any case, however, the maximum term of any proxy shall be three (3) years from the date of its execution. No proxy shall be irrevocable and may be revoked following the procedures given in Section 5613(b) of the California Nonprofit Public Benefit Corporation Law.

All proxies shall state the general nature of the matter to be voted on and, in the case of a proxy given to vote for the election of Directors, shall list those persons who were nominees at the time the notice of the vote for election of Directors was given to the members. In any election of Directors, any proxy which is marked by a member "withhold" or otherwise marked in a manner indicating that the authority to vote for the election of Directors is withheld shall not be voted either for or against the election of a Director.

Proxies shall afford an opportunity for the member to specify a choice between approval and disapproval of each matter or group of related matters intended, at the time the proxy is distributed, to be acted upon at the meeting for which the proxy is solicited. The proxy shall also provide that when the person solicited specifies a choice with respect to any such matter, the vote shall be cast in accordance therewith.

SECTION 9. CONDUCT OF MEETINGS

Meetings of members shall be presided over by the President of the corporation or, in his or her absence, by the Vice-President of the corporation or, in the absence of all of these persons, by a Chairman chosen by a majority of the voting members, present in person or by proxy. The Secretary of the corporation shall act as Secretary of all meetings of members, provided that in his or her absence, the presiding officer shall appoint another person to act as Secretary of the meeting.

Meetings shall be governed by Roberts' Rules of Order, as such rules may be revised from time to time, insofar as such rules are not inconsistent with or in conflict with these Bylaws, with the Articles of Incorporation of this corporation, or with any provision of law.

SECTION 10. ACTION BY WRITTEN BALLOT WITHOUT A MEETING

Any action which may be taken at any regular or special meeting of members may be taken without a meeting if the corporation distributes a written ballot to every member entitled to vote on the matter. The ballot shall set forth the proposed action, provide an opportunity to specify approval or

disapproval of each proposal, provide that where the person solicited specifies a choice with respect to any such proposal the vote shall be cast in accordance therewith, and provide a reasonable time within which to return the ballot to the corporation. Ballots shall be mailed or delivered in the manner required for giving notice of meeting specified in Section 4(b) of this Article.

All written ballots shall also indicate the number of responses needed to meet the quorum requirement and, except for ballots soliciting votes for the election of Directors, shall state the percentage of approvals necessary to pass the measure submitted. The ballots must specify the time by which they must be received by the corporation in order to be counted.

Approval of action by written ballot shall be valid only when the number of votes cast by ballot within the time period specified equals or exceeds the quorum required to be present at a meeting authorizing the action, and the number of approvals equals or exceeds the number of votes that would be required to approve the action at a meeting at which the total number of votes cast was the same as the number of votes cast by ballot.

Directors may be elected by written ballot. Such ballots for the election of Directors shall list the persons nominated at the time the ballots are mailed or delivered. If any such ballots are marked "withhold" or otherwise marked in a manner indicating that the authority to vote for the election of Directors is withheld, they shall not be counted as votes either for or against the election of a Director.

A written ballot may not be revoked after its receipt by the corporation or its deposit in the mail, whichever occurs first.

SECTION 11. REASONABLE NOMINATION AND ELECTION PROCEDURES

This corporation shall make available to members reasonable nomination and election procedures with respect to the election of Directors by members. Such procedures shall be reasonable given the nature, size and operations of the corporation, and shall include:

- (a) A reasonable means of nominating persons for election as Directors.
- (b) A reasonable opportunity for a nominee to communicate to the members the nominee's qualifications and the reasons for the nominee's candidacy.
- (c) A reasonable opportunity for all nominees to solicit votes.
- (d) A reasonable opportunity for all members to choose among the nominees.

Upon the written request by any nominee for election to the Board and the payment with such request of the reasonable costs of mailing (including postage) the corporation shall, within ten (10) business days after such request (provided payment has been made) mail to all members or such portion of them that the nominee may reasonably specify, any material which the nominee shall furnish and which is reasonably related to the election, unless the corporation within five (5) business days after the request allows the nominee, at the corporation's option, the right to do either of the following: (1) inspect and copy the record of all members' names, addresses and voting rights, at reasonable times, upon five (5) business days' prior written demand upon the corporation, which demand shall state the purpose for which the inspection rights are requested; or (2) obtain from the Secretary, upon written demand and payment of a reasonable charge, a list of the names, addresses and voting rights of those members entitled to vote for the election of Directors, as of the most recent record date for which it has been compiled or as of any date specified by the nominee subsequent to the date of demand. The demand shall state the purpose for which the list is requested and the membership list shall be made available on or before the later of ten (10) business days after the demand is received or after the date specified therein as the date as of which the list is to be compiled.

If the corporation distributes any written election material soliciting votes for any nominee for Director at the corporation's expense, it shall make available, at the corporation's expense, to each other nominee, in or with the same material, the same amount of space that is provided any other nominee, with equal prominence, to be used by the nominee for a purpose reasonably related to the election.

Generally, any person who is qualified to be elected to the Board of Directors shall be nominated at the annual meeting of members held for the purpose of electing directors by any member present at the meeting in person or by proxy. However, if the corporation has five hundred (500) or more members, any of the additional nomination procedures specified in subsections (a) and (b) of Section 5521 of the California Nonprofit Public Benefit Corporation Law may be used to nominate persons for election to the Board of Directors.

If this corporation has five thousand (5,000) or more members, then the nomination and election procedures specified in Section 5522 of the California Nonprofit Corporation Law shall be followed by this corporation in nominating and electing persons to the Board of Directors.

SECTION 12. ACTION BY UNANIMOUS WRITTEN CONSENT WITHOUT MEETING

Except as otherwise provided in these Bylaws, any action required or permitted to be taken by the members may be taken without a meeting, if all members shall individually or collectively consent in writing to the action. The written consent or consents shall be filed with the minutes of the proceedings of the members. The action by written consent shall have the same force and effect as the unanimous vote of the members.

SECTION 13. RECORD DATE FOR MEETINGS

The record date for purposes of determining the members entitled to notice, voting rights, written ballot rights, or any other right with respect to a meeting of members or any other lawful membership action, shall be fixed pursuant to Section 5611 of the California Nonprofit Public Benefit Corporation Law.

ARTICLE 5. DIRECTORS

SECTION 1. NUMBER

The corporation shall have nine (9) Directors and collectively they shall be known as the Board of Directors. The number may be changed by amendment of this Bylaw, or by repeal of this Bylaw and adoption of a new Bylaw, as provided in these Bylaws.

SECTION 2. POWERS

Subject to the provisions of the California Nonprofit Public Benefit Corporation Law and any limitations in the Articles of Incorporation and Bylaws relating to action required or permitted to be taken or approved by the members, if any, of this corporation, the activities and affairs of this corporation shall be conducted and all corporate powers shall be exercised by or under the direction of the Board of Directors.

SECTION 3. DUTIES

It shall be the duty of the Directors to:

(a) Perform any and all duties imposed on them collectively or individually by law, by the Articles of Incorporation of this corporation, or by these Bylaws.

(b) Appoint and remove, employ and discharge, and, except as otherwise provided in these Bylaws, prescribe the duties and fix the compensation, if any, of all officers, agents and employees of the corporation.

(c) Supervise all officers, agents and employees of the corporation to assure that their duties are performed properly.

(d) Meet at such times and places as required by these Bylaws.

(e) Register their addresses with the Secretary of the corporation, and notices of meetings mailed or telegraphed to them at such addresses shall be valid notices thereof.

SECTION 4. TERMS OF OFFICE

Directors shall be elected for a term of three years such terms to be staggered so that three Directors stand for election at each annual meeting. Unless the articles or these Bylaws provide otherwise, each Director, including a Director elected to fill a vacancy, shall hold office until the expiration of the term for which elected and until a successor has been elected and qualified.

SECTION 5. COMPENSATION

Directors shall serve without compensation except that they shall be allowed and paid their actual and necessary expenses incurred in attending Directors meetings. In addition, they shall be allowed reasonable advancement or reimbursement for expenses incurred in the performance of their regular duties as specified in Section 3 of this Article. Directors may not be compensated for rendering services to the corporation in any capacity other than Director unless such other compensation is reasonable and is allowable under the provisions of Section 6 of this Article.

SECTION 6. RESTRICTION REGARDING INTERESTED DIRECTORS

Notwithstanding any other provision of these Bylaws, not more than forty-nine percent (49%) of the persons serving on the Board may be interested persons. For purposes of this Section, "interested persons" means either:

(a) any person currently being compensated by the corporation for services rendered it within the previous twelve (12) months, whether as a full- or part-time officer or other employee, independent contractor, or otherwise, excluding any reasonable compensation paid to a Director as Director; or

(b) any brother, sister, ancestor, descendant, spouse, brother-in-law, sister-in-law, son-in-law, daughter-in-law, mother-in-law, or father-in-law of any such person.

SECTION 7. PLACE OF MEETINGS

Meetings shall be held at the principal office of the corporation unless otherwise provided by the Board or at such place within or without the State of California which has been designated from time to time by resolution of the Board of Directors. In the absence of such designation, any meeting not held at the principal office of the corporation shall be valid only if held on the written consent of all Directors given either before or after the meeting and filed with the Secretary of the corporation or after all Board members have been given written notice of the meeting as hereinafter provided for special meetings of the Board. Any meeting, regular or special, may be held by conference telephone or similar communications equipment, so long as all Directors participating in such meeting can hear one another.

SECTION 8. REGULAR AND ANNUAL MEETINGS

Regular meetings of Directors shall be held within one business day after regular meetings of the members at a time designated by the Board of Directors.

SECTION 9. SPECIAL MEETINGS

Special meetings of the Board of Directors may be called by the President, the Vice-President, the Secretary, or by any two Directors, and such meetings shall be held at the place, within or without the State of California, designated by the person or persons calling the meeting, and in the absence of such designation, at the principal office of the corporation.

SECTION 10. NOTICE OF MEETINGS

Regular meetings of the Board may be held without notice. Special meetings of the Board shall be held upon four (4) days' notice by first-class mail or forty-eight (48) hours' notice delivered personally or by telephone or telegraph. If sent by mail or telegram, the notice shall be deemed to be delivered on its deposit in the mails or on its delivery to the telegraph company. Such notices shall be addressed to each Director at his or her address as shown on the books of the corporation. Notice of the time and place of holding an adjourned meeting need not be given to absent Directors if the time and place of the adjourned meeting are fixed at the meeting adjourned and if such adjourned meeting is held no more than twenty-four (24) hours from the time of the original meeting. Notice shall be given of any adjourned regular or special meeting to Directors absent from the original meeting if the adjourned meeting is held more than twenty-four (24) hours from the time of the original meeting.

SECTION 11. CONTENTS OF NOTICE

Notice of meetings not herein dispensed with shall specify the place, day and hour of the meeting. The purpose of any Board meeting need not be specified in the notice.

SECTION 12. WAIVER OF NOTICE AND CONSENT TO HOLDING MEETINGS

The transactions of any meeting of the Board, however called and noticed or wherever held, are as valid as though the meeting had been duly held after proper call and notice, provided a quorum, as hereinafter defined, is present and provided that either before or after the meeting each Director not present signs a waiver of notice, a consent to holding the meeting, or an approval of the minutes thereof. All such waivers, consents, or approvals, shall be filed with the corporate records or made a part of the minutes of the meeting.

SECTION 13. QUORUM FOR MEETINGS

A quorum shall consist of a majority of the Board of Directors.

Except as otherwise provided in these Bylaws or in the Articles of Incorporation of this corporation, or by law, no business shall be considered by the Board at any meeting at which a quorum, as hereinafter defined, is not present, and the only motion which the Chair shall entertain at such meeting is a motion to adjourn. However, a majority of the Directors present at such meeting may adjourn from time to time until the time fixed for the next regular meeting of the Board.

When a meeting is adjourned for lack of a quorum, it shall not be necessary to give any notice of the time and place of the adjourned meeting or of the business to be transacted at such meeting, other than by announcement at the meeting at which the adjournment is taken, except as provided in Section 10 of the Article.

The Directors present at a duly called and held meeting at which a quorum is initially present may continue to do business notwithstanding the loss of a quorum at the meeting due to a withdrawal of Directors from the meeting, provided that any action thereafter taken must be approved by at least a majority of the required quorum for such meeting or such greater percentage as may be required by law, or the Articles of Incorporation or Bylaws of this corporation.

SECTION 14. MAJORITY ACTION AS BOARD ACTION

Every act or decision done or made by a majority of the Directors present at a meeting duly held at which a quorum is present is the act of the Board of Directors, unless the Articles of Incorporation or Bylaws of this corporation, or provisions of the California Nonprofit Public Benefit Corporation Law, particularly those provisions relating to appointment of committees (Section 5212), approval of contracts or transactions in which a Director has a material financial interest (Section 5233) and indemnification of Directors (Section 5238e), require a greater percentage or different voting rules for approval of a matter by the Board.

SECTION 15. CONDUCT OF MEETINGS

Meetings of the Board of Directors shall be presided over by the President of the corporation or, in his or her absence, by the Vice-President of the corporation or, in the absence of each of these persons, by a Chairman chosen by a majority of the Directors present at the meeting. The Secretary of the corporation shall act as Secretary of all meetings of the Board, provided that in his or her absence, the presiding officer shall appoint another person to act as Secretary of the meeting.

Meetings shall be governed by Roberts' Rules of Order, as such rules may be revised from time to time, insofar as such rules are not inconsistent with or in conflict with these Bylaws, with the Articles of Incorporation of this corporation, or with provision of law.

SECTION 16. ACTION BY UNANIMOUS WRITTEN CONSENT WITHOUT MEETING

Any action required or permitted to be taken by the Board of Directors under any provision of law may be taken without a meeting, if all members of the Board shall individually or collectively consent in writing to such action. For the purposes of this section only, "all members of the Board" shall not include any "interested Director" as defined in Section 5233 of the California Nonprofit Public Benefit Corporation Law. Such written consent or consents shall be filed with the minutes of the proceedings of the Board. Such action by written consent shall have the same force and effect as the unanimous vote of the Directors. Any certificate or other document filed under any provision of law which relates to action so taken shall state that the action was taken by unanimous written consent of the Board of Directors without a meeting and that the Bylaws of this corporation authorize the Directors to so act, and such statement shall be prima facie evidence of such authority.

SECTION 17. VACANCIES

Vacancies on the Board of Directors shall exist (1) on the death, resignation or removal of any Director, and (2) whenever the number of authorized Directors is increased.

The Board of Directors may declare vacant the office of a Director who has been declared of unsound mind by a final order of court, or convicted of a felony, or been found by a final order or judgment of any court to have breached any duty under Section 5230 and following of the California Nonprofit Public Benefit Corporation Law.

If this corporation has any members, then, if the corporation has less than fifty (50) members, Directors may be removed without cause by a majority of all members, or, if the corporation has fifty (50) or more members, by vote of a majority of the votes represented at a membership meeting at which a quorum is present.

Any Director may resign effective upon giving written notice to the Chairman of the Board, the President, the Secretary or the Board of Directors, unless the notice specifies a later time for the effectiveness of such resignation. No Director may resign if the corporation would then be left without a duly elected Director or Directors in charge of its affairs, except upon notice to the Attorney General.

Vacancies on the Board may be filled by a majority of Directors then in office, whether or not less than a quorum, or by a sole remaining Director. If this corporation has members, however, vacancies created by the removal of a Director may be filled only by the approval of the members. The members, if any, of this corporation may elect a Director at any time to fill any vacancy not filled by the Directors.

A person elected to fill a vacancy as provided in this Section shall hold office until the expiration of the term for which elected and until a successor has been elected and qualified.

SECTION 18. NON-LIABILITY OF DIRECTORS

The Directors shall not be personally liable for the debts, liabilities, or other obligation of the corporation.

SECTION 19. INDEMNIFICATION BY CORPORATION OF DIRECTORS, OFFICERS, EMPLOYEES AND OTHER AGENTS

To the extent that a person, who is, or was, a Director, officer, employee or other agent of this corporation has been successful on the merits in defense of any civil, criminal, administrative or investigative proceeding brought to procure a judgment against such person by reason of the fact that he or she is, or was, an agent of the corporation, or has been successful in defense of any claim, issue or matter, therein, such person shall be indemnified against expenses actually and reasonably incurred by the person in connection with such proceeding.

If such person either settles any such claim or sustains a judgment against him or her, then indemnification against expenses, judgments, fines, settlements and other amounts reasonably incurred in connection with such proceedings shall be provided by this corporation but only to the extent allowed by, and in accordance with the requirements of, Section 5238 of the California Nonprofit Public Benefit Corporation Law.

SECTION 20. INSURANCE FOR CORPORATE AGENTS

The Board of Directors may adopt a resolution authorizing the purchase and maintenance of insurance on behalf of any agent of the corporation (including a Director, officer, employee or other agent of the corporation) against any liability other than for violating provisions of law relating to self-dealing (Section 5233 of the California Nonprofit Public Benefit Corporation Law) asserted against or incurred by the agent in such capacity or arising out of the agent's status as such, whether or not the corporation would have the power to indemnify the agent against such liability under the provisions of Section 5238 of the California Nonprofit Public Benefit Corporation Law.

SECTION 1. NUMBER OF OFFICERS

The officers of this corporation shall be a President, a Vice-President, a Secretary and a chief financial officer who shall be designated the Treasurer. The corporation may also have, as determined by the Board of Directors, Assistant Secretaries, Assistant Treasurers, or other officers. Any number of offices may be held by the same person except that neither the Vice-President, the Secretary nor the Treasurer may serve as the President.

SECTION 2. QUALIFICATION, ELECTION, AND TERM OF OFFICE

The President, Vice-President, Secretary and Treasurer shall be elected by the Board of Directors from among the serving Directors. The term of office shall be two years. Should an officer's term as Director expire prior to the expiration of his or her term as an elected officer, his or her position will be deemed vacant and will be filled from among the serving Directors. Officers elected to fill vacancies shall hold office until expiration of the term for which elected and until a successor has been elected and qualified.

SECTION 3. SUBORDINATE OFFICERS

The Board of Directors may appoint such other officers or agents as it may deem desirable, and such officers shall serve such terms, have such authority, and perform such duties as may be prescribed from time to time by the Board of Directors.

SECTION 4. REMOVAL AND RESIGNATION

Any officer may be removed, either with or without cause, by the Board of Directors, at any time. Any officer may resign at any time by giving written notice to the Board of Directors or to the President or Secretary of the corporation. Any such resignation shall take effect at the date of the receipt of such notice or at any later date specified therein, and, unless otherwise specified therein, the acceptance of such resignation shall not be necessary to make it effective. The above provisions of this Section shall be superseded by any conflicting terms of a contract which has been approved or ratified by the Board of Directors relating to the employment of any officer of the corporation.

SECTION 5. VACANCIES

Any vacancy caused by the death, resignation, removal, disqualification, or otherwise, of any officer shall be filled by the Board of Directors. In the event of a vacancy in any office other than that of President, such vacancy may be filled temporarily by appointment by the President until such time as the Board shall fill the vacancy. Vacancies occurring in offices of officers appointed at the discretion of the Board may or may not be filled as the Board shall determine.

SECTION 6. DUTIES OF PRESIDENT

The President shall be the chief executive officer of the corporation and shall, subject to the control of the Board of Directors, supervise and control the affairs of the corporation and the activities of the officers. He or she shall perform all duties incident to his or her office and such other duties as may be required by law, by the Articles of Incorporation of this corporation, or by these Bylaws, or which may be prescribed from time to time by the Board of Directors. Unless another person is specifically appointed as Chairman of the Board of Directors, he or she shall preside at all meetings of the Board of Directors. If applicable, the President shall preside at all meetings of the members. Except as otherwise expressly provided by law, by the Articles of Incorporation, or by these Bylaws, he or she shall, in the name of the corporation, execute such deeds, mortgages, bonds, contracts, checks, or other instruments which may from time to time be authorized by the Board of Directors.

SECTION 7. DUTIES OF VICE-PRESIDENT

In the absence of the President, or in the event of his or her inability or refusal to act, the Vice-President shall perform all the duties of the President, and when so acting shall have all the powers of, and be subject to all the restrictions on, the President. The Vice-President shall have other powers and perform such other duties as may be prescribed by law, by the Articles of Incorporation, or by these Bylaws, or as may be prescribed by the Board of Directors.

SECTION 8. DUTIES OF SECRETARY

The Secretary shall:

Certify and keep at the principal office of the corporation the original, or a copy, of these Bylaws as amended or otherwise altered to date.

Keep at the principal office of the corporation or at such other place as the Board may determine, a book of minutes of all meetings of the Directors, and, if applicable, meetings of committees of Directors and of members, recording therein the time and place of holding, whether regular or special, how called, how notice thereof was given, the names of those present or represented at the meeting, and the proceedings thereof.

See that all notices are duly given in accordance with the provisions of these Bylaws or as required by law.

Be custodian of the records and of the seal of the corporation and see that the seal is affixed to all duly executed documents, the execution of which on behalf of the corporation under its seal is authorized by law or by these Bylaws.

Keep at the principal office of the corporation a membership book containing the name and address of each and any members, and, in the case where any membership has been terminated, he or she shall record such fact in the membership book together with the date on which such membership ceased.

Exhibit at all reasonable times to any Director of the corporation, or to his or her agent or attorney, on request therefor, the Bylaws, the membership book, and the minutes of the proceedings of the Directors of the corporation.

In general, perform all duties incident to the office of Secretary and such other duties as may be required by law, by the Articles of Incorporation of this corporation, or by these Bylaws, or which may be assigned to him or her from time to time by the Board of Directors.

SECTION 9. DUTIES OF TREASURER

Subject to the provisions of these Bylaws relating to the "Execution of Instruments, Deposits and Funds," the Treasurer shall:

Have charge and custody of, and be responsible for, all funds and securities of the corporation, and deposit all such funds in the name of the corporation in such banks, trust companies, or other depositories as shall be selected by the Board of Directors.

Receive, and give receipt for, monies due and payable to the corporation from any source whatsoever.

Disburse or cause to be disbursed the funds of the corporation as may be directed by the Board of Directors, taking proper vouchers for such disbursements.

Keep and maintain adequate and correct accounts of the corporation's properties and business transactions, including accounts of its assets, liabilities, receipts, disbursements, gains and losses.

Exhibit at all reasonable times the books of account and financial records to any Director of the corporation, or to his or her agent or attorney, on request therefor.

Render to the President and Directors, whenever requested, an account of any or all of his or her transactions as Treasurer and of the financial condition of the corporation.

Prepare, or cause to be prepared, and certify, or cause to be certified, the financial statements to be included in any required reports.

In general, perform all duties incident to the office of Treasurer and such other duties as may be required by law, by the Articles of Incorporation of the corporation, or by these Bylaws, or which may be assigned to him or her from time to time by the Board of Directors.

SECTION 10. COMPENSATION

The salaries of the officers, if any, shall be fixed from time to time by resolution of the Board of Directors, and no officer shall be prevented from receiving such salary by reason of the fact that he or she is also a Director of the corporation, provided, however, that such compensation paid a Director for serving as an officer of this corporation shall only be allowed if permitted under the provisions of ARTICLE 5, Section 6, of these Bylaws. In all cases, any salaries received by officers of this corporation shall be reasonable and given in return for services actually rendered the corporation which relate to the performance of the charitable or public purposes of this corporation.

ARTICLE 7. COMMITTEES

SECTION 1. EXECUTIVE COMMITTEE

The Board of Directors may, by a majority vote of Directors then in office, designate two (2) or more of its members (who may also be serving as officers of this corporation) to constitute an Executive Committee and delegate to such Committee any of the powers and authority of the Board in the management of the business and affairs of the corporation, except with respect to:

(a) The approval of any action which, under law or the provisions of these Bylaws, requires the approval of the members or of a majority of all of the members.

(b) The filling of vacancies on the Board or on any committee which has the authority of the Board.

(c) The fixing of compensation of the Directors for serving on the Board or on any committee.

(d) The amendment or repeal of Bylaws or the adoption of new Bylaws.

(e) The amendment or repeal of any resolution of the Board which by its express terms is not so amendable or repealable.

(f) The appointment of committees of the Board or the members, thereof.

(g) The expenditure of corporate funds to support a nominee for Director after there are more people nominated for Director than can be elected.

(h) The approval of any transaction to which this corporation is a party and in which one or more of the Directors has a material financial interest, except as expressly provided in Section 5233(d)(3) of the California Nonprofit Public Benefit Corporation Law.

By a majority vote of its members then in office, the Board may at any time revoke or modify any or all of the authority so delegated, increase or decrease but not below two (2) the number of its members, and fill vacancies therein from the members of the Board. The Committee shall keep regular minutes of its proceedings, cause them to be filed with the corporate records, and report the same to the Board from time to time as the Board may require.

SECTION 2. OTHER COMMITTEES

The corporation shall have such other committees as may from time to time be designated by resolution of the Board of Directors. Such other committees may consist of persons who are not also members of the Board. These additional committees shall act in an advisory capacity only to the Board and shall be clearly titled as "advisory" committees.

SECTION 3. MEETINGS AND ACTION OF COMMITTEES

Meetings and action of committees shall be governed by, noticed, held and taken in accordance with the provisions of these Bylaws concerning meetings of the Board of Directors, with such changes in context of such Bylaw provisions as are necessary to substitute the committee and its members for the Board of Directors and its members, except that the time for regular meetings of committees may be fixed by resolution of the Board of Directors or by the committee. The time for special meetings of committees may also be fixed by the Board of Directors. The Board of Directors may also adopt rules and regulations pertaining to the conduct of meetings of committees to the extent that such rules and regulations are not inconsistent with the provisions of these Bylaws.

ARTICLE 8. EXECUTION OF INSTRUMENTS, DEPOSITS AND FUNDS

SECTION 1. EXECUTION OF INSTRUMENTS

The Board of Directors, except as otherwise provided in these Bylaws, may by resolution authorize any officer or agent of the corporation to enter into any contract or execute and deliver any instrument in the name of and on behalf of the corporation, and such authority may be general or confined to specific instances. Unless so authorized, no officer, agent, or employee shall have any power or authority to bind the corporation by any contract or engagement or to pledge its credit or to render it liable monetarily for any purpose or in any amount.

SECTION 2. CHECKS AND NOTES

Except as otherwise specifically determined by resolution of the Board of Directors, or as otherwise required by law, checks, drafts, promissory notes, orders for the payment of money, and other evidence of indebtedness of the corporation shall be signed by the Treasurer and countersigned by the President of the corporation.

SECTION 3. DEPOSITS

All funds of the corporation shall be deposited from time to time to the credit of the corporation in such banks, trust companies, or other depositories as the Board of Directors may select.

SECTION 4. GIFTS

The Board of Directors may accept on behalf of the corporation any contribution, gift, bequest, or devise for the charitable or public purposes of this corporation.

ARTICLE 9. CORPORATE RECORDS, REPORTS AND SEAL

SECTION 1. MAINTENANCE OF CORPORATE RECORDS

The corporation shall keep at its principal office in the State of California:

(a) Minutes of all meetings of Directors, committees of the Board and, if this corporation has members, of all meetings of members, indicating the time and place of holding such meetings, whether regular or special, how called, the notice given, and the names of those present and the proceedings thereof.

(b) Adequate and correct books and records of accounts, including accounts of its properties and business transactions and accounts of its assets, liabilities, receipts, disbursements, gains and losses.

(c) A record of its members, if any, indicating their names and addresses and, if applicable, the class of membership held by each member and the termination date of any membership.

(d) A copy of the corporation's Articles of Incorporation and Bylaws as amended to date, which shall be open to inspection by the members, if any, of the corporation at all reasonable times during office hours.

SECTION 2. CORPORATE SEAL

The Board of Directors may adopt, use, and at will alter, a corporate seal. Such seal shall be kept at the principal office of the corporation. Failure to affix the seal to corporate instruments, however, shall not affect the validity of any such instrument.

SECTION 3. DIRECTORS' INSPECTION RIGHTS

Every Director shall have the absolute right at any reasonable time to inspect and copy all books, records and documents of every kind and to inspect the physical properties of the corporation.

SECTION 4. MEMBERS' INSPECTION RIGHTS

If this corporation has any members, then each and every member shall have the following inspection rights, for a purpose reasonably related to such person's interest as a member:

(a) To inspect and copy the record of all members' names, addresses and voting rights, at reasonable times, upon five (5) business days' prior written demand on the corporation, which demand shall state the purpose for which the inspection rights are requested.

(b) To obtain from the Secretary of the corporation, upon written demand and payment of a reasonable charge, a list of the names, addresses and voting rights of those members entitled to vote for the election of Directors as of the most recent record date for which the list has been compiled or as of the date specified by the member subsequent to the date of demand. The demand shall state the purpose for which the list is requested. The membership list shall be made available on or before the later of ten (10) business days after the demand is received or after the date specified therein as of which the list is to be compiled.

(c) To inspect at any reasonable time the books, records, or minutes of proceedings of the members or of the Board or committees of the Board, upon written demand on the corporation by the member, for a purpose reasonably related to such person's interests as a member.

SECTION 5. RIGHT TO COPY AND MAKE EXTRACTS

Any inspection under the provisions of this Article may be made in person or by agent or attorney and the right to inspection includes the right to copy and make extracts.

SECTION 6. ANNUAL REPORT

The Board shall cause an annual report to be furnished not later than one hundred and twenty (120) days after the close of the corporation's fiscal year to all Directors of the corporation and, if this corporation has members, to any member who requests it in writing, which report shall contain the following information in appropriate detail:

- (a) The assets and liabilities, including the trust funds, of the corporation as of the end of the fiscal year.
- (b) The principal changes in assets and liabilities, including trust funds, during the fiscal year.
- (c) The revenue or receipts of the corporation, both unrestricted and restricted to particular purposes, for the fiscal year.
- (d) The expenses or disbursements of the corporation, for both general and restricted purposes, during the fiscal year.
- (e) Any information required by Section 7 of this Article.

The annual report shall be accompanied by any report thereon of independent accountants, or, if there is no such report, the certificate of an authorized officer of the corporation that such statements were prepared without audit from the books and records of the corporation.

If this corporation has members, then, if this corporation receives TWENTY-FIVE THOUSAND DOLLARS (\$25,000), or more, in gross revenues or receipts during the fiscal year, this corporation shall automatically send the above annual report to all members, in such manner, at such time, and with such contents, including an accompanying report from independent accountants or certification of a corporate officer, as specified by the above provisions of this Section relating to the annual report.

SECTION 7. ANNUAL STATEMENT OF SPECIFIC TRANSACTIONS TO MEMBERS

This corporation shall mail or deliver to all directors and any and all members a statement within one hundred and twenty (120) days after the close of its fiscal year which briefly describes the amount and circumstances of any indemnification or transaction of the following kind:

(a) Any transaction in which the corporation, or its parent or its subsidiary was a party, and in which either of the following had a direct or indirect material financial interest:

(1) any director or officer of the corporation, or its parent or subsidiary (a mere common directorship shall not be considered a material financial interest); or

(2) any holder of more than ten percent (10%) of the voting power of the corporation, its parent or its subsidiary.

The above statement need only be provided with respect to a transaction during the previous fiscal year involving more than FIFTY THOUSAND DOLLARS (\$50,000) or which was one of a number of transactions with the same person involving, in the aggregate, more than FIFTY THOUSAND DOLLARS (\$50,000).

Similarly, the statement need only be provided with respect to indemnifications or advances aggregating more than TEN THOUSAND DOLLARS (\$10,000) paid during the previous fiscal year to any Director or officer, except that no such statement need be made if such indemnification was approved by the members pursuant to Section 5238(e)(2) of the California Nonprofit Public Benefit Corporation Law.

Any statement required by this Section shall briefly describe the names of the interested persons involved in such transactions, stating each person's relationship to the corporation, the nature of such person's interest in the transaction and, where practical, the amount of such interest; provided, that in the case of a transaction with a partnership of which such person is a partner, only the interest of the partnership need be stated.

If this corporation has any members and provides all members with an annual report according to the provision of Section 6 of this Article, then such annual report shall include the information required by this Section.

ARTICLE 10. FISCAL YEAR

SECTION 1. FISCAL YEAR OF THE CORPORATION

The fiscal year of the corporation shall begin on the 1st of January and end on the 31st of December in each year.

ARTICLE 11. BYLAWS

SECTION 1. AMENDMENT

Subject to any provision of law applicable to the amendment of Bylaws of public benefit nonprofit corporations, these Bylaws, or any of them, may be altered, amended, or repealed and new Bylaws adopted as follows:

(a) subject to the power of the members, if any, to change or repeal these Bylaws under Section 5150 of the Corporations Code, by approval of the Board of Directors unless the Bylaw amendment would materially and adversely affect the rights of members, if any, as to voting or transfer, provided, however, if this corporation has admitted any members, then a Bylaw specifying or changing the fixed number of Directors of the corporation, the maximum or minimum number of Directors, or changing from a fixed to variable Board or vice versa, may not be adopted, amended; or repealed except as provided in subparagraph (b) of this section; or

(b) by approval of the members, if any, of this corporation.

ARTICLE 12. AMENDMENT OF ARTICLES

SECTION 1. AMENDMENT OF ARTICLES BEFORE ADMISSION OF MEMBERS

Before any members have been admitted to the corporation, any amendment of the Articles of Incorporation may be adopted by approval of the Board of Directors.

SECTION 2. AMENDMENT OF ARTICLES AFTER ADMISSION OF MEMBERS

After members, if any, have been admitted to the corporation, amendment of the Articles of Incorporation may be adopted by the approval of the Board of Directors and by the approval of the members of this corporation.

SECTION 3. CERTAIN AMENDMENTS

Notwithstanding the above Sections of this Article, this corporation shall not amend its Articles of Incorporation to alter any statement which appears in the original Articles of Incorporation and of the names and addresses of the first Directors of this corporation nor the name and address of its initial agent, except to correct an error in such statement or to delete either statement after the corporation has filed a "Statement by a Domestic Non-Profit Corporation" pursuant to Section 6210 of the California Nonprofit Corporation Law.

ARTICLE 13. PROHIBITION AGAINST SHARING CORPORATE PROFITS AND ASSETS

SECTION 1. PROHIBITION AGAINST SHARING CORPORATE PROFITS AND ASSETS

No member, Director, officer, employee, or other person connected with this corporation, or any private individual, shall receive at any time any of the net earnings or pecuniary profit from the operations of the corporation, provided, however, that this provision shall not prevent payment to any such person or reasonable compensation for services performed for the corporation in effecting any of its public or charitable purposes, provided that such compensation is otherwise permitted by these Bylaws and is fixed by resolution of the Board of Directors; and no such person or persons shall be entitled to share in the distribution of, and shall not receive, any of the corporate assets on dissolution of the corporation. All members, if any, of the corporation shall be deemed to have expressly consented and agreed that on such dissolution or winding up of the affairs of the corporation, whether voluntarily or involuntarily, the assets of the corporation, after all debts have been satisfied, then remaining in the hands of the Board of Directors, shall be distributed as required by the Articles of Incorporation of this corporation and not otherwise.

WRITTEN CONSENT OF DIRECTORS ADOPTING BYLAWS

We the undersigned, are all of the persons named as the initial Directors of APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY, a California nonprofit corporation, and, pursuant to the authority granted to the Directors by these Bylaws to take action by unanimous written consent without a meeting, consent to, and hereby do, adopt the foregoing Bylaws, consisting of 21 pages, as the Bylaws of this corporation.

Dated: _____ Director

Dated: _____ Director

Dated: _____ Director

Dated: _____ Director

Dated: _____ Director

Dated: _____ Director

Dated: _____ Director

Dated: _____ Director

Dated: _____ Director

CERTIFICATE

This is to certify that the foregoing is a true and correct copy of the Bylaws of the corporation named in the title thereto and that such Bylaws were duly adopted by the Board of Directors of said corporation on the date set forth above.

Dated: _____ Secretary

EIGHTH COMPUMAG CONFERENCE
on the
COMPUTATION OF ELECTROMAGNETIC FIELDS

Sorrento, Italy, July 7-11, 1991

The Eighth COMPUMAG Conference on the Computation of Electromagnetic Fields will be held in Sorrento, Italy from July 7 to July 11, 1991. Previous COMPUMAG Conferences were held in Oxford, U.K. (1976), Grenoble, France (1978), Chicago, USA (1981), Genoa, Italy (1983), Fort Collins, USA (1985), Graz, Austria (1987) and Tokyo, Japan (1989).

The aim of the conference is to discuss recent developments and practical applications in the numerical computation of electromagnetic fields for physicists and engineers engaged in the design of electromagnetic devices. Reflecting the new trends and rapid progress in the field, the presentation of papers on inverse problems, coupled problems and parallel computing in applied electromagnetics is encouraged. Prominent speakers will be invited to present overviews and focus attention on future trends in areas of interest to the conference.

Short versions of papers are due by November 15, 1990. Full versions of papers are due at the conference. A digest of short versions of the papers accepted for the conference will be made available to all participants at the start of the conference. The Conference Proceedings will be published in IEEE Transactions on Magnetics. All submitted manuscripts, invited as well as contributed, will be evaluated by peer reviewers to determine their suitability for publication.

An on-line computer display and exhibition of both commercial and university/research organizations is planned during the conference.

Persons or organizations who desire further information on the conference should contact:

COMPUMAG - Secretariat, Dipartimento di Ingegneria Elettrica
Universita di Napoli "Federico II", Via Claudio, 21
I-80125 Napoli, Italy, Fax: +39 81 616897

FOURTH BIENNIEL IEEE CONFERENCE
on
ELECTROMAGNETIC FIELD COMPUTATION

Toronto, Canada, October 22-24, 1990

The Fourth Biennial IEEE Conference on Electromagnetic Field Computation will be held October 22-24 at the Westbury Hotel, Toronto, Canada. The three-day conference is being sponsored by Region 7 and the Toronto Section of the IEEE, in cooperation with the IEEE Antennas and Propagation, Magnetics and Microwave Theory and Techniques Societies and the Applied Computational Electromagnetics Society. The conference will provide a forum for Engineers and Numerical Analysts having interests in low and high frequency computational electromagnetics to discuss common issues relating to numerical and analytical techniques for 2D and 3D problems and applications; parallel computing for E.M. field analysis; CAE and visualization; automatic mesh generation; verification and validation of field analysis codes. Parallel sessions will be kept to a minimum. Information concerning this conference can be obtained from:

CEFC'90 Conference Secretariat
Department of Electrical Engineering
University of Toronto
Toronto, CANADA M5S 1A4

JOINT ACES/TEAM INTERNATIONAL WORKSHOP ON CANONICAL PROBLEMS IN COMPUTATIONAL ELECTROMAGNETICS

October 25-26, 1990, Toronto, CANADA

The Applied Computational Electromagnetics Society (ACES) will join with the TEAM (Testing Electromagnetics Analysis Methods) Workshops to conduct a workshop on canonical problems in computational electromagnetics. The workshop will be held at Hydro-Place, 799 University Ave., Toronto, on October 25-26, 1990, following the Fourth Biennial IEEE Conference on Electromagnetic Field Computation (CEFC), October 22-24, 1990, at the Westbury Hotel, 475 Yonge St. Toronto. Hydro-Place is a 10 minute walk from the Westbury Hotel.

The TEAM Workshops, now in their fifth year, comprises an international series of workshops to compare numerical computer codes for electromagnetic analysis against benchmark problems for which results have been obtained either by measurement or by analytic solution.

The Joint Workshop will provide an opportunity for participants to present brief, informal, descriptions of their methods, with emphasis on new work and on capability or application extension to existing computer codes and models. These presentations will allow participants to contribute to the development of universal code performance standards, modeling guidelines, computational electromagnetics data bases, and tools for validation of codes and models.

Solutions will be presented for the TEAM Workshop Set, Round 3 and for the ACES *Collection of Canonical Problems-Set 1*. These problems represent diverse applications.

- high, as well as low frequencies
- penetrable, as well as perfectly-conducting bodies
- nondestructive evaluation, radar cross-section, inverse scattering, coupled, and non-linear problems
- transient and steady-state waveforms

Following the presentations of the solutions of existing problems, there will be a discussion of these solutions, and an opportunity to propose new problems for future workshops. The solutions, together with a summary of the Workshop, will be published in the *ACES Journal*. The official Workshop language will be English.

The TEAM Workshop Set, Round 3 can be obtained from Dr. Larry Turner, Argonne National Laboratory, Bldg. 362, 9700 Cass Avenue, Argonne, IL 60439, USA. This publication is available at no charge.

The *ACES Collection of Canonical Problems* — Set 1 can be obtained from Prof. Richard W. Adler, Naval Postgraduate School, Code ECAB, Monterey, CA 93943, USA. The prices are:

ACES members *:	US \$12 (\$ 9 within the USA)
non-members:	US \$20 (\$15 within the USA)

* Participants in past TEAM workshops may purchase this publication at the ACES member rates.

Indicate your interest in attending the Workshop and presenting a solution to a canonical problem by September 15, 1990 to the Workshop Chairman:

Harold A. Sabbagh
Sabbagh Associates, Inc.
4639 Morningside Drive
Bloomington, IN 47401 USA
PHONE: (812) 339-8273
FAX: (812) 333-1269

The

Applied Computational Electromagnetics Society

announces a

CALL FOR PAPERS

for a special issue of the *ACES Journal* on:

APPLICATIONS OF HIGH FREQUENCY METHODS AND COMPUTER TECHNIQUES IN ELECTROMAGNETICS

Suggested topics for papers include:

- GTD and asymptotic techniques
- Spectral Domain Techniques
- PTD and Equivalent Current Methods
- Radar Polarimetric Methods
- Direct and Inverse Scattering
- Image Processing
- Graphical I/O
- Computer Modeling for HF Techniques
- Computer Aided Design in HF Problems
- Computer Code Validation

Applications include:

- Antennas
- High Frequency Propagation
- ElectroMagnetic Compatibility
- Frequency selective surfaces
- Acoustic scattering and propagation
- Antennas mounted on Satellites, Aircraft, Ships, etc
- Radar Cross Section
- Remote sensing

Deadline is September 30, 1990

Send papers and/or inquiries to:

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**EUROPEAN TEAM WORKSHOP
and
4TH INTERNATIONAL IGTE SYMPOSIUM
on
NUMERICAL FIELD CALCULATION
IN ELECTRICAL ENGINEERING**

CALL FOR PAPERS

The European TEAM Workshop and the 4th International IGTE Symposium on Numerical Field Calculation in Electrical Engineering will be held at the Meerscheinschlossl, Graz, Austria from October 10 to October 12, 1990.

The TEAM workshops (Testing Electromagnetic Analysis Methods), now in their fifth year, comprise an international series of workshops to compare numerical computer codes for electromagnetic analysis against benchmark problems for which results have been obtained by measurement or by analytic solution.

Current workshop problems are:

- Problem 8. Coil over a conducting plate containing a crack: an NDT problem driven at a single frequency.
- Problem 10. An iron loop passing through a solenoid with its current switched on: a 3D nonlinear transient problem.
- Problem 12. Transient magnetic field causing a copper cantilever to vibrate: a coupled magnetic/structural problem.
- Problem 13. An iron loop passing through a solenoid with DC drive: a nonlinear static problem

The symposium intends to provide a special forum for presentation of new developments in the numerical calculation of fields in electrical engineering.

The working language will be English.

The contributions to the Symposium will be published in the proceedings.

Details of the TEAM workshop will be sent to registrees on request.

A registration fee of ATS 1200.- (including Conference Dinner and refreshment during the conference) will be charged to the participants.

Correspondence regarding the Workshop and Symposium should be addressed to:

W. Rucker
Institut für Grundlagen und Theorie der Elektrotechnik
Technische Universität Graz
Kopernikusgasse 24
A-8010 Graz, Austria
Tel: +43 316 873 7256
Fax: +43 316 831946

The 7th Annual Review of Progress in Applied Computational Electromagnetics

March 19 - 21, 1991

Naval Post Graduate School; Monterey, California

DEADLINE FOR ABSTRACT SUBMITTAL - NOVEMBER 1, 1990

The purpose of this annual review is to bring analysts together to share information about the practical application of EM analysis using computational methods. Contributions by both users and developers of electromagnetic modeling tools are solicited pertaining to experience gained in practical applications. Papers about the solution of practical EM problems encountered in design or problem solving are of particular interest. This symposium also provides a forum for discussion of code enhancements and the development of new techniques and codes. Suggested topics include:

APPLICATIONS

Antenna Analysis
EMC/EMI
EMP, shielding, radiation effects
Impulse and transient analysis
Scattering
 μ - and mm-wave components
EM machines and devices
Power Transmission
Accelerator design
Biological applications
Modeling guidelines
Code studies of basic Physics

NUMERICAL METHODS

Differential form methods
Integral form methods
Method of Moments
Finite Element methods
Finite Difference methods
GTD methods
Spectral Domain techniques
Low & high frequency methods
Time Domain techniques
Hybrid techniques
New mathematical algorithms
Data interpretation

CODE DEVELOPMENT

Field Codes
NEC
GEMACS
System Compatibility Codes
IEMCAP
SEMCA
AAPG
COEDS
Time Domain Codes
Code Optimization
Code Validation
Graphical I/O Techniques

Plan early for paper preparation and submittal. Prospective authors are required to submit four copies of an abstract describing their work for review by the program committee. Abstracts should be as complete as possible but must be limited to a single page, including figures. The initial screening for candidate papers is based solely on these abstracts. The abstract must clearly indicate the paper's value in order to be considered for publication. Therefore, it is essential that your initial submission be carefully prepared. A suggested format for both the abstract and technical paper is outlined below.

- | | |
|---|--|
| <p>1. Abstract and Paper format:</p> <ol style="list-style-type: none"> a. Problems or Questions Addressed. b. Objective of your effort with regard to Problem. c. Approach you employed to achieve Objective. d. Progress, Work Performed. e. Results and/or Conclusions Reached. | <p>2. For each author:</p> <ol style="list-style-type: none"> a. Name b. Work - mail address, phone no., and FAX no. c. Home - mail address and phone no. d. Brief professional biography. |
|---|--|

The deadline for submission of abstracts to the Symposium Chairman is Nov. 1, 1990. Authors of accepted presentations will be required to submit a camera-ready summary paper by Jan 18, 1991 for publication in the conference proceedings.

1991 ACES Symposium Chairman

Frank E. Walker
Boeing Aerospace and Electronics
P.O. Box 3999; M/S 85-84
Seattle, WA. 98124-2499
(206) 773-6299; FAX (206) 773-2111

Conference Administrator

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ACES President

Stanley Kubina
Concordia University
7141 Sherbrooke Street West
Montreal, Quebec; Canada H4B 1R6
(514) 848-3093; FAX (514) 848-3492

All submittals become the property of the Symposium and will not be returned. The author of each paper accepted for publication will be required to provide author and sponsoring organization Copyright Releases to the Symposium Proceedings. Copyright release forms will be provided. The author and sponsoring organization will retain the right to free use of the copyprotected material.

Share your knowledge and expertise with your colleagues
at the Applied Computational Electromagnetics Society's
7th Annual Review of Progress

The Annual ACES Conference is an ideal opportunity to participate in a large gathering of EM analysis enthusiasts. Whether your interest is to learn or share what you know, this conference is sponsored for you. In addition to technical publication the conference organizes live demonstrations, vendor presentations, and short courses. All aspects of electromagnetic computational analysis are represented.

DEMONSTRATIONS

Computer demonstrations
Poster papers
Keynote speakers

SHORT COURSES

Numerical techniques
Computational methods
Surveys of EM analysis
Code usage instruction

VENDOR BOOTHS

Product demonstrations
Subcontract capabilities
Instruction
New commercial codes

If you wish to participate in these proceedings as an author, a vendor, a short course presenter, or simply wish to demonstrate a new development, contact the Symposium Chairman at the addresses listed on the reverse side. The Conference registration fee is \$180.00 (\$195.00 after March 10). Short course topics and lecturers will be announced. The average fee for short course attendance is anticipated to be \$75.00 per person for a half day session and \$100.00 for full day lectures.

The Applied Computational Electromagnetics Society

Call For Papers

1991

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FROM:

Frank E. Walker
1991 ACES Symposium Program Committee Chairman
Boeing Aerospace and Electronics
P.O. Box 3999; M/S 85-84
Seattle, WA. 98124-2499

1991 ACES Symposium

Sponsored by: ACES, DOD/USA ECOM, US-AISESA, NOSC, DOE/LLNL.
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THE APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY, INC.

ACES sponsors a 3-day Annual Review of Progress in Applied Computational Electromagnetics around the third week in March in Monterey, CA. Publications of the society include the Annual Conference Proceedings, 2 Journals and 3 Newsletters per year. In addition, special publications are produced as the need arises. A special Journal issue on Computer Code Validation and the ACES Canonical Problem Set are examples. The Newsletter informs members of Society activities and provides a forum for modeling and code information exchanges.

The Software Committee provides a means to exchange information about electromagnetic computational codes and maintains a small software library.

The Technical Activities Committee identifies needs in applied computational electromagnetics. This committee also identifies and implements ways to address those needs.

Membership in ACES is attained through payment of a membership/subscription fee (see below).

For further information regarding ACES or on becoming a member in the Applied Computational Electromagnetics Society, contact ACES Secretary, Dr. Richard W. Adler, Code EC/AB, Naval Postgraduate School, Monterey, CA. 93943, telephone (408) 646-2352, Fax: (408) 646-2955. You can subscribe to the Journal and become a member of ACES by completing and returning the form below.

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Mail to: Dr. Richard W. Adler
Naval Postgraduate School
Code EC/AB
Monterey, CA 93943

ACES QUESTIONNAIRE

JUNE 1990

THE PURPOSE OF THIS QUESTIONNAIRE IS TO PROVIDE VALUABLE FEEDBACK TO THE BOARD OF DIRECTORS IN SETTING FISCAL POLICY WHICH CONFORMS TO THE WISHES OF THE MEMBERS.

PLEASE COMPLETE AND RETURN THIS FORM TODAY.

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APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY

CODE USER GROUP RESPONSE FORM

YOUR NAME _____

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CODES FOR WHICH YOU WOULD LIKE USER GROUPS FORMED:

You may also include graphics codes and other "input/output" codes which are commonly used in computational electromagnetics.

If possible, please state the general capability of each code (for example: antennas, radar scattering, plasmas, shielding, power transmission) and the code developer or other point of contact.

Please return this form to:

Christopher C. Smith
ACES Code User Group Chairman
Kaman Sciences Corporation
P.O. Box 7463
Colorado Springs, CO 80933
USA

ANNOUNCING

A SPECIAL ACES PUBLICATION

The ACES Collection of Canonical Problems — Set 1

Guest Editor: Harold A. Sabbagh

The problems range in frequency from 10 GHz to 900 Hz, and they include penetrable as well as perfectly conducting bodies. They include diverse applications — radar cross section to nondestructive evaluation and even inverse scattering. Both transient excitation and sinusoidal steady-state excitation problems are included.

Solutions to these problems — and also to TEAM Workshop problems — will be presented and discussed at an international workshop, scheduled for 25-26 October 1990 in Toronto, Canada. The workshop will be sponsored jointly by TEAM and ACES.

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_____ *The Proceedings of the Sixth Annual Review of Progress in Applied Computational Electromagnetics*
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