Reliabilit

NEWSLETTER

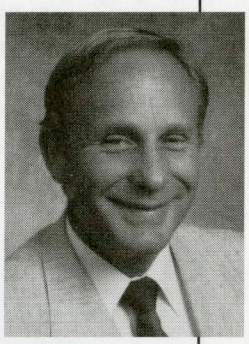
. 38, No. 4, October 1992 (ISSN 1059-8642)

IEEE

CONTENTS

Editor:
Bruce Bream

Message from the President



We just held our Summer Adcom meeting Friday and Saturday, July 17 and 18 in Boulder, Colorado. This is where I am located and I took advantage of this to host our executive meeting here. We hold four adcom meetings a year. These are the leadership meetings of the Reliability Society. The Summer meeting is typical just for executive officers. Any one can attend but the invitations are sent to the officers only. The other three Adcom meetings invite all of the elected ADCom members as well as Chapter Chairman. Our next Adcom meeting is scheduled October 19 at the Xerox training facility in Leesburg Va. This is held in conjunction with the CAD/CAE conference that the reliability society sponsors. That meeting will run from 1 to 5 pm and any interested members are invited.

People interested in working at the national level should either come to one of our ADCOM meetings or contact myself or one of the other officers and let your interest be known. This past week I was contacted by Michael Cushing, who works with the Army. He has an interest in Standards activity and is willing to lead our efforts in that area. This has been vacant since Dave Troxel retired. It really feels good to have a vital focus in each our key areas.

Another key area that is needed someone to fill is the generation of a reliability course. We tried to do this a few years back. We could not complete the effort at that time but our key lead person, Vince Lalli, went ahead and published his book through NASA. The IEEE headquarters is the prompter now. They want us to publish such a course. The task is easier than it was when he tried to do it before. This time what is required is developing a study guide to lead the student through a standard text. It will provide additional examples and provide a fuller understanding by the the student. So if you think that you might be interested, forward your proposal to our Vice President of technical operations, Joe Gruessing.

(continued on page 3)

Editor's Column .....

Have your thought about how to keep current in the R&M field? I hope that the contents of this newsletter fulfills this in part. We try to provide useful information to our members on current topics in R&M. There are other sources that should be considered as well. I recently took a course on Reliability from a local college. While it takes more effort than the 2-3 day seminars, I think everyone will agree that it is a much better environment for learning. College credit courses also stand a better chance of getting company reimbursement. The IEEE society chapter meetings are another great place to meet others in your field and exchange ideas. (Note to chapter chairmen: let us know what you are doing. The newsletter can be good advertising for your activities and also give ideas to other chapters for their meetings.) Conferences on specialized topics like RAMS, IRPS, InterRAMQ, etc., provide an even better opportunity to find out the most current information in your field. The local engineering college library is another place I like to frequent. There is always another interesting book or journal on the R&M field to be found. The University of Arizona is even offering courses in R&M through their VideoCampus and University of Maryland is offering courses via satellite. Of course there is also the courses, videoconferences and seminars sponsored by IEEE. I'm sure I've missed some ways to keep current. If you have some ideas you'd like to share, drop me a line.

Bruce Bream
Editor
IEEE Reliability Society Newsletter

Reliability Society Newsletter Inputs

All RS newsletter inputs should be sent to:
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Email: scbream@lims02.lerc.nasa.gov

The schedule for submittals is:

Newsletter	Due Date
January	November 19
April	February 20
July	May 21
October	August 20

ADVERTISING RATES

All copy that contains graphics or special fonts must be camera-ready or delivered on computer disk and be received by the due dates indicated.

Ad Size	One Time	2-3	4+
Full Page	$400	375	350
Half Page	$300	280	260
Third Page (vertical)	$240	225	210
Quarter Page	$205	190	180
Eighth Page	$120	110	100

Discounted per issue rates are shown for ads run in more than one issue.

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RELIABILITY SOCIETY OFFICERS

NATIONAL ENGINEERS WEEK

National Engineers Week will be celebrated 14-20 February 1993.

New NASA Reliability Publication

A manual entitled "Reliability Training" (NASA RD-1253, June 1992) has been published by NASA. The theme of this manual is failure physics - the study of how products, hardware, software, and systems fail and what can be done about it. The intent is to impart useful information, to extend the limits of production capability, and to assist in achieving low-cost reliable products. In a broader sense the manual should do more. It should underscore the urgent need for mature attitudes toward reliability. Five of the chapters were originally presented as a classroom course to over 1000 Martin Marietta engineers and technicians. Another four chapters and three appendices have been added. We begin with a view of reliability from the years 1940 to 2000. Chapter 2 starts the training material with a review of mathematics and a description of what elements contribute to product failures. The remaining chapters elucidate basic reliability theory and the disciplines that allow us to control and eliminate failures. The document can be obtained from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA, 22161, (703)487-4650.

Message from the President

(continued from front cover)

Along with our educational efforts I went to IEEE headquarters in Piscataway NJ in June and video taped a two hour course in Software Reliability. This was accompanied with an outline of foils and some text. Their are two other IEEE tapes in the same subject. One done by John Musa and the other by Professor Amrit Goel. The IEEE will market the package of tapes on the subject.

As the IEEE reliability society president, I also attend three meetings a year with the other Society presidents. By the time this letter is published I will have met July 30, 31 and August 1 in Reno Nevada. The next TAB meeting as they are called, will be in Phoenix in December. In 1993 one of our meetings will be Singapore. There is a goal of having at least one meeting a year of the three outside of the USA.

Best regards on your professional endeavors.

Dr. Samuel Keene
President
IEEE Reliability Society

Chapter Activities .....

Cleveland

The Cleveland Chapter has had two meetings.

Our last meeting was on professional activities. Jim Satson gave an outstanding presentation entitled "From Sea to Shining Sea". This presentation was first seen at Section Congress '90. Music and slides take you on a tour of the IEEE world, the benefits of membership, the value of volunteer organizations, the need for total quality management to stay competitive and satisfy our customers. This meeting was joint with the Section. The combination of a social hour, dinner, awards, elections, a spirited presentation and dancing is always well received. Thanks Jim, for your usual excellent presentation.

Our first meeting of the new service year was on Environmental Issues and Impacts To Engineers. This meeting was a re-broadcast from the IEEE Learning Channel Video Conference Seminars. Eight experts: Diana J. Bendy, et al, talked about:

- Policies, strategies, and organization
- Environmentally conscious products
- Packaging with environmental attributes
- Solid waste management
- Reducing chemical emissions
- Chlorofluorocarbon (CFC) emissions
- External outreach programs

Every seat was filled. Some could only get the notes. All went well. We would like to thank Sherry Gaul for all of her hard work in caring for the IEEE Video Conferences. Sherry is on maternity leave. Thanks for your help-Sherry. A lot of people benefitted from your work.

All-in-all here in Cleveland we are having fun serving our members and looking forward to expanded activities in the future.

Vincent Lalli
Chairperson, Cleveland Chapter

CALCE – Physics-of-Failure

The CALCE EPRC just received $1M for a one-year effort to support the development of a generic physics-of-failure methodology and associated software tools for the design and assessment of reliability at the microelectronic packaging level. The effort is being sponsored by the Army AMSAA - the Army's Center of Excellence for Systems Analysis, and the Army Electronic Technology and Devices Laboratory. This effort includes documentation of a generic physics-of-failure approach, identification and modeling of the key failure mechanisms relevant to microelectronic hardware, and software tools which aid in the reliable design, screen, and test of semiconductor, hybrid, and multi-chip module packages. For further information, please contact Carl Rust (CALCE) at (301) 405-5323 or Michael Cushing (AMSAA) at (301) 278-8808.

What is Physics-of-Failure

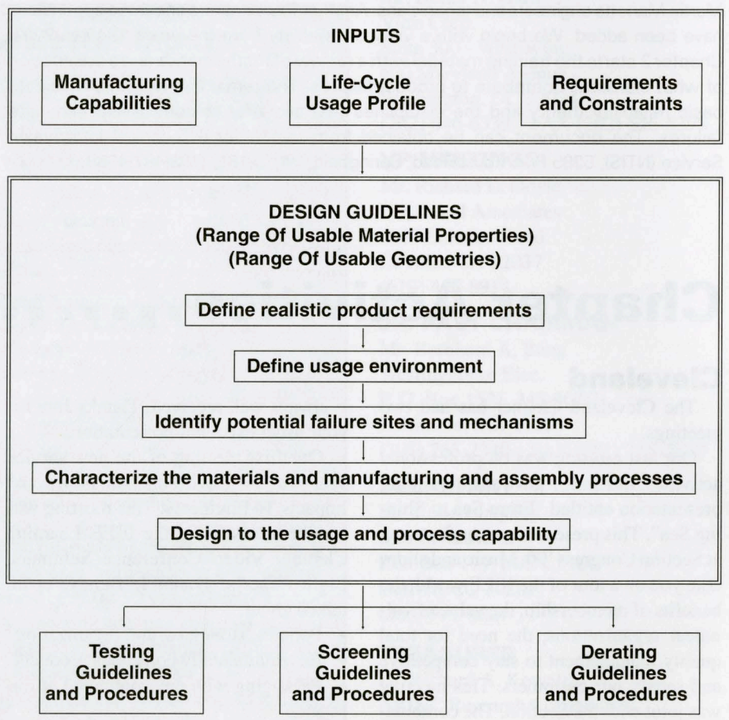
Physics-of-failure is an up-front approach to reliability which utilizes the knowledge of failure mechanisms to prevent product failures through robust design and manufacturing practices. The physics-of-failure approach is based on the identification of potential failure mechanisms and failure sites for the product. Each failure mechanism is described by a generic failure model, which relates the stresses and their variabilities at each potential failure site to the product reliability. The stress at each failure site is obtained as a function of environmental and usage conditions, as well as product geometry and material properties.

The physics-of-failure approach enables selection of material and geometric parameters of the product to attain high reliability. The approach proactively incorporates reliability in the design process. It establishes a scientific basis for evaluation of new materials, structures, and technologies and for designing tests, screens, safety factors, and acceleration transforms.

Why is Physics-of-Failure Necessary

Reliability is often defined as the probability that a product will perform its intended function within specified tolerance under stated conditions for a given period of time. This concept of reliability as a probability, typically quantified by assessing the mean time between failures, implies that field failure is inevitable.. This common paradigm of reliability has been exploited, as is evident from the estimates of the failure rates of electronic components based on empirical models fit to field data, available in several handbooks [MIL-HDBK 217F 1991], [RPP 1988], [CNET 1983], [BT 1984], and [NTT 1982]. The failure models used by these empirical handbooks are typically not derived from or based on any physics or mechanics of failure, and as such, they do not give the designer any insight into or control over the actual failure mechanisms. Thus, when designing, screening, and testing a new product or a product with new technologies, these models may be inappropriate and misleading.

Physics-of-failure is the key to reliability enhancement of products. Traditional reliability assessment techniques heavily penalize new materials, structures, and technologies because of lack of sufficient failure data. This approach, based on the "fear of the unknown" rather than any science-based analysis, discourages design changes, hindering the process of reliability enhancement. The physics-of-failure approach, on the other hand, is based on generic failure models which are as effective for new materials and structures as they are for existing designs. The approach encourages innovative designs by a realistic reliability assessment.



The Physics-of-Failure Approach to Reliable Design

What are the Steps to the Physics-of-Failure Approach

The concept of design for reliability requires a scientific approach founded on the principles of physics and engineering, rather than solely on the manipulation of statistical information. There are eight basic steps to implement the physics-of-failure approach.

1. Define realistic product requirements.
2. Define the design usage environment. The usage profile defines the mechanical, thermal, electrical, and chemical loads that are experienced over time. These loads may be associated with manufacturing, testing, storage, repair, handling, and operating conditions.
3. Identify the potential failure sites and failure mechanisms. Critical parts and their interconnections, and the potential failure mechanisms and modes must be identified early in the design. Potential architectural and stress interactions must also be defined.
4. Characterize the materials and the manufacturing and assembly processes. It is unrealistic and potentially dangerous to assume defect-free structures. Materials often have naturally occurring defects, and manufacturing processes can induce additional defects.
5. Design to the usage and process capability (i.e., the quality level that can be controlled in manufacturing and assembly). The design stress spectra, the part test spectra, and the full-scale test spectra must be based on the anticipated life-cycle usage conditions. Modeling and analysis is a step toward assessment. Tests may be conducted to verify the results for complex structures.
6. Qualify the product manufacturing, assembly, and maintenance processes.
7. Control the manufacturing and assembly processes addressed in the design.
8. Manage the life-cycle usage of the product, using closed-loop management procedures. These procedures include realistic inspection and maintenance procedures, tracking procedures, deficiency reporting, and updates in procedures based on actual usage.

References

BT, Handbook of Reliability Data for Electronic Components Used in Telecommunications Systems, British Telecom Handbook HRD3, Issue 3, January 1984.

CNET, Recueil de Donnees de Fiabilitie du CNET (Collection of Reliability DATA from CNET), Centre National d'Etudes des Telecommunications (National Center for Telecommunication Studies), 1983.

MIL-HDBK 217F, Reliability Prediction of Electronic Equipment, MIL-HDBK 217F, U.S. Department of Defense, Washington D.C., 1991.

NTT, Standard Reliability Table for Semiconductor Devices, Nippon Telegraph and Telephone Corporation, March, 1985.

RPP, Reliability Prediction Procedure for Electronic Equipment, TR-TSY-000332, Issue 2, Bellcore, July, 1988.

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Notice: RADC Releases Page Changes To MIL-HDBK-217F

A Notice 1 Change, dated 10 July 1992, has been issued against MIL-HDBK-217F, "Reliability Prediction of Electronic Equipment", and is a page change update. Notice 1 has been issued "to correct minor typographical errors in the basic F Revision." This change is available from the U.S. Government Standardization Document Order Desk, 700 Robbins Avenue, Bldg 4, Sec. D, Philadelphia, PA 19111-5094, (215)697-2667.

CAD SPURS CONTROVERSY ON RELIABILITY

Reliability Engineering has benefitted from the Computer-Aided Acquisition and Logistics Support (CALS) initiative with design impact at all phases of design. This is most evident in the electronic design automation (EDA) industry where the production of computer-aided design frameworks have included the integration of third party tools for thermal analysis, reliability prediction, etc. These frameworks basically create a design environment in which a designer develops an optimum design by invoking grading tools to permit achievement of an integrated product design. It is interesting to note, however, that while this can be viewed as progress, there is concern about the data and equations employed to perform the prediction of reliability. What we have is two distinct camps that have the same objective but different approaches for achievement. If we look at the present day environment with emphasis on total quality and design application being defined as satisfying six sigma quality levels we are confronted with a focus on process driven design. Supporters of this philosophy insist that data such as found in MIL-HDBK-217 is not sufficient to achieve these levels but instead require a physics of failure approach to design process optimization. On the other hand, framework vendors are integrating tool sets that rely on prediction data and equations primarily taken from MIL-HDBK-217 to establish a quantitative level of reliability. There has been much controversy about MIL-HDBK-217 and its application to design. Since prediction techniques as well as failure analysis play a role in engineering design, a solution to these concerns can be found in the collective continuation of reliability engineering as manufacturing technology in strict research and development judgements and thereby limit expenditure for IR&D in this area.

Joseph A. Gruessing
VP Technical Operations

Rome Laboratory Microelectronics Reliability Division

"Field Reliability Assessment Program"

Points of Contact: RL/ERDR, Jim Dobson, Dan Burns

The Department of Defense (DOD) has recently expanded the Air Force's Field Reliability Assessment Program which has been gathering knowledge about microelectronic field failures since 1987 in close cooperation with the Air Logistics Centers and the Defense Electronics Supply Center. In order to improve fielded system reliability and to reduce maintenance costs, this program has focused on eliminating the root causes of field failures. High replacement rate components have been targeted using maintenance data bases and during visits to field units. Electrical and materials analysis has been used to determine the responsible physical failure mechanisms. Corrective actions have been aimed at component and system design, manufacturing, test, screen, and procurement practices. Cooperation among the microcircuit manufacturer, Government parts procurement authorities, and the Logistics Centers has been very positive. Existing and emerging corporate and non-DOD government field return programs have been investigated. Results of the Air Force program, to date, have identified electrical overstress and retest good as major categories. These point out the need for more robust system (and component) designs, more precise system debug capability, and for improved in-use system failure event monitoring and diagnostics. Several cases have identified other specific, correctable problems involving vibration, corrosion, and particulate contamination. For more information on this program and a summary of the findings, please contact Dan Burns at Rome Laboratory, RL/ERDA, 525 Brooks Rd, Griffiss AFB NY 13441-4505, telephone (315) 330-2868.

IEEE EMPLOYMENT GUIDE

For recent technology graduates and for engineers and scientists hit by defense industry cutbacks, help in finding employment is now available through a single source.

Two volumes of an Employment Guide for Engineers and Scientists, updated for the '90s, are being offered by IEEE-USA, the United States Activities arm of IEEE. The Guide is available in two editions: one designed for those with employment experience; the other, for students and recent graduates.

The student edition, just published in July, contains basic information on conducting a job search. Special features include a list of the 50 most-asked questions during a job interview.

Both publications contain information on salaries, along with solid advice on how to conduct a job search. They also provide assistance on how to:

- cope with job loss
- write resumes
- prepare for interviews
- work with employment services
- interact with colleagues and friends
- evaluate compensation packages
- assess legal rights in the employment process

Both versions include a Directory of Employers of Engineers, a comprehensive state-by-state sourcebook that lists hundreds of companies, including telephone numbers and contact persons.

The Guides are sold through the IEEE Service Center: $14.95 to members, $19.95 to non-members, plus tax and shipping. To order, call 1-800-678-4333 and request Catalog No. UH0186-7, for the experienced engineer; or UH0188-3, for the student edition.

A copy of either Guide will be provided at no charge to non-student IEEE members who are unemployed. Written requests, including membership number, should be sent to William R. Anderson, IEEE-USA, 1828 L Street, N.W., Suite 1202, Washington, DC 20036.

Addition to Reliability Speakers List

Puran Luthra,Senior Staff Engineer, Design Reliability, MS 4210, Electronics & Space Corporation, 8100 W. Florissant Avenue, St. Louis, MO 63136, Off: (314) 553-4210, Fax: (314) 553-4114, Home: (314) 355-4824

Author of R&M Symposium papers in 1990 and 1991. ASQC presentations "Reliability - What It Means" and "Environmental Stress Screening". Received ASQC St. Louis Section TQM Award for 1992.

Geographical Limitations: None.

Transportation Requirements: Negotiable

Topics:

- FMECA
- Environmental Stress Screening
- Reliability Growth & Management

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Conference Calendar

DATE	CONFERENCE	PLACE

1993

Jan. 11-14 — Quality through Engineering Design — Bangalore, India

Competitiveness in world markets is an essential elements of national economic development. Focusing on advanced materials and parts manufacture, this conference will foster understanding and collaboration among scientists and engineers from India, Japan, and North America in the fields of engineering design, computational approaches in design, statistical design and analysis, reliability, and quality control.

Contact: Kaye Wade, NIST, Admin. Bldg. A337, Gaithersburg, MD 20899
Tel: (301)975-2839, Fax: (301)990-4127, Email: wade@micf.nist.gov

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Jan. 25-28 — Reliability and Maintainability Symposium (RAMS) — Westin Peachtree Plaza Hotel, Atlanta, Georgia
"Assurance Technologies for Tomorrow's Envrionment"

(See advertisement in this issue for details)

March 22-25 — International Reliability Physics Symposium — Hyatt Regency Hotel, Atlanta, Georgia

Emphasis will be on building reliability into VLSI devices as the means of achieving the low failure rate expectations of the 90's. Testing methodologies and analyzing for reliability will also be covered. Optoelectonics failure mechanisms and models are also included.

(See the conference advertisement in this issue of the newsletter.)

Nov. 1-5 — 4th International Symposium on the Physical & Failure Analysis of Integrated Circuits — Singapore

Organised by the IEEE Singapore Section in co-operation with the Centre for Integrated Circuit Failure Analysis & Reliability, National University of Singapore.

The Technical Committee is now inviting the submission of papers for presentation at IPFA 93. Papers should deal with work on:

Failure Mechanisms, Failure Analysis Techniques, EOS/ESD Studies, Reliability Testing, Design and Process Control for Reliability in LSI/VLSI, Semiconductor-insulator interfaces, contacts and metallisation, Packaging, bonding, die attach and encapsulation, Opto-electronic devices, Power devices

Authors are requested to submit two copies of a 500 word summary and a 50 word abstract to:

Technical Committee Chairman, c/o IPFA 93 Secretariat, IEEE Singapore Section, PO Box 1066, Kent Ridge Post Office, Singapore 9111. Tel: (65) 291-9690 Fax: (65) 292-8596

Final date for submission of summary and abstracts: 1 March 1992.

A four day exhibition of FA & Reliability related equipment and services will be held concurrently with the Symposium.

Contact: SWEE Yong Khim, IEEE Singapore Section, 200 Jalan Sultan, #11-03, Textile Centre, Singapore 0719, Tel: (65)291-9690, Fax: (65)292-8596
or IPFA , 93, Daniel Chan, National University of Singapore, Electrical Engineering Department, 10 Kent Ridge Crescent, Singapore 0511, Email: ELECSHD@NUSVM.BITNET

1993 ANNUAL RELIABILITY AND MAINTAINABILITY SYMPOSIUM

January 25-28, 1993

Westin Peachtree Plaza Hotel
Atlanta, GA USA

THEME

ASSURANCE TECHNOLOGIES FOR TOMORROW'S ENVIRONMENT

- Total Quality Management
- R&M Management
- Software R&M
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Beckman Instruments, Inc.
200 S. Kraemer Blvd.
MS: W351
Brea, CA 92621 USA
(714)961-3793
FAX (714)961-3743

1993 International Reliability Physics Symposium

March 22-25, 1993 ■ Hyatt Regency ■ Atlanta, Georgia USA

The 1993 Symposium continues to emphasize building reliability into VLSI devices as the means of achieving the low failure rate expectations of the Nineties. "Building-in-Reliability" papers will be presented that trace the progression from: reliability physics - reliability engineering - design-for- tolerance - fabrication/assembly process control. Emphasis will be on key input variables during manufacture and how the input variables impact reliability when when out of control. The 1993 Symposium continues its long standing tradition of presenting reliability physics papers on new VLSI failure mechanisms and new understanding of existing failure mechanisms.

LATE PAPERS: A limited number of late papers reflecting **important last-minute** developments will be considered on a space-available basis. Abstracts and summary must be received no later than **December 4, 1992.**

For Conference Information:

USA
Dr. David Baglee
General Chairman, IRPS
Intel Corporation, MS F9-99
4100 Sara Road
Rio Rancho, NM 87124
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Fax:505-893-1049

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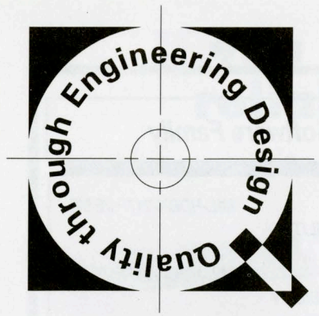

Preliminary Program and Registration

Quality through Engineering Design

An Indo–U.S.–Japan Conference
A part of the P. C. Mahalanobis Centenary

Bangalore, India • January 11-14, 1993

Competitiveness in world markets is an essential element of national economic development. Focusing on advanced materials and parts manufacture, this conference will foster understanding and collaboration among scientists and engineers from India, Japan, and North America in the fields of engineering design, computational approaches in design, statistical design and analysis, reliability, and quality control.

Cosponsors of the conference:

- National Institute of Standards and Technology (NIST)
- National Science Foundation (NSF)
- Army Research Office (ARO)
- Union of Japanese Scientists and Engineers (JUSE)
- Indian Statistical Institute (ISI)

Bangalore is the capital of Karnataka. Situated at 3,250 feet above sea level, it has a pleasant climate throughout the year. During January it is dry with temperatures between 50°F and 80°F. Bangalore is famous as the city of gardens. Founded in 1537 AD, it grew rapidly during the British period and is now a focal point of Indian science, technology, and industrialization. Other beautiful cities and historic spots such as Mysore are within a day's travel. There are excellent hotels in Bangalore including the TAJ Residency, the location of the conference.

For program and registration information contact

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Admin. Bldg. A337
Gaithersburg, MD 20899
TEL: 301-975-2839
FAX: 301-990-4127
EMAIL: WADE@MICF.NIST.GOV

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M. Koike
Way Kuo
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