

# Components for Military & Space Electronics Conference & Exhibition

February 11 - 14, 2008  
Sheraton Mission Valley Hotel  
San Diego, CA

12<sup>th</sup> ANNUAL CMSE CONFERENCE

Updated January 31, 2008

## ADVANCE PROGRAM & REGISTRATION



### Highlights of 2008 Conference

- **Seminars**
  - Component Engineering Basics for Reliability
  - Counterfeit Components Avoidance
  - Reliability Issues with IC Packages, Pb Free Solder and COTS Electronics
- **Seven Technical Sessions**
  - Design & Implementation with COTS
  - Packaging & Soldering Impact
  - Component Selection & Application
  - Radiation Hardness Advancements
  - Process & Prediction
  - Testing & Reliability Assessment Practices
  - New Products

**CMSE IS THE PREMIER CONFERENCE ON THE USE OF  
COMPONENTS IN MILITARY AND SPACE ELECTRONICS**

Organized by  
**Components Technology Institute, Inc.**

Co-Sponsored by

Astro Expo  
ECA  
Electronic Products

Military Embedded Systems  
VME and Critical Systems

## Invitation to CMSE 2008

To the Military and Space Electronics Industry;

The CMSE Conference was organized in 1997 to promote the exchange of experiences and promote good practices for selecting and applying all components and COTS electronics, when required, so they will operate successfully and reliably in the military and space environments.

It was soon discovered that many components used in computers, cell phones, consumer electronics and even automobiles were not suitable for military and space systems without testing, uprating, upscreening and in some situations required protection from temperature extremes and radiation levels. The low prices of commercial components as compared to those available to military specifications imply this is a much lower cost approach. Once companies realized the amount of testing and stress mitigation practices required, the cost savings from using COTS components became smaller and in some cases more expensive. The major issue is that many newer technology components are only available as COTS and have to be used.

The CMSE Conference is dedicated to provide tutorials on current topics of great interest to the industry and peer presented topics in the technical sessions. The technical sessions contain presentations on case studies, design and manufacturing with COTS, components engineering practices, reliability and lifetime prediction, components testing and obsolescence mitigation.

The three seminars this year provide valuable knowledge and experience on:

- Components Engineering Basics for Reliability
- Counterfeit Components Avoidance
- Reliability Issues with IC Packages, Pb Free Solder and COTS Electronics

Components equivalent to COTS have been used for decades in military and space systems. They were identified as non-standard or non-preferred components because they had not been qualified and tested to suitable specifications. Once the circuit performance was identified, the design was qualified and production items screened for reliability. A similar approach can be applied to commercial components, but methods and techniques may differ and cost has to be identified and controlled to be efficient.

CMSE is the biggest and most comprehensive conference addressing successful practices for the use of COTS electronics in military and space systems, though sometimes controversial. Everyone working in this field is encouraged to attend CMSE 2008 to learn about the latest information and visit the exhibits which promote current equipment, information and services on components and COTS for military and space use.

I look forward to seeing you in San Diego at CMSE 2008.

Leon Hamiter  
Program Chairman

# Components for Military and Space Electronics Conference

Organized by engineers for engineers and engineering management, this is the premier conference for military and space electronics issues. This 12th Annual Conference addresses systems, subsystems, circuit boards and components while also emphasizing new technology, and design practices.

## Venue

### Accommodations:

**Sheraton Mission Valley Hotel**  
1433 Camino Del Rio South  
San Diego, CA 92018  
Tel: 619-260-0111  
Fax: 619-497-0808

Reservations should be made directly with Sheraton Gateway Hotel. Mention CMSE Conference.

### Registration:

**Monday, February 11**  
7:00 am - 5:30 pm  
**Tuesday, February 12**  
7:00 am - 5:30 pm  
**Wednesday, February 13**  
7:30 am - 5:30 pm  
**Thursday, February 14**  
7:30 am - 12 noon

### Seminar Schedule (see details herein)

**Monday, February 11**  
8:30 am - 5:00 pm                      Seminars 1, 2 & 3

### Conference Schedule

**Tuesday, February 12**  
8:30 am - 5:00 pm  
  
**Wednesday, February 13**  
8:30 am - 5:00pm  
  
**Thursday, February 14**  
8:30 am - 3:00 pm

### Exhibit Schedule

**Tuesday, February 12**  
12:00 noon - 7:30 pm  
  
**Wednesday, February 13**  
10:00 am - 2:00 pm

### Get Acquainted Reception

**Tuesday, February 12**  
5:30 pm - 7:30 pm

## General Information

### REGISTRATION

The Registration fee now includes the tutorials. Advance registration is strongly recommended for space availability in the selected tutorial. At the door changing of tutorials will only be allowed if space permits.

The Conference registration fee includes the a choice of Seminars, Technical Sessions, Conference Notes, refreshment breaks, buffet lunch, reception on Tuesday and the Exhibits. Advance registration is recommended and provides a discount. **Payment must be submitted with the Registration.** See the Registration Form for fees. Company Purchase Orders will be charged a \$25 processing fee.

The Advance Registration cutoff extended to **January 18th** and refunds will not be given after this date for cancellations. Cancellations before **January 18th** will be charged a \$100 administration fee. Substitutions can be made at any time.

### HOTEL ACCOMMODATIONS

Special rates of \$139 single or double, excluding taxes, have been arranged with the Sheraton Mission Valley Hotel. A limited number of rooms at government per diem are available with appropriate identification. Rates will be honored 3 days prior and following the Conference. The cut off for these rates is **January 10, 2008**. To book these rates ask Hotel for on site reservations. Check in time is 3:00 pm and check out is 12:00 pm. Any guest departing prior to checkout date will pay early departure fee. Reservations must be canceled more than 24 hours before arrival date to avoid a charge.

### TRANSPORTATION TO HOTEL

The Hotel provides complimentary shuttle service between the airport and hotel, call 619-260-0111 for pickup. Go to the transportation island for pickup at the hotel shuttle sign. Cloud 9 Supper Shuttle is available to hotel for \$12.00, call 800-974-8885. Self parking at the hotel is \$12.00 per day.

**Monday 8:30am - 5:00pm**

## **Seminar 1**

### **Components Engineering Basics for Reliability**

John Devaney and Howard Dicken, Hi-Rel Labs

This course reviews the early years of the industry and how manufacturing evolved, how they were influenced by technology. It explains ways that Component Engineering can prevent system failures and save mega dollars \$\$\$ and the ways business aspects of competitive technology affect quality, reliability and availability. Case histories and a discussion of a Failure Analyst's definition of a failure and finding the root cause. Explanation of ways that Component Engineers can look at the metallization pattern on a device and ascertain its ESD sensitivity!

Plastic or hermetic packages? Basic assembly steps for a dual in line plastic and ceramic package. Advantages and testing regimens for each. The rise of LEDs and optocouplers as well as the fast gallium arsenide devices are discussed.

The unexpected rise of the MOSFET, CMOS circuit design, basics of fabrication and layout plus latchup causes. Discussion of the various components found in the hybrid and problems with modern hybrids. A visual guide to the variety of diodes and devices hidden within that simple glass envelope. The construction of both solid tantalum and ceramic capacitors will be detailed as well as the design advantages of each.

## **Seminar 2**

### **Counterfeit Components Avoidance**

Leon Hamiter, CTI, Thomas Lee, Jabil

Don Trenholm, Custom Analytical Services

Mark Marshall, Integra Technology, Larry Pappas, Attorney,  
Others

Counterfeit Components entering the supply chain, including military spec parts, are causing a huge economic impact in the Electronics Industry. Counterfeiting and fake components take many forms. In some cases, counterfeiters abrasively remove existing IC markings, blacktop the ICs, and lay down new ink. Sometimes they do high-quality remarking that is difficult to distinguish from markings on authentic ICs. The only tell tale difference in some cases may be that the top of the IC is darker than its sides; color should be consistent across the plastic/epoxy package. DPA investigations of a variety of ICs have found that some have the correct package and identification markings but contain an incorrect die or no die at all. Counterfeiters also may create totally counterfeit die with chips that may in fact work, but that are not from the manufacturer represented on the label. Sometimes counterfeit devices are marked upside down and can be inserted backwards or the pins do not properly align. There are cases where everything looks perfect from the outside but the die is wrong. Many of these components have been subjected to ESD stresses that if they have not failed are now "walking wounded" just waiting to fail.

This seminar is designed to educate the attendees to the kind of counterfeit components that have been discovered and recommend practices to detect and avoid them. These range from purchasing practices to testing, inspection and analysis which will identify items that are counterfeit or fake. This Workshop provides many of these practices and should prove very educational to the attendees.

## **Seminar 3**

### **Reliability Issues with IC Packages, Pb Free Solder and COTS Electronics**

#### **Part 1: Impact of Advanced IC Packages & Lead Free Solder on Reliability**

Robert Darveaux, Amkor Technology

Dr. Reza Ghaffarian, NASA, JPL

John Maxwell, Johanson Dielectrics

Doug Patterson, Aitech

The change from SnPb solder to Pb free in the component lead plating and assembly soldering processes are causing great concern and reliability issues. This seminar will first address the advanced IC packages, large BGA, Wafer scale, COB, etc. and their impact on electronic reliability. Experts are predicting that Sn balls with their close spacing on high density BGAs and other packages will experience growth of whiskers and ball fractures from temperature cycling after long term use.

The acute problems pure tin and other alloys are causing whisker growth will be explained with suggestions to minimize the problem. Various types of components board designs and assembly practices will be discussed.

As the availability of components with SnPb lead plating diminish those projects that prohibit the use of pure Sn will have to attempt to change the lead finish back to SnPb. There are a number of companies offering processes for this change, however, there are quality problems with most of them. These issues and proposed solutions will be presented.

#### **Part 2: Achieving Reliable COTS Electronics**

Anthony Lai, Aitech,

Corey Mack, Magellan Aerospace,

Chris Brown, Pacer Corporation.

The speakers in Part 2 of the Seminar will address key factors that must be considered in selecting COTS electronics which will give reliable performance in the intended applications. There are many different factors to be assessed when the customer was not involved in the design, manufacturing and testing of the COTS.

Another speaker provides in-depth and highly useful procedure for performing cost analysis of COTS Electronics to select the most suitable for the project.

All of the presentations in Seminar 3 provide excellent visibility of reliability issues and practices for making sound decisions in selecting electronics for military and space applications.

## tuesday, february 12

8:30 - 9:15am

### Keynote: Key Issues Facing Military Electronics & Components;

Murray Slovick, Editorial Director, Electronics Group  
Hearst Business Media

9:15am - 12:00noon

### Session 1: Design Implementation with COTS

Chair: John Prymak, Kemet Electronics

- 1.1 **Market Forces and Government Procurement Practices Impact the successful use of COTS based Open Systems;**  
S. Blackman, LynuxWorks Inc.
- 1.2 **Selecting the Best COTS Products for Deployed Applications;**  
M. Gust, Mercury Computer Systems Inc.
- 1.3 **Thermal Trends for Rugged COTS Modules and Improvements in Air, Conduction, and Liquid Cooling;**  
I. Straznicky, Curtiss-Wright Controls
- 1.4 **Comparison of Emerging Switch Interconnect Technologies;**  
M. Chan, Cornet Technology Inc.
- 1.5 **Minimizing Host System Noise and its Adverse Effects on Reliable High-Speed Data Transfer;**  
G. Drosell, SiliconSystems Inc.

12:00 - 2:00pm **Lunch with the Exhibitors**

2:00 - 3:30pm

### Session 2: Packaging & Soldering Impact on Components

Chair: Richard Wavrik, Sandia National Labs

- 2.1 **Solder reflow failures in manually soldered electronic components encapsulated in plastics;**  
A. Teverovsky, C. Greenwell, F. Felt, Perot Systems
- 2.2 **Embedded Passives' Role in Three-Dimensional Packaging and SiP;**  
H. Holden, Mentor Graphics
- 2.3 **The Future Manufacturing Method Using Embedded Die for Military Electronics;**  
J. Raby, STI Electronics Inc.
- 2.4 **Solder Joint Built-in-Self-Test™ (SJ BIST™), Fault Detection in Solder Joints of FPGAs: Update and Availability;**  
J. Hofmeister, E. Ortiz, T. Tracy, Ridgetop Group Inc.

3:45 - 5:00pm

### Session 3: New Products by Exhibitors

Chair: Andrew Moor, JHU Applied Physics Lab

This is a new Session for Exhibitors to explain their products and services that are presented at their Exhibit. Those presenting include: Actel, Aeroflex, Austin Semiconductor, AVX, Fischer Technology, Integra, ITW Paktron, NASA NEPP, Teledyne and Vishay.

5:30 - 7:00pm **Get Acquainted Reception in Exhibit Hall**

## wednesday, february 13

8:30 - 9:00am

### Keynote 2: Current state-of-the-art in MEMs Technologies for Military and Space Applications

Richard Waters, CTO  
Lumedyne Technologies Inc.

9:00 - 12:00noon

### Session 4: Components Selection & Applications

Chair: Alexander Teverosky, NASA GSFC, Perot Sys.

- 4.1 **Guidelines for Reliable DC/DC Converters for Space Use;**  
J. Plante, NASA GSFC Safety & Mission Assurance
- 4.2 **Designing with High Performance Hermetic Gate Driver Optocouplers;**  
J. Khan, Avago Technologies
- 4.3 **Key Considerations in Selecting FPGAs for Mission Critical Applications;**  
M. Kocher, QuickLogic
- 4.4 **Development of FPGA-Based Verification Simulation Accelerator;**  
G. Burke, J. Oh, Jet Propulsion Lab
- 4.5 **Electronic Components for Use in Extreme Temperature Aerospace Applications;**  
R. Patterson, A. Hammoud, NASA;  
M. Elbuluk, University of Akron
- 4.6 **Misidentified Failures in Plastic Encapsulated FETs;**  
M. Gores, Hi-Rel Labs
- 4.7 **Commercial Hi-Rel Tantalum Capacitors: Combining Reliability Performance with the Latest in Capacitor Technology ;**  
C. Pothier, Vishay Intertechnology Inc.

12:00 - 2:00pm **Lunch with the Exhibitors**

## Parallel Sessions for 5 and 6

2:00 - 5:00pm

### Session 5: Design & Process Improvements

Chair: Lori Bechtold, Boeing Integrated Defense Sys.

- 5.1 **Paradigm Shift in Design Assurance and Reliability Prediction;**  
E. Dodd, C. Bonn, Y. Bot, BQR Reliability Engineering, Israel;  
C. Hillman, DFR Solutions
- 5.2 **Advanced High Density, High Efficiency, Light Weight MIL-COTS DC-DC Power Conversion Solutions;**  
S. Oliver, V-I Chip Inc.
- 5.3 **Alternate Methods of Defining Dielectric Quality with Step Surge Stress Testing (SSST) and Scintillation Testing;**  
J. Prymak, P. Blais, B. Long, A. Ifri, E. Jones, Kemet Elec.
- 5.4 **Parametric Instability of MLC Capacitors compared to Multilayer Polymer MLP Film Capacitors - The Parasitics Revealed;**  
I. Clelland, R. Price, T. Saunders, ITW Paktron.
- 5.5 **Die Bonding Evaluation for Hermetic Packages;**  
J. Hochrein, B. Jakoboski, M. Baker, J. Mitchell, M. White,  
J. Brown, S. Thornberg, Sandia National Labs.
- 5.6 **Timely Resolution of Parts Obsolescence/Substitution Using EDA;**  
B. Stallard, M. Silverman, JW Smith, Ops A La Carte  
Reliability Consultants

### Session 6 in Parallel with 5

2:00 - 5:00pm

### Session 6: Space & Radiation Hardness

Chair: Larry Harzstark, The Aerospace Corp.

- 6.1 **Single-Event Upset and Soft Error Rate in Power Architecture Microprocessors;**  
D. Belin, E2V Semiconductors;  
R. Velazco, P. Peronnard, CNRS-TIMA;  
Michel Pignol, CNES; D. Gauthier,  
D. Alexandrescu, IROC Technologies, France.
- 6.2 **SpaceWire Networking Solutions;**  
J. Larsen, Aeroflex Colorado Springs
- 6.3 **Design of a COTS Based 4Gb Radiation Hardened NAND Flash Module;** M. Goksel, D. Czajkowski, E. Lai, Space Micro  
and P-E. Berthet, 3D-Plus.
- 6.4 **Migrating a COTS SRAM to a RadTolerant-by-Design SRAM for High-Reliability Environments**  
B. Bauer, M. Leslie, C. Hafer, Aeroflex Colorado Springs
- 6.5 **Managing Robust Li-Ion Battery Electronics Units (BEUs) for Satellite Applications;**  
G. Altemose, Aeroflex Plainview

- 6.6 **Radiation Characterization of Flash-Based FPGAs,** S. Rezgui, J. Wang, B. Cronquist, J. McCollum, Actel Corp.

## thursday, february 14

8:30 - 12:00pm

### Session 7: Reliability Assessment Practices

Chair: Andrew Kostic, The Aerospace Corp.

- 7.1 **Failures in Hybrid Microcircuits During Environmental Stress Testing. History Cases;**  
A. Teverovsky, Perot Systems
- 7.2 **Board Level Reliability Testing under Harsh Environment Conditions for High-Rel Microprocessors Associated to RoHS Packaging Solutions;**  
O. Gaillard, E2V Semiconductors, France
- 7.3 **Best Detection Methods for Counterfeit Components;**  
M. Marshall, Integra Technologies
- 7.4 **New Reliability Prediction Activities;**  
L. Bechtold, Boeing, D. Query, NSWC Crane
- 7.5 **Recording Storage Environments to Predict COTS Parts Lifetimes;**  
J. Lopez, J. Sweet, R. Wavrick, Sandia National Labs
- 7.6 **A Generalized Approach to Availability Prediction of Non Electronic Components;**  
A. Howard, MTI

12:00 - 1:00pm **Lunch**

## Close of CMSE 2008

1:00 - 3:00pm

### Study Session:

Chair: J. Trupiano, BAE Systems

A Special Interest Group to discuss Components Characterization Screening processes. The following topics offered for discussion & qualification.

1. Scope of components characterization/screening and environmental qualification activities.
2. Lessons learned
3. Evaluation of screening services
4. Experience with alternatives to screening and use of Enhanced Plastic Parts or other initiatives.
5. Analytical processes and experience with suspect counterfeit components.
6. Feasibility of forming a Screening Services User Consortium and sharing selected test data and findings.

**For latest CMSE Program changes see:**

**[www.cti-us.com](http://www.cti-us.com)**

# Exhibition Information

Tuesday, February 12  
Wednesday, February 13

12:00am to 7:30pm  
10:00am to 2:00pm

Exhibiting and Sponsorships are available. For information contact Clay Hamiter, 256-536-1304, [chamiter@cti-us.com](mailto:chamiter@cti-us.com) or visit the web: [www.cti-us.com](http://www.cti-us.com)

## Previous Exhibitors

3D Plus USA  
Abelconn LLC  
Acromag  
Actel Corp.  
Aeroflex Circuit Technology  
Aeroflex UTMC  
AIM USA  
Aitech Defense Systems Inc.  
Aldec Inc.  
Allied Signal  
Analytical Solutions  
AP Labs  
Applied Microsystems Corp.  
APW Electronic Solutions  
Atmel  
Austin Semiconductor  
Avago Technologies  
Avionics Magazine  
AVX  
Bell Technologies  
Belobox Networks  
Blue Wave Systems  
Boeing/Integrated Defense  
Calculex  
Carlo Gavazzi, Inc.  
Catalina Research, Inc.  
Catalyst Enterprises, Inc.  
Cetia, Inc.  
Corfin Industries LLC  
COTS Journal  
Crestwood Technology Group  
Defense News  
Dense Pac  
Dolphin Interconnect Solutions  
DPA Components International  
dSPACE, Inc.  
DY 4 Systems, Inc.  
Electronic Packaging Solutions  
ELMA Electronic, Inc.  
EMJ Embedded Systems  
Eonic Systems Inc.  
Fischer Technology  
General Test Laboratory, Inc.  
GET Engineering Corporation  
GIDEP  
Green Hills Software, Inc.

Harwin Inc.  
Hi-Rel Laboratories, Inc.  
Hi-Test Labs Inc.  
ICE  
ICS Radiation Technologies  
IHS  
Industrial Computing Inc.  
Innovative Integration  
Integra Technologies  
International Rectifier  
ITCN, Inc.  
ITW Paktron  
KEMET Electronics  
Knurr  
Kyocera America Inc.  
Lambda Advanced Analog  
Landsdale Semiconductor  
Launchspace Magazine  
Lineo, Inc.  
Lockheed Martin  
LSI Logic  
LynuxWorks, Inc.  
Lynx Real-Time Systems  
Macrolink, Inc.  
Mango DSP Ltd.  
Manufacturing Technology Inc.  
Mercury Computer Systems  
Micro Memory  
Micropac Industries, Inc.  
Microsemi Corporation  
Miltron Systems, Inc.  
Minco Technology Labs, Inc.  
Mission Research Corp.  
Modular Devices Inc.  
M-Systems  
Nallatech  
NAVSEA PMS440  
NNSA's Kansas City Plant  
NxGen/US-Semi  
Objective Interface Systems  
One Stop Systems  
Ops A La Carte  
Pentek, Inc.  
Peregrine Semiconductor  
Phoenix International  
Primagraphics Ltd.  
Pulse Instruments

QP Semiconductor  
QPI Sales  
Quick Logic  
Real Time Innovations  
Red Rock Technologies  
RT Logic  
RTC Group  
SBS Technologies, Connectivity Products  
Signaal Special Products  
Six Sigma  
Sky Computers  
Soldering Technology Int'l.  
Solid State Devices  
Space Electronics  
Space News  
Spectrum Signal Processing  
Storage Concepts  
Sun Microsystems  
SVAD  
Synergy Microsystems  
Synplicity Inc.  
Sypris Test & Measurements  
Systems Test  
Systran Corporation  
Teledyne Electronic Technologies  
Teledyne Relays  
Texas Instruments  
Texel Ltd.  
Thales Computers  
The Math Works  
Total Parts Plus  
Tracewell Systems, Inc.  
Traquair Data Systems, Inc.  
Tri-M Systems, Inc.  
UTMC Microelectronic Systems  
VenturCom  
Vertel Corporation  
Vertical Circuits Inc.  
Via Satellite Magazine  
Vishay Intertechnology  
VisiCom  
Vista Controls  
VMIC  
Voltage Multipliers Inc.  
VPT Inc.  
Wind River Systems, Inc.  
Winslow Automation Inc.

Register by January 18 for discount

# CMSE Conference Registration Form

## Registration Information (please type or print clearly)

Name \_\_\_\_\_  
Title \_\_\_\_\_ Company \_\_\_\_\_  
Division \_\_\_\_\_  
Address \_\_\_\_\_ M/S or Suite # \_\_\_\_\_  
City \_\_\_\_\_ State/Prov \_\_\_\_\_ Postal Code \_\_\_\_\_  
Country \_\_\_\_\_  
Phone \_\_\_\_\_ Fax \_\_\_\_\_  
E-mail \_\_\_\_\_

### Registration Fees

Attendees - ALL Events (including Seminar 1, 2, or 3) \*1, \*2  
Technical Sessions Only (Tues - Thurs)  
Seminar 1, 2 or 3 Only  
Speakers and Session Chairmen  
Exhibition Only

#### Advance

\$725 \_\_\_\_\_  
\$595 \_\_\_\_\_  
\$420 \_\_\_\_\_  
\$420 \_\_\_\_\_  
\$0 \_\_\_\_\_

#### After Jan 18th

\$845 \_\_\_\_\_  
\$695 \_\_\_\_\_  
\$470 \_\_\_\_\_  
\$470 \_\_\_\_\_  
\$50 \_\_\_\_\_

Total \_\_\_\_\_

If attending a Seminar you must designate which one: 1 \_\_\_ 2 \_\_\_ or 3 \_\_\_

\*1 Includes Conference Notes (One Seminar and Sessions), continental breakfast, breaks, lunches, and reception. Fees not refundable after Jan. 14.

\*2 Groups of 3 or more, from the same company and registering at the same time get \$75 discount for ALL events.

### Payment

Payment must accompany registration. Registrations without payment will not be processed. Company checks must be made out to Components Technology Institute, Inc. and payable in US dollars drawn on a US bank. Credit card payment requires card number, expiration date, and signature. Please note confirmation and cancellation policy listed inside. **FAX THIS FORM TO: 256-539-8477.**

Payment Method:  AMEX  VISA  MC  Check

For Info Call: 256-536-1304

Card Number \_\_\_\_\_ Exp. Date \_\_\_\_\_

Name on Card \_\_\_\_\_

Signature \_\_\_\_\_

**Components Technology Institute, Inc.**

**904 Bob Wallace Avenue / Suite 117**

**Huntsville, AL 35801**

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**CMSE 2008**  
**ADVANCE PROGRAM & REGISTRATION FORM**