Demonstrations: Now that I have your attention, the following is submitted for your approval:

by Andy Drozd, EMC Society and Education and Student Activities Committee

The scene: a high-speed digital logic board. The crime: a poorly designed grounding scheme resulting in excessive radiated interference. The investigation: follow clues to determine the root cause of the problem and find an effective scheme for reducing the radiated emissions. The solution: call in the EMC Crime Scene Investigator (EMCSI)! This is a nifty scenario that might describe a typical day for the EMC engineer and one that certainly captures the spirit of our annual EMC Experiment Demonstrations at the annual EMC Symposium.

As we head into our fourteenth year of holding the "demos," I would like to take a moment to recap this past year's program held at Chicago's Navy Pier Exhibit Hall, consider ways to improve upon what we feel is a successful formula, and look ahead to next year's program. Since 1993, the demos have been a very popular and a well-rounded complement to the traditional paper sessions and other symposium activities. From the beginning, the demos have been sponsored by the EMC Society Education and Student Activities Committee (ESAC). The ESAC's goal is to raise awareness of the importance of EMI and its effects, and to educate engineers in practical techniques for finding and fixing EMI problems.

The demos have evolved fairly recently into two separate tracks: hardware experiments and computer based demonstrations. Multiple demos are run in parallel over a two-day period, where each emphasizes some fundamental aspect of EMI phenomenology and effects, along with practical methods of EMI trouble-shooting. The demos are designed to be an interactive educational tool for learning about novel methods of hands-on EMI problem solving, but at a somewhat basic level and through the use of fairly inexpensive devices. Over the past several years, the focus has shifted slightly from the 'basics' to more complex and problem-specific EMC issues encountered by industry, such as the EMI associated with printed circuit boards, electronic assemblies, and shielded enclosures for automotive and wireless communications applications. Nonetheless, the goal of the demonstrations remains the same: to demystify EMC using examples and problems that are often encountered in our day-to-day work. Whereas the live hardware experiments spotlight methods for troubleshooting actual devices on the spot, the computer demos are an exercise in virtual troubleshooting. Both provide excellent opportunities for closely examining the electromagnetic phenomena, physics, and mechanisms underlying EMI coupling including methods for mitigating interference.

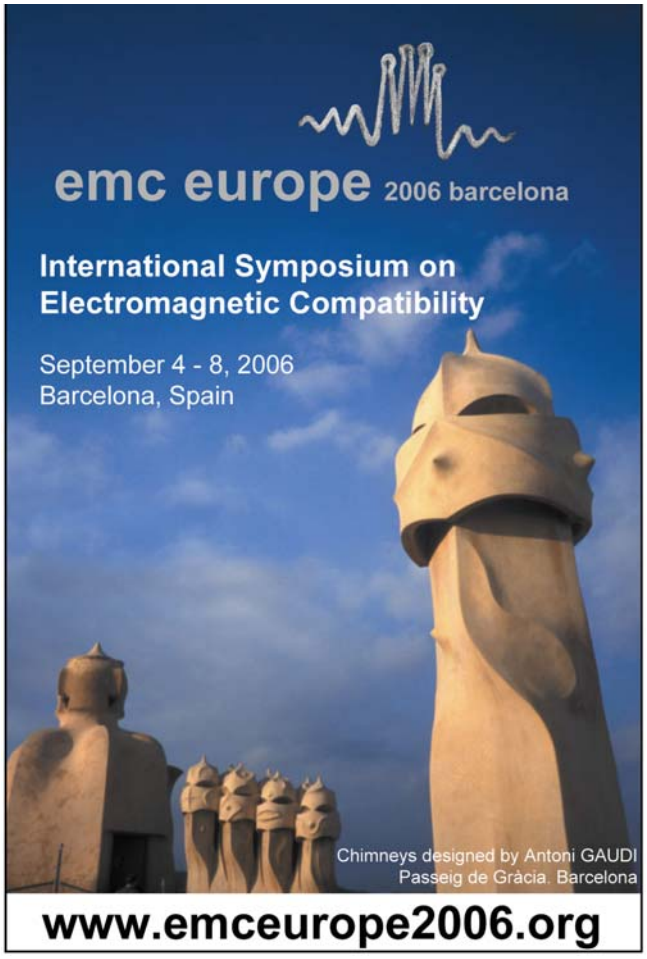
So, if EMI is the crime, then EMC is our scene and the EMC expert is the investigator, thus allowing us to coin a new term, Electromagnetic Compatibility Crime Scene Investigator or EMCSI, borrowing of course, from the popularity of the Crime Scene Investigation genre. Indeed, the idea of an EMCSI is in vogue in view of the recent swelling of interest by our up and coming scientists and technologists to pursue careers in a CSI field. We could advertise our newly-minted title of EMCSI to new engineers I suppose. What better way to get them interested in EMC technology than by exposing them to a series of instructive, hands-on demonstrations? I digress, however.

In fact, our cadre of experts who have performed demonstrations over the years represent a select group of professionals skilled in the art and science of EMI crime scene investigation. Many thanks are due to people like Clayton Paul, Henry Ott, and others for their original vision and guidance in helping to make all this happen.

PHOTOS BY KEN WYATT

Federico Centola, Flomerics, is shown in action presenting "Demonstration of Reciprocity of Shielding Effectiveness (SE) by Immunity and Emissions Analysis" to an attentive audience on the exhibition floor.

EMC veteran Lothar O. (Bud) Hoeft, Consultant, Electromagnetic Effects presented "Measurement of Surface Transfer Impedance of Cables and Connectors" as part of the demonstrations session in Chicago.



We will continue to stress this EMCSI theme and plan to add new topics as well as a fresh batch of experiments in the future, but more about next year's plans a little later. Now, what took place this year in Chicago you ask?

In Chicago, a total of 14 unique hardware experiments were conducted over a two-day period. The agenda read like a Who's Who of EMC. The hardware experiments and presenters included:

- *Measurement of Surface Transfer Impedance of Cables and Connectors* by Lothar O. (Bud) Hoeft, Consultant, Electromagnetic Effects.
- *Narrowband vs. Broadband* by Dr. Candace Suriano, Suriano Solutions.
- *Factors Affecting the Measurement Performance of Isotropic Field Probes* by Zhong Chen and Dave Baron, ETS-Lindgren.
- *Low Cost Measurement and Characterization of RF Connectors, Adapters, Attenuators, Probes and Antennas using Ebay and a Spectrum Analyzer* by Lee Hill, Silent-Solutions.
- *Circuit to Circuit Interference – Creating Harmony Between Sibling Circuits* by Randal Vaughn, Silent-Solutions.
- *Demonstration of SAR/HAC Measurements to IEC, EN, IEEE and FCC Standards* by David Seabury, ETS-Lindgren.
- *Smoking Ken: Simulated Dangers of RF Energy* by Fred Heather and Bob Nelson, JSF Program and North Dakota State University.
- *Location of Impulsive Events in 3D Space by Time of Arrival* by Doug Smith, D.C. Smith Consultants.
- *A Practical Comparison of Protection Methods for Avionics Against Lightning Induced Transients* by Scott Carlson and Erik Borgstrom, Environlab.

Randal Vaughn, Silent-Solutions (back to camera) presented "Circuit to Circuit Interference – Creating Harmony Between Sibling Circuits" then answered many questions, including one posed by Tom Van Doren from the University of Missouri-Rolla (leaning in left to Randal). Based upon the success of his demonstration last year in Santa Clara, symposium attendees were pleased to see him listed on the schedule for Chicago this year.

- *How Parasitic Effects in Inductors and Capacitors Affect Electrical Equipment* by James Whalen, SUNY Buffalo.
- *How To Verify MIL-STD CS Calibrations* by Tim Lusha and Josh Bakk, D.L.S. Electronic Systems Inc.
- *Improving the Accuracy of EMC Automotive Measurements* by Ray Klouda, Elite.
- *Demonstration of Antenna Pattern Measurements* by Dr. Michael Foegelle, ETS-Lindgren.
- *Demonstration of RF Susceptibility Test Method Using a Stripline* by George Cooley, Garmin International.

Additionally, this year's agenda of computer modeling and simulation demonstrations (a total of 13), which were run in parallel with the hardware experiments, included:

- *Investigation of Heatsink Radiated EMI Noise and Impact of EMI Consideration in Heatsink Design* by Xin Wu, Chunwei Yu and Prabhu Sathyamurthy of ICE Electronic Products Division, Fluent Inc.
- *A Software Approach for Analyzing the EMC of Integrated Circuits* by Etienne Sicard of INSA/Dgei.
- *Evaluation and Elimination of Printed Circuit Board Edge Radiation Introduced by Core Switching Noise and I/O Simultaneous Switching Noise Inside PCB Power Delivery Systems* by Jin Zhao, Raymond Chen, and Michael Leins of Sigrity Inc.
- *System Level Radiated Emissions Compliance Using Mathematical Modeling* by Darren James Carpenter of One IT, BT.
- *Modeling the Coupling of Radiated High Intensity Fields to Cables Attached to Electrically-Initiated Devices (EIDs) in Electrically-Large Structures* by Irina P. Kasperovich and Andrew C. Blackburn of ANDRO Computational Solutions, LLC.
- *SPICE Simulations of Inter-Cabinet Resonance* by Doug Smith of D. C. Smith Consultants.
- *Quantitative Data Comparisons* by Antonio Orlandi of University of L'Aquila and Alistair Duffy of De Montfort University.
- *Application of Fast Integral Equation Techniques to the Solution of Challenging EMC Problems* by C. J. Reddy of EM Software

& Systems.

- *Using FDTD for Real-World EMC Simulation* by Bruce Archambeault of IBM, Research Triangle Park.
- *A Demonstration of the Shielding of Gasketed Joints* by George Kunkel of Spira Manufacturing Corporation.
- *EMC Simulation of Complex High-Performance PCBs and Shielding Effectiveness* by Zol Cendes and Jack Parkes of Ansoft Corporation.
- *CEM Code Validation Using Thermal Imaging Techniques* by John Norgard of the University of Colorado and the US Air Force Academy.
- *Demonstration of Reciprocity of Shielding Effectiveness (SE) by Immunity and Emissions Analysis* by David P. Johns of Flomerics, Inc.

The computer demos highlighted fundamental EMC modeling approaches and simulation methods applied to EMI trouble shooting and problem solving. Various computational electromagnetic (CEM) modeling techniques were applied to simple canonical models as well as more sophisticated models in order to show how specific EMC problems can be resolved. These include the application of the moment method (MoM), uniform theory of diffraction (UTD) and variations on the asymptotic ray tracing method, finite difference time-domain (FDTD), finite element modeling (FEM), transmission line (TL) theory, and other useful methods. Several popular topics and demonstrations from last year were also reprised. The computer demonstrations further showed how modeling and analysis can be an effective means of identifying and mitigating EMI problems, as a complement to EMC design and measurement.

Arranging for 27 demos over two-days was no small feat. Our dedicated organizers included Roy Leventhal, Jack Prawica, and Bruce Archambeault. They are commended for their efforts to make this a successful forum. Of course nothing went on without a hitch. We ended up having to make some schedule adjustments at the last minute, but for the most part the demos went rather smoothly, thanks again to our organizers and the Chicago Symposium support staff. Large gatherings could be found at the demo stations where Lee Hill, Doug Smith, and Bruce Archambeault were presenting, for example. Virtually all the presenters had a healthy and highly interested crowd at one time or another. All of the demos were of very high technical caliber and originality, and the presenters did an outstanding job. Presenters, we thank you!

We are once again indebted to the equipment suppliers which included Tektronix, Rohde & Schwarz, Advantest, Agilent/Hewlett-Packard, KeyTek, and Schaffner EMC for providing the oscilloscopes, spectrum and network analyzers, EMI receivers, signal and function generators, meters and probes, and other hardware for the hardware demonstrations. Their ongoing support on behalf of the demos continues to be very much appreciated and we look forward to their assistance next year in Portland.

Speaking of Portland, we are in the process of planning next year's demonstrations. **A Call for Experiments and Demonstrations for next year's event has been prepared and is available on the 2006 Portland EMC Symposium web site (http://www.emc2006.org/). If you have ideas for a demonstration and want to have it considered, please contact me (a.l.drozd@ieee.org) or Bruce Archambeault (barch@US.IBM.com).** We are particularly interested in hardware experiments that have a computer modeling and/or technical paper counterpart. We are also trying to get somewhat back to basics by focusing on EMC fundamentals. Whereas the more recent demos have explored some very subtle, but problem-specific EMC issues involving fairly complicated setups, next year we hope to streamline the demos for simplicity. Many of these will likely draw upon experiments or simple benchmark problems documented for instance in the ESAC's EMC Experiments Manual. We encourage you to submit your proposal and look forward to your feedback. **EMC**

New to the demonstrations format, Dr. Michael Foegelle, ETS-Lindgren, presented "Demonstration of Antenna Pattern Measurements." Dr. Foegelle learned that this format provides a unique way of sharing technical information in a more informal manner than the traditional paper presentations.