

# Highlights of the IEEE EMC Society 2007 International Symposium for the IBIS Community

From July 8-13, 2007, the IEEE Electromagnetic Compatibility Society held its annual international symposium in Hawaii, marking its 50<sup>th</sup> anniversary. Roy Leventhal, who was an interested observer with no official IEEE function, prepared this report for the IBIS and Signal Integrity communities. Jim Nadolny, chair of SI Technical Committee (TC10) for 2005-2007 reviewed the report. To learn more about the IEEE EMC Society, see: <http://www.ewh.ieee.org/soc/emcs/>.

## Summary

At the past few symposiums, there has been a dramatic increase in the interest shown in signal integrity (SI), power integrity (PI), modeling, and simulation. While at this year's symposium, I was pleased that most attendees were future-focused and up-to-date on IBIS modeling and signal integrity.

Computational electromagnetics (CEM) has always received a lot of attention. Today, through modeling and simulation, CEM is being vigorously applied to electromagnetic interference, integrity, and control (EMI/EMC). Many CEM and EMI/EMC papers presented at the symposium addressed SI/PI issues. The attendees recognize that EMI/EMC issues usually start because of SI/PI issues and design actions. One example of the overlap occurs when the output drive current's high frequency content is increased from a programmable strength IC. An SI engineer may take this action to compensate for high frequency losses in multi-gigabit nets. Then the EMI/EMC engineer may take an action that directly impacts what an SI engineer may need to accomplish. For example, a large-valued resistor can be used to limit I/O driver current. This action reduces EMI, but it can interfere with source termination matching and signal integrity.

Everyone I spoke with at the symposium agreed that design challenges in timing, SI, PI, and EMI/EMC are multidisciplinary in nature. That is, they felt that in any given design, engineers must take every discipline into account and solve design issues concurrently. Further, those who have traditionally done only test and measurement increasingly believe that modeling and simulation is now very important.

## *Two Examples of Information Presented at EMC2007*

### **An Intel IC Paper**

“Comparison of Radiation from Two Microprocessor Test Packages,” written by Xiaopeng Dong, Kevin Daniel, and Kevin Slattery, Intel Corporation ©2007 IEEE EMC Society  
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This paper compared the radiation from two package types with the same microprocessor. One package featured a microstrip power supply plane and the other package featured a stripline (continuous) power supply plane. Radiation at 2GHz was significantly enhanced from the stripline configuration, because this arrangement created a resonant cavity at 2GHz! There was good agreement between measurements and simulation.

Further, it is possible that the continuous supply plane may behave as a patch antenna elevated from the IC/board return planes. Secondly, the vias from the microstrip arrangement through the volume that formed the resonant cavity are a common microwave engineering technique.

Lastly, there was a discussion of whether silicon chips radiate directly; there was a consensus that it probably did not. But the chip signal and power ports (pads) are a likely source of *conducted* emissions, which can be radiated by the physically much larger package and PC board mounting.

*RL comment: By the year 2013, silicon technology roadmaps call for 30 nm processes and 25GHz core switching rates. 25GHz is in the K band radar range. When dealing with such chips, engineers will need to design for a frequency range of DC to 80GHz. Meanwhile silicon chips are growing larger as more functionality gets packed onto them. So the potential for direct radiation off the silicon exists in the not too distant future.*

## **A New Power Integrity Book**

Prof. Madhavan Swaminathan and Dr. Ege Engin presented papers previewing some of the subjects covered in their forthcoming new book: *Power Integrity Modeling and Design for Semiconductors and Systems*, M. Swaminathan and E. Engin, Prentice Hall available 12/2007, ISBN: 0-136-15206-6. <http://www.prenhallprofessional.com/title/0136152066>

The book provides a collection of data from 10 years of research at the Georgia Institute of Technologies Packaging Research Center. The book starts with the basic concepts of power delivery design and delves into the modeling of planes, simultaneous switching noise, time domain simulation methods and several applications. Using several examples, the various modeling techniques are illustrated. The book also provides a software package for modeling power integrity.

For further information, please contact Dr. Ege Engin: [engin@ece.gatech.edu](mailto:engin@ece.gatech.edu)

## **Feature Selective Validation (FSV)**

### **Introduction**

FSV is a recently developed mathematical method of comparing two data sets (measurement-measurement, measurement-simulation, simulation-simulation). FSV provides measures of correlation goodness. In addition, the mathematical method is correlated with the subjective visual-graphical judgments of experienced observers classified through a decision tree. FSV offers sufficient granularity and precision to put data correlation on a much greater accuracy footing for all of engineering and science.

FSV was developed by EMI/EMC engineers for correlating waveform spectrums, S-parameters, etc. It is immediately applicable to time domain waveform correlations as well as other data sets. A standard, P1597™ (see next topic) is being developed by an IEEE EMC Society sub-committee that applies the FSV method to areas of particular concern to EMI/EMC.

FSV can be combined with the methods of statistical significance when we have to account for the natural variance of a population of manufactured units. David Banas presented a shortened version on FSV and statistical methodologies at the last IBIS Summit Meeting.

- The shortened presentation can be downloaded from:  
<http://www.vhdl.org/pub/ibis/summits/jun07/leventhal.pdf>
- The full presentation can be downloaded from:  
<http://www.semiconductorsimulation.com/Verification%20of%20Simulation%20Results.pdf>

### **P1597 “Standard for Validation of Computational Electromagnetics Computer Modeling and Simulation”**

The P1597.1™D4.2 Draft is currently out for balloting by the IEEE EMC Society sub-committee members. The members are currently developing a Draft P1597.2™ “Recommended Practice for Validation of Computational Electromagnetics Computer Modeling and Simulation.”

When the EIA IBIS Open Forum is ready to deal with the issue of model accuracy and verification, it should be able to benefit from the pioneering work being done in FSV and the P1597 standard by the IEEE EMC Society.

## ***Technical Committee 10 on Signal Integrity***

### **Responsibilities of Technical Committee 10 on Signal Integrity (TC10)**

Technical committees in the IEEE EMC Society set direction and scope for the tutorials, workshops, technical paper sessions, poster sessions, tabletop measurement demonstrations, and simulation demonstrations. They solicit, review, referee, and approve the above, as well as request facilities and equipment in conjunction with local chapters and the IEEE Society. During the annual symposium, they meet in person. During the rest of the year, most of their business is conducted by email and telephone.

### **Report on IBIS to TC10**

At the symposium, I presented a report (*not in an official capacity*) on current IBIS committee activities to TC10. The report received prior review by Michael Mirmak, Arpad Muranyi, Bob Ross, and Mike LaBonte. The report made the EMI/EMC community aware of EIA IBIS Open Forum activities in S-Parameters (Touchstone 2.0), Advanced Technology Modeling (VHDL-AMS, BER and jitter, etc.), IBIS Quality Spec Review, IBIS interest in “3S,” and FSV/model accuracy. The EMI/EMC community now understands that there is much more to IBIS than I-V and V-T model data tables.

The committee members see themselves as directly benefiting from 3S – the possibility of an IBIS-like standard for SPICE – plus the efforts in BER and jitter measurement standards.

Touchstone 2.0 seems to me to be moving forward faster than ICEM 62014-3, “Electromagnetic Compatibility Part 3 Integrated Circuits Electrical Modeling,” being developed by the International Electrotechnical Commission (IEC). I raised the possibility of Touchstone 2.0 and an equivalent current source embedded in the IC (an idea borrowed from 62014-3) being applied to PI problems.

The full report about IBIS to the TC10 committee can be viewed at:  
<http://www.eda.org/ibis/docs/IBISReportJuly2007.pdf>

### **Reaction to Report**

The TC10 committee was very interested and supportive of the work of the IBIS Committee. Several members wondered “How can we get the silicon guys (also meaning PCB engineers and EDA software companies) more involved in our (IEEE EMC Society) activities?” I believe the TC10 committee will follow up on this idea.

### **Officers of TC10**

Current officers of TC10 are:

Chair 2007	Antonio Orlandi	<a href="mailto:orlandi@ing.univaq.it">orlandi@ing.univaq.it</a>	Univ. Of L’Aquila
Vice-Chair 2007	Giulio Antonini	<a href="mailto:antonini@ing.univaq.it">antonini@ing.univaq.it</a>	Univ. Of L’Aquila
Secretary 2007	Xiaoning Ye	<a href="mailto:xiaoning.ye@intel.com">xiaoning.ye@intel.com</a>	Intel

### ***Papers and Sessions***

#### **Level of SI/PI activity**

Ten half-day tutorials were presented. Four were of general EMI/EMC interest, and one was a tutorial, “Limitations of Simulation Technologies and Proper Model Validation For Both Signal Integrity and EMI/EMC.” This tutorial was of specific SI/PI interest.

Fifty half-day technical papers sessions oriented to the latest developments were presented. Twenty sessions were of general EMI/EMC interest to PCB engineers and an additional twelve were of specific SI/PI interest.

The sessions of particular interest to SI/PI were:

- Design and Modeling Methods For Power Integrity
- Electromagnetic Bandgap Structures For EMI/EMC Applications
- Electromagnetic Bandgap Structures
- Signal Integrity I, II, and III
- Poster Session 01: PCB and IC EMC

- Special Session: Power Integrity / Signal Integrity For Next Generation Systems
- Printed Circuit Board EMC I
- Integrated Circuit EMC
- Electronic Packaging EMC and Signal Integrity
- Printed Circuit Board Modeling

### High Interest Papers About SI/PI

Over 30 papers out of about 240 presented at EMC2007 may be of particular interest to the SI/PI community. Probably another 45 papers were of related interest to the SI/PI community. Some of particular interest were:

- *Signal and Power Integrity Co-Simulation for Multi-layered System on Package Modules.*
- *Concurrent Analysis of Signal-Power Integrity and EMC for High-Speed Signaling Systems.*
- *Circuit Board Layout for Automotive Electronics.*
- *Signal Integrity Analysis of a 1.5 Gbit/s LVDS Video Link.*
- *Noise Isolation Modeling and Experimental Validation of Power Distribution Network in Chip-Package.*
- *Implementation of On-Chip and On-Package Reactive Equalizer to Minimize Inter-symbol Interference (ISI) and Jitter from Frequency Dependent Attenuation.*
- *Experimental evaluation of isolation effect on printed circuit board with gapped power plane.*
- *EMC of Integrated Circuits: A Historical Review.*
- *Load Current Funneling Examination for Power Distribution in High Performance Multi-core Silicon.*
- *Multi-Gigabit I/O Link Circuit Design Challenges and Techniques.*
- *Power and Ground Bounce Effects on Component Performance Based on Printed Circuit Board Edge Termination Methodologies.*
- *Modeling & Measurement of Mutual Coupling Resulting from Via Structures within Printed Circuit Boards.*
- *Multimodal Analysis of Guard Traces.*
- *Comparison of Radiation from Two Microprocessor Test Packages.*
- *Numerical and Experimental Investigation of Power Supply Noise Decoupling Strategies on Single-Sided Printed Circuit Boards.*
- *Modeling of Signal and Power Integrity in System on Package Applications.*
- *Accurate Characterization of Package and Board Components for Efficient System Level Signal Integrity Analysis.*

### CD-ROM of EMC2007

Readers interested in any of the papers presented can order a CD-ROM. As of this writing, the CD is *not* yet available.

- To order, go to <http://shop.ieee.org/ieeestore/>
- To check on availability, go to [Customer.service@ieee.org](mailto:Customer.service@ieee.org) or call 1-800-678-4333