2007 IEEE Workshop on Signal Propagation on Interconnects

Ruta di Camogli, Italy
13-16 May 2007

IEEE Catalog Number:	**CFP07SPI-PRT**
ISBN 10:	**1-4244-1223-4**
ISBN 13:	**978-1-4244-1223-5**

Table of Contents

Keynote Speech I

Designing for Energy Efficient Mobile Platforms
T. R. Arabi, A. Muhtaroglu, G. Taylor*
Mobile Platform Architecture Development, *Logic Technology Development
Intel Corporation, USA 1

Session I – On-Chip Interconnects I

Effect of Noise on Timing or Data-Pattern Dependent Delay Variation When Transmission-Line Effects are Taken Into Account for On-Chip Wiring
A. Deutsch, H. H. Smith*, C. Vakirtzis*, J. Kozhaya**, L. M. Greenberg*
IBM T. J. Watson Research Center, USA, *IBM Systems and Technology Group, Poughkeepsie, NY,
**IBM Systems and Technology Group, Burlington,VT 7

Spice-Accurate SystemC Macromodels of Noisy On-Chip Communication Channels
N. Terrassan, D. Bertozzi, A. Bogliolo*
University of Ferrara, Italy, *University of Urbino, Italy 11

Equalization of Interconnect Propagation Delay with Negative Group Delay Active Circuits
B. Ravelo, A. Pérennec, M. Le Roy
LEST, France 15

Session II – On-Chip Interconnects II

Silicon-chip Single and Coupled Coplanar Transmission Line Measurements and Model Verification up to 50GHz
D. Goren, S. Shlafman, B. Sheinman, W. Woods*, J. Rascoe*
IBM Haifa Research Labs, Israel, *IBM Burlington Design Enablement, USA 21

Comparison of the benefits, from SiO2 to ultralow-K dielectric and air spacing introduction, in term of interconnects performances, for the future high speed Ic's in a multicoupled lines system
F. Ponchel, JF. Legier, E. Paleczny, C. Seguinot, D. Deschacht*
IEMN, France, *LIRMM, France 25

Comparison Between Metallic Carbon Nanotube and Copper Future VLSI Nano-interconnects
A. Maffucci, G. Miano*, F. Villone
University of Cassino, Italy, *University of Napoli "Federico II", Italy 29

Session 3 – Transmission Lines and High-Speed Channels I

Effect of Uncertainties in the Cross-Sectional Parameters on the Wideband Electrical Properties of Coplanar Waveguides
J. Leinhos, U. Arz
PTB, Germany 35

Interconnect Length Impact Investigation by Measurements
M. Sotman, A. Kostinsky, G. Zobin
Intel, Israel 39

Session 4 – Macromodeling by Vector Fitting

Broadband Macromodeling of Sampled Frequency Data Using z-domain Vector-Fitting Method
Y. S. Mekonnen, J. E. Schutt-Ainé
University of Illinois at Urbana-Champaign, USA 45

Rational Modeling of Multiport Systems by Modal Vector Fitting
B. Gustavsen, C. Heitz*
SINTEF, Norway, *Institut für Datenanalyse und Prozessdesign, Switzerland 49

Macromodeling of Transfer Functions with Higher-Order Pole Multiplicities
D. Deschrijver, T. Dhaene, Y. Rolain*
University of Antwerp, Belgium, *Vrije Universiteit Brussels, Belgium 53

Well-conditioned Adaptive Interpolation by a Gaussian-Modulated Pole Kernel with Applications to Vector Fitting
L. Knockaert, D. De Zutter
Ghent University, Belgium 57

Keynote Speech II

Future mobile device interconnections
M. Voutilainen
Nokia, Finland 63

Session 5 – Linear Macromodeling I

Model Order Reduction of Large Multiport Interconnect Structures using Waveform Relaxation Techniques
N. Nakhla , M. Nakhla, R. Achar
Carleton University, Canada 69

Fast Passivity Enforcement of Rational Macromodels by Perturbation of Residue Matrix Eigenvalues
B. Gustavsen
SINTEF, Norway 71

On relative error minimization in passivity enforcement schemes
S. Grivet-Talocia, A. Ubolli
Politecnico di Torino, Italy 75

Session 6 – Linear Macromodeling II

Stable model order reduction method using Kautz functions: application to VLSI circuits
M. Telescu, P. Bréhonnet, N. Tanguy, P. Vilbé
LEST, France 81

Removing Redundancy in Interconnect Simulation using Domain Decomposition Techniques
V. Ambalavanar, A. Jerome, P. Gunupudi
Carleton University, Canada 85

Fast Automatic Order Estimation of Rational Macromodels for Signal Integrity Analysis
N. Stevens, D. Deschrijver*, T. Dhaene*
Agilent Technologies, USA, *University of Antwerp, Belgium 89

Session 7 – Transmission Lines and High-Speed Channels II

Frequency domain analysis of transmission zeroes on high-speed interconnects in the presence of an orthogonal metal grid underlayer
Y. Quéré, T. Le Gouguec, P.M. Martin, D. Le Berre, F. Huret
LEST, France 95

Determination of Transmission Line Parameters in Time- and Frequency Domain for Product Related Packaging Structures
T.M. Winkel, A. Deutsch*, G.A. Katopis**, G. V. Kopcsay*, W. D. Dyckman**, B.J. Chamberlin**, C. W. Surovic*, H. Liu**, C. Baks*
IBM Entwicklungs GmbH, Böblingen, Germany, *IBM T J Watson Research Center, USA, **IBM System and Technology Group, USA 99

Signal Propagation Over Perforated Reference Planes
L. Shan, M. Ritter, A. Haridass, R. Weekly, D. Becker, E. Klink
IBM T J Watson Research Center, USA 103

Session 8 – Interconnect Characterization

Characterization of Electromagnetic Leakages throughout the Connector Shell
Y. Bouri, L. Koné[*], J. Razafiarivelo, D. Baudry[**], S. Baranowski[*], B. Démoulin[*]
FCI, Corporate Research Center, France, *University of Sciences and Technologies of Lille, France,
**IRSEEM, France 109

Characterization of Flexible Interconnects in Mobile Devices
P. Kotiranta, I. Kelander, M. Rouvala, J. Takaneva
Nokia, Finland 113

Considerations on Impedance Matrix Determination for Accurate Passive Device Characterization
M. Wojnowski, M. Engl, R. Weigel[*]
Infineon Technologies AG, Germany, [*]University of Erlangen-Nuremberg, Germany 117

Fundamentals of a 3-D "Snowball" Model for Surface Roughness Power Losses
P. G. Huray, S. Hall[*], S. Pytel[*], F. Oluwafemi[*], R. Mellitz[*] , D. Hua[*], P. Ye[*]
University of South Carolina, USA, *INTEL, USA 121

Session 9 – Optical Interconnects

Coupling and Signal Propagation Model of Multimode Waveguides with Rough Core-Cladding Interfaces
K. Halbe, I. Roda, E. Griese
University of Siegen, Germany 127

Prospects of a Polymer-Waveguide-Based Board-Level Optical Interconnect Technology
R. Dangel, C. Berger, R. Beyeler, L. Dellmann, F. Horst, T. Lamprecht, N. Meier, B. J. Offrein
IBM Research GmbH, Switzerland 131

Preserving Signal Integrity in a SOA-based De-Multiplexer used in OTDM interconnections
C. Crognale, V. Ricchiuti, S. Caputo*, S. Saracino**
TechnoLabs S.p.A., Italy, *SMD Elettronica, Italy, **Siemens S.p.A, Italy 135

Session 10 – 3D Modeling

Fast FDTD Simulation of Multiscale 3D Models Using Laguerre-MNA
K. Srinivasan, E. Engin, M. Swaminathan
Georgia Institute of Technology, USA 141

Progress in Representation and Validation of Physics-Based Via Models
C. Schuster, G. Selli*, Y. H. Kwark**, M. B. Ritter**, J. L. Drewniak*
Technical University of Hamburg-Harburg, Germany, *University of Missouri-Rolla, USA
**IBM T J Watson Research Center, USA 145

Accurate Capacitance Extraction in the Entire Package Model Using A Parallel Kernel Independent Hierarchical Extractor
K. Butt, I. Jeffrey, M. Al-Qedra, F. Ling*, V. Okhmatovski
University of Manitoba, Canada, *Cadence Design Systems, USA 149

Session 11 – Packaging and Power Integrity

Toward a Systematic Sensitivity Analysis of On-Chip Power Grids Using Factor Analysis
D. A. Andersson, L. J Svensson, P. Larsson-Edefors
Chalmers University of Technology, Sweden 155

A simple filtering approach to improve the return loss of a PCB to DIE transition trough a PBGA package for over GHz applications
J.R. Cubillo, J. Gaubert, S. Bourdel, H. Barthélémy, P. Pannier
L2MP, France 159

Interconnection effects in Package on Package design
P. Pulici, G. Candela*, G. Campardo, G. P. Vanalli, P. P. Stoppino, A. Losavio, T. Lessio, M. Dellutri, D. Guarnaccia, F. Lo Iacono
STMicroelectronics, Italy, *Politecnico di Milano, Italy 163

Poster Session A - Modeling and Analysis of Interconnects

Robust Passivity Enforcement of Frequency Dependent Transmission Line Models
B. Gustavsen
SINTEF, Norway 169

Modeling Propagation Characteristics of Multimode Graded-Index Waveguides with Finite Elements using Edge-Based Elements
T. Kuehler, E. Griese
University of Siegen, Germany 173

Modeling of Electromagnetic Effects in Complete RF blocks
J. Niehof, H.H.J.M. Janssen, W.H.A. Schilders
NXP Semiconductors Research, The Netherlands 177

Application of Measured Twinax Cable S-Parameters
Z. Chen
IBM Corporation, USA 179

The Low-Loss Interconnects Simulation by Perturbation Methods
A. Ligocka, W. Bandurski
Poznań University of Technology, Poland 182

An Absolutely-Stable Arbitrarily high-order Implicit Numerical Integration Method and its application to the Time-Domain Simulation of Interconnect Circuits
E. Gad, M. Nakhla*, R. Achar*, Y. Zhou*
University of Ottawa, Canada, *Carleton University, Ottawa, Canada 186

Skew and EMI Management in Differential Microstrip Lines up to 15GHz
M. R. Burford, P. A. Levin*, T. J. Kazmierski
University of Southampton, UK, *Xyratex Technology Ltd, UK 188

Differential Insertion Loss and Deterministic Jitter for Different Types of Differential Transmission Lines in High-Speed Serial Backplane Bus
H. Osaka, Y. Uematsu, K. Yamamoto, H. Kanai, N. Chujo
Hitachi Ltd., Japan 192

Crosstalk Timing Model for High-Speed Interconnects with Impedance Discontinuity
A. Kuo, A. Labun*, N. Swart*, A. Ivanov
University of British Columbia, Canada, *University of British Columbia Okanagan, Canada 194

Calculation of Crosstalks in Multiple-Conductor Cables
B. M. Levin
Lod, Israel 198

Evaluation of the propagation constants of differential PCB Interconnections
V. Ricchiuti, A. Orlandi*, G. Antonini*
TechnoLabs S.p.A., Italy, *University of L'Aquila, Italy 202

Poster Session B – Chip, Packaging and Material Issues

Fast Calculation of PEEC Macromodels using Frequency Derivatives
D. Deschrijver, G. Antonini*, T. Dhaene
University of Antwerp, Belgium, *University of L'Aquila, Italy 209

Electromagnetic Coupling Analysis of High Density Bent Interconnects
S. Ghosh, A. Roy, A. Chakrabarty
Indian Institute of Technology, India 213

Analytical Calculation of the Point-to-Point Partial Inductance of a Perfect Ground Plane
U. Paoletti, T. Hisakado, O. Wada
Kyoto University, Japan 217

Analytical Crosstalk Model with Inductive Coupling in VLSI Interconnects
J.V.R. Ravindra, M.B. Srinivas
International Institute of Information Technology (IIIT), India 221

RLC Crosstalk Calculation with Dissymmetrical Attacks
J.E. Lorival, D. Deschacht
LIRMM, France 225

Dielectric Modeling, Characterization, and Validation up to 40 GHz
S. G. Pytel, G. Barnes, D. Hua, A. Moonshiram, G. Brist, R. I. Mellitz, S. H. Hall, P. G. Huray*
Intel Corporation, USA, *University of South Carolina, USA 229

Reduced Order Models for HF Interconnect over Lossy Semiconductor Substrate
D. Ioan, G. Ciuprina, S. Kula
Politehnica University of Bucharest, Romania 233

Power supply noise investigation of a multilayered IC package: full wave simulation and model validation
A. Ciccomancini Scogna, C. Ritota*
CST of America, USA, *Tiesse, Italy 237

Measurement of Interconnect Loss Due to Dummy Fills
A. Tsuchiya, H. Onodera
Kyoto University, Japan 241

Impact of Process Variations on Bus-Encoding Schemes for Delay Minimization in VLSI Interconnects
C. Raghunandan, K. S. Sainarayanan, M. B. Srinivas
International Institute of Information Technology (IIIT), India 245