IBIS in Academia Update

Bob Ross
bob@teraspeed.com

European IBIS Summit
Sorrento, Italy
May 16, 2012

(Updated from June, 2011 DAC IBIS Summit)
Introduction

• IBIS in academia, technical literature, and academic conferences
• IBIS, a base-line for expanded research on I/O buffer algorithms and extensions
• Many national and international papers, several thesis, several tools
  – About 80-100 “IBIS” references from 139 IEEE Xplore hits
  – Google search, technical library electronic access
  – http://www.ece.ncsu.edu/erl/publications/
  – http://www.emc.polito.it/publications/all_pub.asp
  – http://www.teraspeed.com/ibis_resources.htm
• Sampling of interesting papers and tools here
• Purpose – highlight and make visible academic impact
Review of Academic Involvement

• Basic algorithms
• S2ibis
• New algorithms
• Power delivery systems and EMC
• Other work
• Conference references here
  – SPI: IEEE Workshop on Signal and Power Integrity (formerly Signal Propagation on Interconnects) (Europe)
  – EPEP(S): Electrical Performance of Electronic Packaging (and Systems)
  – EMC Compo: International Workshop on Electromagnetic Compatibility of Integrated Circuits (Europe so far)
Basic Algorithms from IBIS

- Early modeling algorithms were just ramp or waveforms & non-linear I-V transitions yielding curved results different from extractions
- IBIS Buffer Algorithms – solving two waveform from low and high-state I-V tables
- Many Summit presentations addressed this issue by B. Ross, X. Chen, A. Muranyi, M. Mirmak, B. Unger, etc.
  - Basic 2-waveform algorithm and development
  - AMS extensions
  - Many V-T tables
  - ECL
  - Add L_fixture, C_fixture
  - C_comp extensions
  - Additional (blocks) to IBIS for Driver Schedule, Submodels, etc.
  - http://www.eda.org/ibis/summits/
Some Early Algorithm References


Spice to IBIS and IBIS Algorithms

- NCSU – Paul Franzon, Michael Steer (also an IBIS Librarian) since about 1995 and students Steve Lipa, Alan Glaser, Ambrish Varma
  - http://www.ece.ncsu.edu/erl/software/ibis_general/
  - http://www.ece.ncsu.edu/erl/publications/
  - (Supported by ARPA and DARPA funding)
- Later, Paul Fernando on AMS macro-modeling and Ting Zhu on IBIS surrogate modeling algorithms
- Spice 2 IBIS development: s2ibis, s2ibis3, s2ibis3, s2ipt
  - Now handled by IO Methodology (Lance Wang)
- Paul Fernando, MS, Ambrish Varma Ph.D. thesis on IBIS topics
- S2IBIS – a major contributor to IBIS success!!
Newer Research and Tools

• **Universities**
  – Politecnico di Torino – Igor Stievano, Flavio Canavero, etc. (Italy)
  – Univ. de Bretagne Occidentale (France)
  – Georgia Tech (Madhaven Swaminathan, Bhyrav Mutnury, etc.)
  – North Carolina State University (Ting Zhu, Paul Franzon, etc.)

• **I/O buffer modeling and model extraction generalization** for power integrity, packages, spline fitting, pre-emphasis, equation based, etc.
  – Radial based functions, and other orthogonal functions as basis
  – M(pi)log tool – includes VHDL-AMS, Spice link
    • [http://www.emc.polito.it/software/Mpiolog/mpilog_home.asp](http://www.emc.polito.it/software/Mpiolog/mpilog_home.asp)
  – Volteria, Volteria-Laguerre model
  – Recurrent neural network
  – Surrogate modeling
New Academic References

New References Continued

- And more buffer modeling topics at SPI 2012, May 2012!!
Power Delivery Systems Project

• Mocha: MOdelling and CHAracterization of SiP Signal and Power Integrity Analysis:
  – http://www.mocha.polito.it/WP2.htm
  – European community funded program

• Academic Involvment
  – Politecnico di Torino (Italy)
  – Instituto de Telecomunicacoes (Portual)

• Industrial partners – Micron Technology, Cadence, Agilent, Microwave Characterization Center
  (A STREP project funded by European Community)

• I/O buffers may be extensions of IBIS
More Power Integrity

EMC/EMI – Academic Involvement

• UTE (Union Technique de L’Electricite) – French standardization group involved with IBIS in 1998
• Industry and the following French universities
  – Institut National des Sciences Appliquees de Toulouse (INSA) - E. Sicard
  – ESEO Institute of Science and Technology - M. Ramdani
  – Institut Europeen de Recherche Sur Les Systemes Electroniques Pour Les TransPorts (IERSET) - M. Lubineau
• ICEM (Integrated Circuits Electromagnetic Model) now IEC 62014-3
• IC-EMC tool from INSA tool references IBIS Package model and has comment lines for IBIS. It also has a BGA display utility (A. Boyer, E. Sicard, INSA – France
  – http://www.ic-emc.org/
Other Contributions

• Non-linear C_comp (BIRD79)

• IBIS Healing Tool free utility
  – Francesco de Paulis, Dinilo Di Febo, Antonio Orlandi, University of L’Aquila, Italy
  – European IBIS Summit, May 2011
  – http://orlandi.in.univaq.it/uaq_laboratory/
International IBIS Sampling


IBIS and Academic Events

• Co-located Summits
  – DAC - Design Automation Conference (1993 – present)
  – SPI (2010 - present and in Europe)
  – DesignCon (more people from academia coming)

• Other conferences with IBIS content and potential involvement
  – EPEP(S)
  – EMC Compo (in Europe, in Japan in 2013)
Conclusion

• Academia and IBIS connected
  – Literature, conferences, tools, thesis
  – Co-located summits with academic events
    • Academic presentations always welcome
  – Student involvement with IBIS
  – IBIS and I/O buffer research continues
    (weighted two-state functions often the basis for buffer algorithms)

• Collaboration beneficial