HICUM - Update

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www.iee.et.tu-dresden.de/iee/eb/eb_homee.html
Outline

- Availability in simulators
- Model support
- Roadmap (migration and future development)
## Availability in Simulators

| simulator     | code made available | implement. ongoing | test phase | release | comments                                                       |
|---------------|---------------------|-------------------|------------|---------|                                                               |
| ELDO-RF       |                     |                   |            | 10/99   | available to customers                                        |
| SPECTRE-RF    |                     |                   |            | 10/99   | • documentation being cleaned up                              |
|               |                     |                   |            |         | • CNXT version = ref. for release                             |
| ADS           |                     |                   |            | 7/00    | • combination with ICCAP                                      |
|               |                     |                   |            |         | • excess phases: ADS related issue                            |
| Smart-SPICE   |                     |                   |            | 11/00   | • combination with UTMOST                                     |
| APLAC         | x (? )              |                   |            |         | target release date: 11/00                                    |
| HSPICE        |                     | x                 |            |         | • combination with AURORA                                     |
| Xpedion       | x                   |                   |            |         | code sent as per request                                     |
| SABER         | x                   |                   |            |         | code sent as per request                                     |
| TEKSPICE      |                     |                   |            |         | in cooperation with MAXIM                                     |
| DEVICE        | -                   | -                 | -          |         | reference simulator (except HB)                               |
Model support

Software and general maintenance (CMC)

• support of implementation in circuit simulators
  • timely bug fixing
  • provide and maintain “original” model code; version control of “original” model code
  • testing and qualification of implementation - options:
    • provide test parameters and data to EDA companies
    • test at CEDIC (depending upon simulator license)

• model documentation
  • parameter list and default values (zeroed and test); OP output in simulators
  • physical background of the model and its equations

• support of parameter extraction
  (provide generic, i.e. not tool specific, support for implementing parameter extraction sequence in commercial software packages)

• maintain web-site

⇒ full-time service that has to be paid for to ensure certain quality

⇒ hire a person for this job (post-doc, ...)
  • contingent on commitment for funding (from CMC or other sources)

• Cost estimate:
  • loaded labor cost: US $50k (at the present exchange ratio)
    (need to pay reasonable salary, otherwise loose person to industry)
  • travel expenses: US $6k (to attend 4 CMC meetings/year)

Note: effort and cost are basically the same as for MOS models ...
Model development support
Semiconductor industry

• present cooperation partners (and contacts)
  • Alcatel (E. Gerhardt)
  • Atmel (W. Kraus)
  • Conexant (M. Matloubian, P. Zampardi)
  • IBM (D. Harame, J. Johnson, K. Newton, ...)
  • Infineon (P. Brenner, J. Berkner, ...)
  • Maxim (S. Simpkins, D. Harper, ...)
  • Motorola (C. McAndrew)
  • Silicon Wave
  • STM (A. Juge, D. Celi, ...)

• Activities include projects in the areas of
  • modeling
    • establishing geometry scalable parameter extraction and model parameter
generation; transfer and implementation of appropriate test structures.
    • predictive and statistical modeling
    • extraction of “pilot” parameter sets
    • *extensions: suggestions of improvements and participation in development are encouraged and welcome* - will continue to do coordination
  • circuit design
    • courses on modeling and response to application relevant questions
    • benchmark circuit design
  • process development
    • feedback and debugging via special test structures and physics-based parameter
eextraction
    • model parameter prediction for next generation processes

⇒ most of the time is presently being spent on the above tasks
Documentation

www: eigroup.org/cmc and iee.et.tu-dresden.de/iee/eb/eb_homee.htm

• Model description
  • www: updated equations and default values for parameters; new OP data suggestion
  • complete CMC presentation of Dec. 98 can be obtained from: mschroter@ieee.org

• Model parameter extraction
  • www: generic extraction procedure (incl. basic idea of some test structures)
  • www: overview on recommended measurements
  • detailed description of test structures (for cooperation partners)
  • detailed description of geometry scalable parameter extraction (for cooperation partners)

• Experimental results on many different processes
  • see www: geometry scalable models for production processes
  • see www: fitted on single transistors (mostly CMC data sets)
Roadmap

Migration path: options, suggestions, and overview on “investment”

- ... from single transistor fitting to geometry scalable modeling capability
  - implement appropriate test structures (also useful for process monitoring and debugging)
  - implement multiple geometry parameter extraction sequence (similar to CMOS)

- ... from SGPM to HICUM - assuming geometry scalable modeling capability
  - understand (physical) background of HICUM to maximize its usefulness
  - incremental additional effort for extracting model-specific parameters of HICUM
  - library generation: parameters of both models can be generated at the same time (e.g., by TRADICA)

- ... from SGPM to HICUM - assuming single transistor fitting
  - understand how to simplify HICUM
  - implement simplified, fitting based, parameter extraction sequence

⇒ documentation and courses are available to facilitate the migration and to support associated activities
   (limited information on single-transistor-fitting though)
Model development

(mostly industrially funded activities)

- SiGe HBTs (both types)
  - issues in >50GHz processes
  - incorporation of features from SiGeM (s. Prof. Rein´s group at RUB) where possible

- III-V HBTs
  - measurement based verification for industrial processes
  - electrothermal modeling

- VNP modeling
  - verification of suitability; parameter extraction and TRADICA capability
    (initial results for minority charge and transit time model (s. D. Celi/STM, 1998) are encouraging)

- Parameter extraction
  - develop improved/new methods and improve reliability of extraction

- Simple version (Level0)
  - finalize and implementation
  - parameter extraction: either from Level2 data or directly on single devices; i.e. no extra effort for user
Acknowledgments

MS is especially thankful to

• the contact persons at the various supporting companies for discussions, suggestions and contributions to HICUM related aspects such as model implementation, formulation and documentation, and

• Mentor Graphics and Agilent for software donations.