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OPTIMAL ELECTRONIC CIRCUITS and MICROSYSTEMS NETWORKED DESIGNER

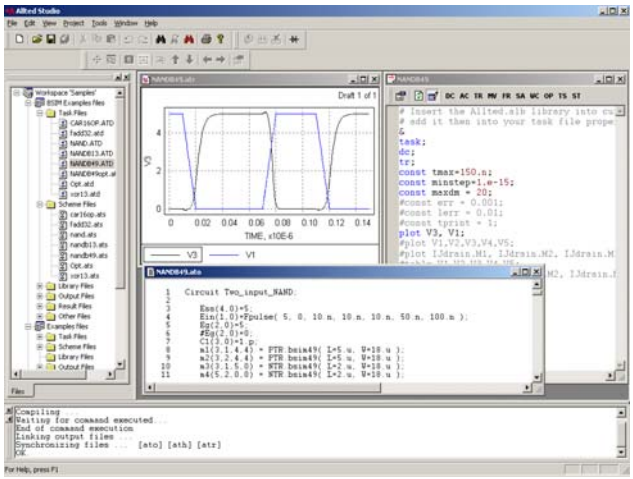
Abstracts: This proposal is relevant to innovative remote design tools and methodology, which allow to create WEB-based CAD framework for design of different technical systems (first of all, for Microelectronics). The WEB-based CAD framework implementation uses the Internet tools and protocols to support the co-operation of several groups of designers working on the common tasks at their different stages.

Description

The proposed interdisciplinary Networked Computer-Aided Design System with invariant computational procedures for design, verification and optimization of micro electro-mechanical systems (MEMS) and large-scale integrated circuits enables development of microsystems in the form of chips. The developed methodology and modeling toolkit allow collective designing of various MEMS adapted for the newest submicron technologies on the system and circuit levels using available or creating new parameterized model of MEMS subsystems. The proposed toolkit takes advantages of NetALLTED (Network ALL Technology Designer) – the authorized system for schematic design of complicated technical systems (including Nonlinear Dynamic Systems) composed of either/and electronic, hydraulic, pneumatic, mechanical, electromagnetic, and other subsystems. NetALLTED is based on **the original numerical algorithms** for all the stages of design: starting from steady state, frequency and transient analyses till **parametrical optimization of a designed device output characteristics, optimal component tolerances assignment, centering of solution, and Yield maximization.** NetALLTED can be used in distributed Web environment and can be embedded in every Intranet area with client-server base configuration.

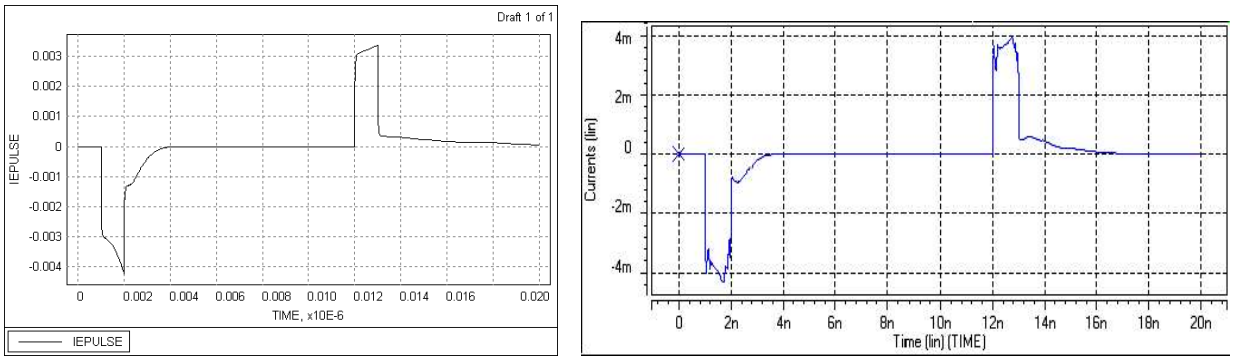
Area of Application

Advantages of above methods in comparison with numerical methods used in SPICE-like simulators are illustrated by the example of simulation of benchmark circuits set being proposed by North Carolina Microelectronics Centre , Table 1:



Circuit	***DC*** Iteration number, ***ALLTED***	***DC*** Iteration number, ***HSPICE***	***TR*** Iteration number, ***ALLTED***	***TR*** Iteration number, ***HPSPICE***
Schmitt trigger	**88**	**67**	**146**	**537**
Bjtinv	**95**	**96**	**1340**	**3239**
Gm3	**80**	**185**	**149**	**219**
Make2	**12**	**10**	**527 but only 256 steps**	**327 but outputs are distorted**

There are visible false oscillations at the plot when simulating the circuit *Make2* with default conditions in HSPICE (Fig.1).



a b

Fig.1. The simulation results obtained by ALLTED (a) and by HSPISE (b).

Simulation time depends on using platform (HSPICE was run on *UNIX*-Working Station and ALLTED- on PC under *Windows*) , but ALLTED made at least some time less time steps during simulation what is extremely important for effective realization of such time-consumed procedures as optimization and Monte-Carlo procedures.

The toolkit in hand was used for selection of optimal ratio W/L (width to lenth) for CMOS in DEC Alpha AXP 64-bit microprocessor resulting in twice increasing its run frequency. The toolkit was used also for General Electric Ultrasonic Transducer simulation (Fig.2).

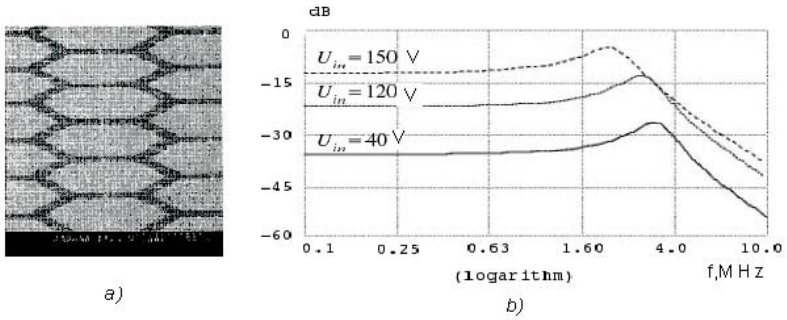


Fig.2. Fragment of ultrasonic transformer (a) and the graph of decreasing a transducer own frequency with applied voltage rise (b).

In comparison with SPICE-like programs Net ALLTED offers:
■ Faster simulation speed and improved numerical convergence;
■ Sensitivity analysis for frequency and transient analyses;
■ Comprehensive optimization procedure and optimal tolerances assignment ;
■ Alternative approach to the secondary response parameters determination (delays, rise and fall times, etc.);
■ Powerful user-defined modeling capability,
■ Original way of generating a system-level model of MEMS from FEM component equations.

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