MEMS *Pro v6.0*

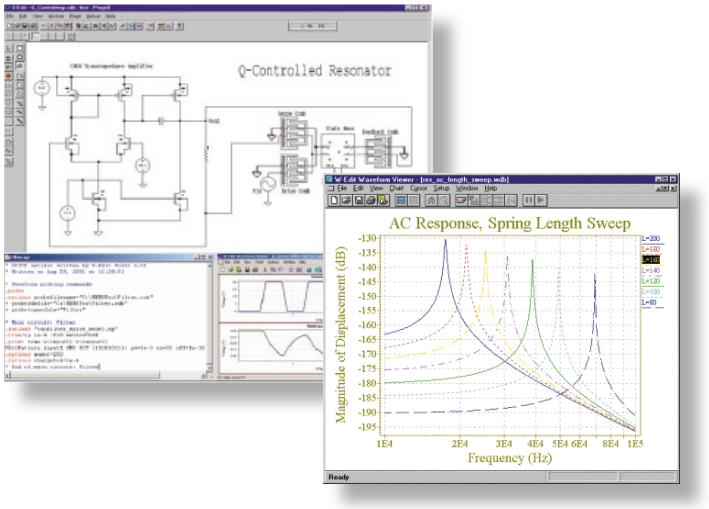
MEMS Pro is a flexible, powerful, easy-to-use CAD tool suite for the design and analysis of micro-electro-mechanical systems (MEMS). It offers an integrated solution for the design process that shortens development time while providing designers reliable analysis for manufacture. Functionalities include mixed MEMS/IC schematic capture and simulation, full custom mask layout capability and verification, 3D model generation and visualization, behavioral model creation and links to 3D analysis packages.

Features

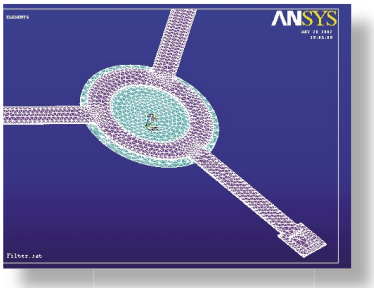
System-level Tools: **MEMS Pro** provides system-level design capability through fully hierarchical schematic capture and behavioral level simulation of MEMS devices with electronics and packaging. MEMS devices are represented with multi-physics signals in mechanical, thermal, magnetic, fluidic, optical, and electro-static domains. MEMS models are represented in high level behavioral languages, SPICE, C-code, or data tables.

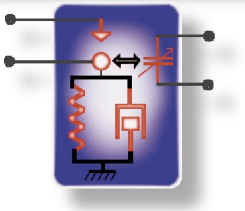
- Simulation modes include AC, DC operating point, DC transfer sweep, Fourier, Noise, Transient, Transfer function, and Parametric Sweep.
- Powerful optimization algorithms determine device or process parameters that will optimize MEMS design performance.
- Statistical analysis allows designers to simulate process corners, run Monte Carlo simulations with statistical distributions of process and geometrical parameters, create response surface models, and perform sensitivity analysis to understand which geometrical or process parameters most effect device performance and estimate yield.

For designs that contain both MEMS and IC devices, **MEMS Pro** allows easy creation and modification of schematics, and generates netlists for simulation, optimization, statistical analysis, and layout verification. The simulation library includes symbols and parameterized behavioral models for a variety of MEMS components. The integrated simulation environment allows users to probe signals of interest on the schematic and simulation waveforms are automatically displayed.



Modeling Tools: MEMS Modeler automatically generates behavioral models ready for system simulation with electronics and packaging from 3D data from finite element analysis programs. Complex, finite element models involving a large number of degrees of freedom are reduced to behavioral models with a few master degrees of freedom. Users can also create their own models from analytical equations and the tool generates simulation-ready descriptions in a variety of popular formats.





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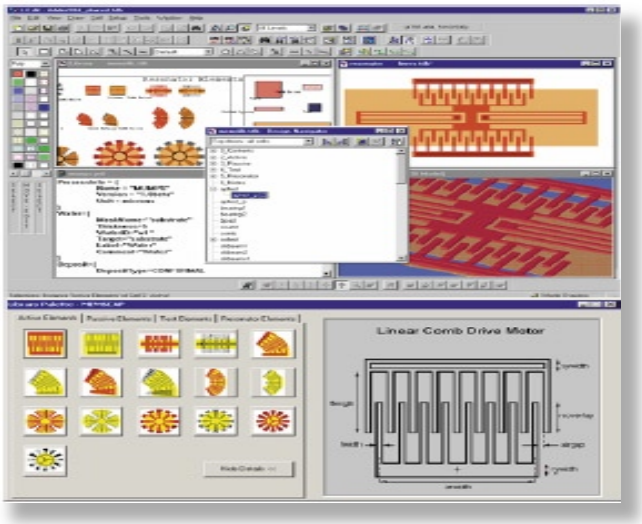


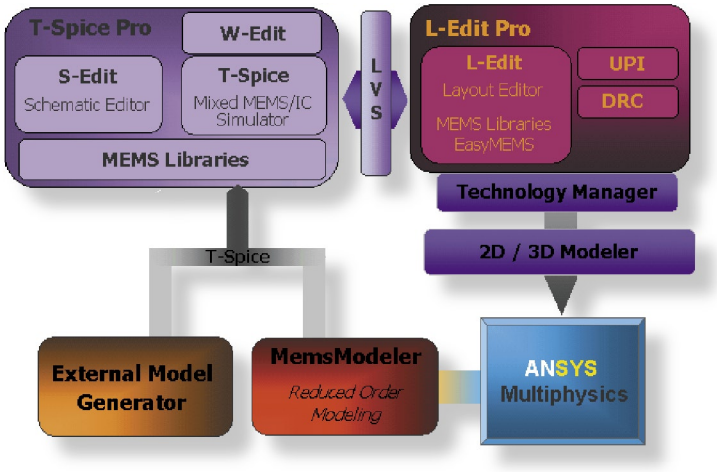
Layout Editing: MEMS Pro's physical design environment includes a fully hierarchical and full custom mask editor engineered for MEMS and IC design. The program uses an intuitive interface and provides specific MEMS-related capabilities that greatly reduce layout time. A curve generator allows designers to create MEMS primitives, such as splines, fillets and general equation-based curves. The **EasyMEMS** tool helps to automate tasks that are time-consuming for creating MEMS mask layout such as creating polar arrays. Useful macros include the generation of holes and dimples to properly release MEMS structures.

A **Library** of scalable MEMS device layouts is provided through a handy graphical library browser. The library devices are linked to user-specified or foundry design rules to ensure manufacturability. The library includes thermal, mechanical, optical, fluidic, and electrostatic devices. A powerful interface is included for automating, customizing and extending the layout editor command and function set using the C language. Popular output formats are supported so mask designs are "foundry ready".

MEMS Verification provides a configurable **Design Rule Checker** that verifies MEMS layout against fabrication requirements to prevent costly design errors. In addition, application and device specific context sensitive rule checking is included. An Extractor generates a SPICE netlist from a MEMS layout including MEMS devices, their parameters and multi-domain connectivity. The LVS (Layout vs. Schematic) tool takes the extracted data and compares it against the SPICE netlist from the schematic editor to ensure that the mask layout captures the designer's intent.

The **3D Solid Modeler** creates a 3D view of a MEMS device from the device layout and fabrication process description. An easy to use GUI permits designers to enter fabrication process steps and sequences. Surface and bulk micromachining process steps such as material deposit, etch, mechanical polish, diffusion, growth, electroplating and wafer manipulation steps are supported. The 3D model may be scaled and a subset of mask layers may be selected for view. Models can be viewed with rotations, zooms, and preset views. The **Cross Section Viewer** displays a cutaway view in the z-dimension based on a user-specified cut line. Model displays may be animated to show process sequences.

Material properties and boundary conditions may be defined and can be transferred along with the 3D model to third party 3D analysis programs for further simulation. A MEMS-specific mesher creates efficient meshes for analysis. **3D-To-Layout** converts 3D solid models in ANSYS into 2D mask layouts using user-specified fabrication process descriptions, enabling capture of device mask modifications made in 3D analysis programs.



Foundry Modules enable targeting of specific process technologies and provide process-specific device intellectual property. A variety of foundry-specific modules are fully integrated with SoftMEMS' tool suites to ensure process compatibility and manufacturability with the world's leading MEMS foundries. Foundry modules include mask and device design rules, mask layer descriptions, device descriptions for extraction, process parameters and material properties, and foundry fabrication process sequence descriptions.

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