
## Inertial Sensors Applications

MEMS inertial sensors, including accelerometers and gyroscopes, are widely used in automotive applications, and are rapidly expanding into consumer electronics such as mobile phones and gaming systems and other important applications as well, in the aerospace, military and industrial markets.

For more than a decade, Coventor has worked closely with leading suppliers of MEMS inertial sensors to insure that our products meet their needs. No other vendor's MEMS design software can match Coventor's experience with supporting its customers on such a wide variety of inertial sensor applications, design approaches and fabrication methods.

CoventorWare™ is an ideal tool for designing and analyzing inertial sensors. Though many MEMS designers feel most comfortable with the finite element analysis (FEA) provided by Designer and ANALYZER, we think (and leading manufacturers agree) that ARCHITECT is the place to start. Whether you are exploring design concepts, refining a design, or creating a derivative design, ARCHITECT is the fastest way to get your work done. The comprehensive electromechanical component library allows you to quickly assemble a schematic design. The underlying models simulate in seconds or minutes, not hours or days like FEA. ARCHITECT's simulation speed allows you to do things you've never done before, like simulating the transient behavior of a gyroscope and its control circuit, taking full account of non-linear electrostatic effects and fringing fields. Plus, you'll have time to explore many more design and fabrication variations, which can result in a better optimized design and one that's more likely to work when it comes out of the fab, saving costly fab cycles and bringing your design to market sooner.

With ARCHITECT, you'll be able to perform many types of analysis on your inertial sensor design, from basic to advanced:

- Modal analysis, to identify mode shapes and frequencies
- Harmonic response
- Electrostatic pull-in
- Full transient response, including control circuits
- Temperature sensitivity
- Environmental effects, such as temperature sensitivity
- Packaging effects on device performance
- Virtual drop tests
- Quadrature effects due to manufacturing variations, such as varying sidewall angles


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But make no mistake, the Designer and ANALYZER modules are a powerful complement to ARCHITECT for inertial sensor design. The automated 2D-to-3D solid model builder and mesh generation in Designer have been optimized for the multi-layered construction that is typical of MEMS inertial sensors, whether surface- or bulk-micro-machined. Many customers tell us that Designer is the easiest way to create 3D models for FEA. The MEMS solvers in ANALYZER, including MemMech, MemElectro, and CoSolve-EM provide best-in-class coupled electro-mechanics. Unlike competing FEA tools, the hybrid finite element / boundary element approach used by CoSolve-EM fully captures electrostatic fringing fields, assuring accurate results. MemDamping offers a comprehensive, unique approach to analyzing damping; it fully exploits the physical effects that are characteristic of MEMS, such as squeeze films and low Reynolds number, to deliver accurate answers quickly. For inertial sensors that rely on other sensing and actuation principles, such as piezo-resistive, piezoelectric, or thermo-mechanical effects, MemMech and MemPZR are the tools to use.

To perform advanced analysis, such as transient analysis of a gyroscope or packaging effects on device performance, CoventorWare makes it easy to combine the strengths of ARCHITECT and ANALYZER. Look around, and you'll find that we offer the most efficient way to perform these challenging analyses.

When it's time to send your design to the fab, you'll find that MEMulator quickly proves its worth, both for communicating and resolving fabrication issues. Because it builds highly realistic, 3D models of the fabricated device, starting from GDSII layout, it's often possible to identify potential fabrication issues before tape out. MEMulator also provides a quick way to understand the impact of manufacturing variations.

**Additional Links:**
Gyro Technical Paper