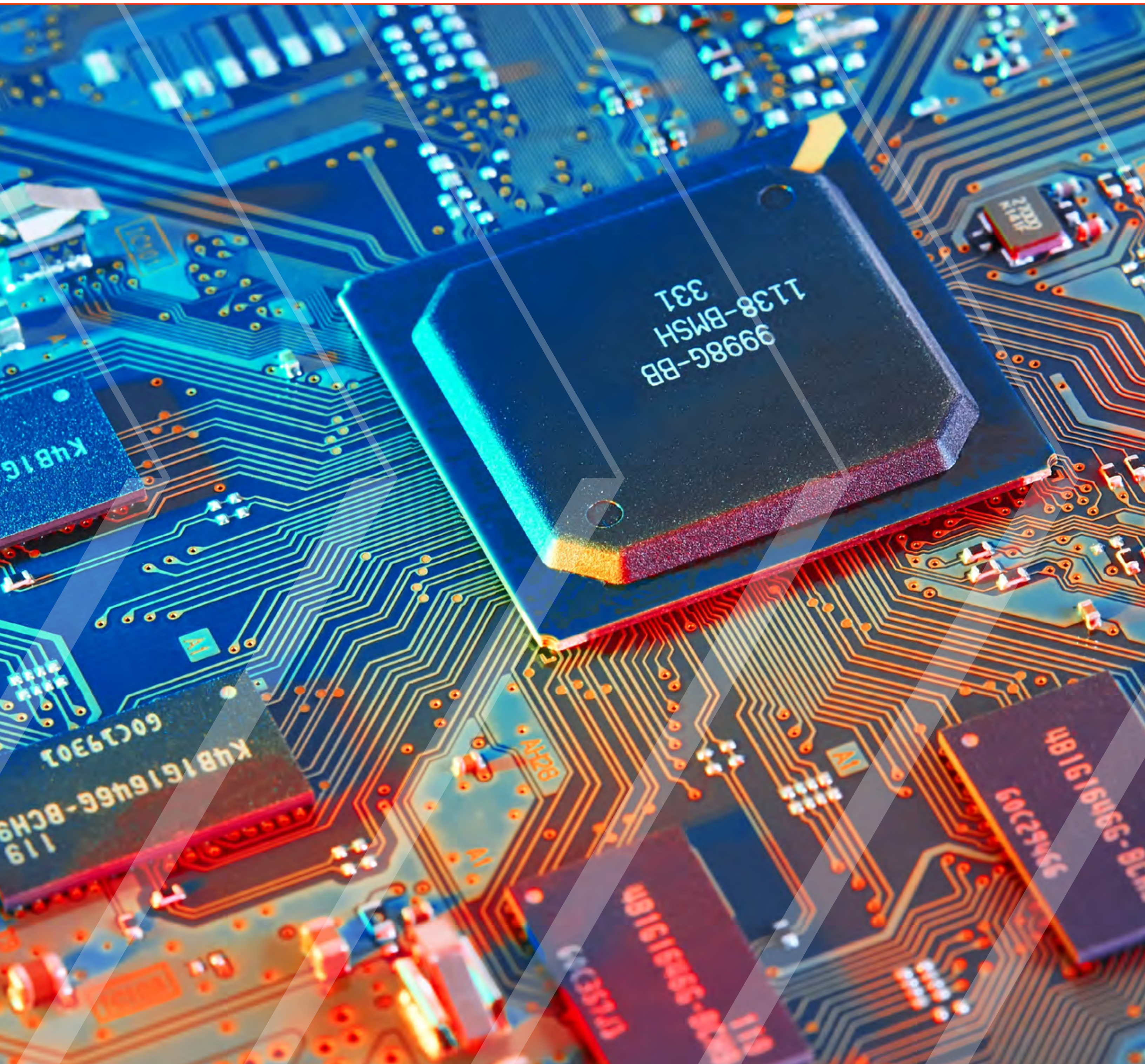
GUIDE TO ELECTRONIC SYSTEM DEVELOPMENT



INTRODUCTION

Manufacturers today are tasked with designing smart, connected products at a breakneck pace to stay ahead of the competition. As performance demands continually increase, packaging sizes become smaller, and device connectivity becomes more critical, schematic engineers and product designers need ways to make efficient design decisions and collaborate with one another to optimize complex interconnected mechanical and electromagnetic systems. To develop the next generation of smart products, organizations are turning simulation to improve device performance and drive profitability.

Electronic System Development Guide

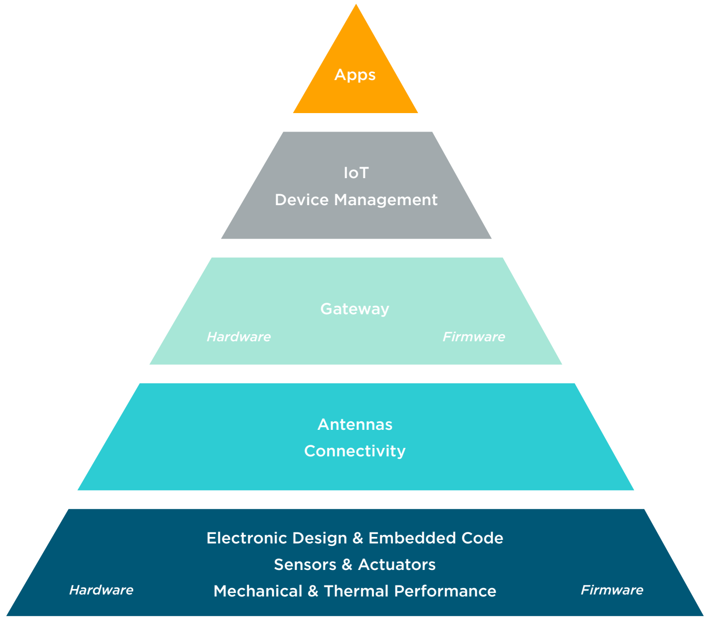
Electronics are a part of our lives – both professionally and personally – with the latest gadgets delivering an immediate gateway to the world. Innovation, time to market and lower cost are the keys to electronics success, and the pressures to quickly deliver innovative products at lower cost is intense. This guide demonstrates the use of simulation-driven design to accelerate smart, efficient electronics product development.

Electronic System Development Guide

WHAT IS A SMART PRODUCT?

A smart product has built-in intelligence to read, adapt, and react to the operating environment in which it is used. Smart products have sensors to perceive their surroundings, and electronics, embedded code, and on-board systems to decipher the incoming signal from the sensors. Depending on the system design logic, sensor data is then stored locally or transmitted to and from the cloud. Finally, algorithms found either locally or on the cloud utilize this data to arrive at the appropriate action and trigger the actuators which execute the action.

IOT HIERARCHY OF NEEDS



This guide provides an overview of the electronic system development process for smart connected devices.

If you want to learn how to design an IoT strategy and effectively connect your smart devices at scale Read the Guide to Smart Product Development.

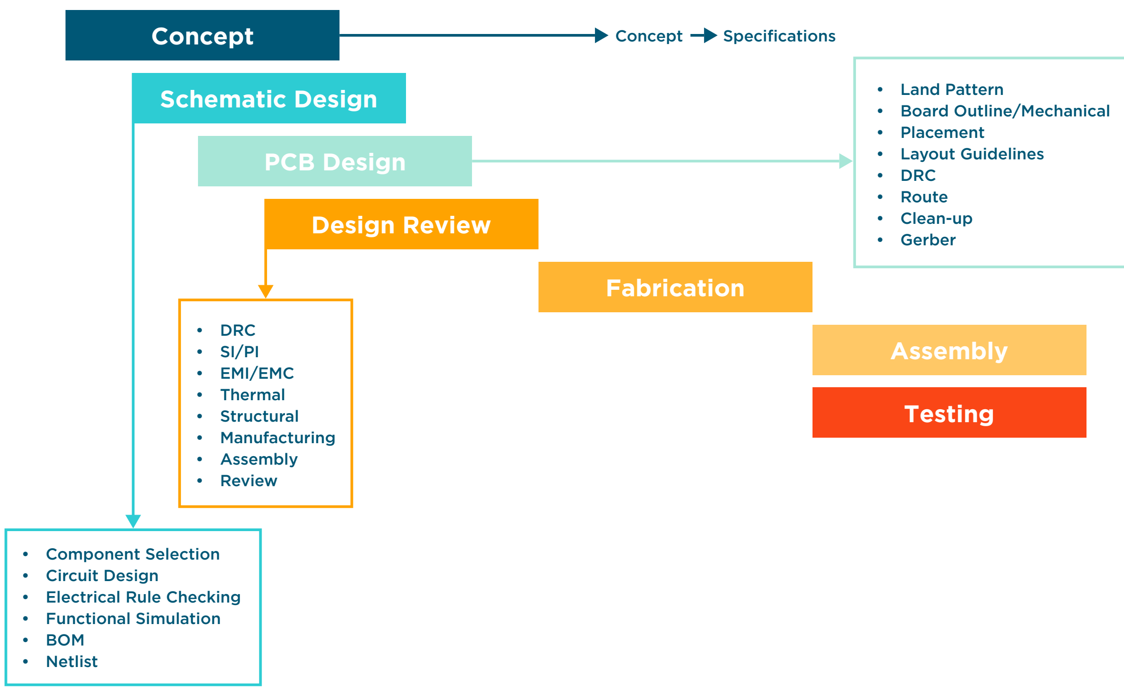
“Smart, connected products require a fundamental rethinking of design. At the most basic level, product development shifts from largely mechanical engineering to true interdisciplinary systems engineering.”

Porter, Michael, Heppelmann, James (2015), “How Smart, Connected Products Are Transforming Companies”, Harvard Business Review October 2015, Harvard Business Publishing, Accessed 17 November 2020

ELECTRONIC DESIGN

Delivering electronics that delight consumers requires more than just linking the ECAD and MCAD worlds, it requires physics analysis at the speed of design and collaboration across disciplines throughout development. Altair PollEx™ brings Altair's simulation-driven design philosophy to the electronics industry, inspiring innovation while ensuring timing, performance, reliability, and compliance targets are met.

Designing consumer electronics for mass production requires a team of experts focusing on various aspects of design and manufacturing process. With a fragmented engineering process, exchange of models and information can cost valuable time in a competitive landscape. Central to a successful design collaboration process is an agile toolset used within the component, subsystem, and system-level design as well as across logical and physical design spaces.



PollEx offers a unified part library for physical, logical, thermal, electrical, and assembly attribute data so teams can seamlessly share data and modify designs at any stage of the development cycle. PollEx also integrates with all major ECAD and simulation tools, increasing efficiency and performance while fitting into existing tool chains with unsurpassed connectivity.

Concept Design

The first step in an electronics design process is to visualize and review the initial concept design. Using PCB design software at an early stage allows designers to detect design faults and avoid costly downstream issues.

PollEx is the most comprehensive and integrated set of PCB design viewing, analysis, and verification tools for electrical, electronics, and manufacturing engineers. PollEx transfers data flawlessly between the industry's most popular ECAD and simulation tools and enables many of the world's major electronics corporations to quickly visualize and review PCB designs. Its checking tools detect issues early in the design to avoid product failures and simplify manufacture and assembly.

Schematic Design

Simulation enables schematic engineers to make better product design decisions earlier in the design process and PCB schematic data allows for optimization of the underlying programming logic. Early checks can be performed for signal integrity, power integrity, electromagnetic interference (EMI) vulnerability, and electrostatic discharge (ESD) protection, ensuring return path routing, balanced differential pairs, and verifying many other essential features.

PollEx offers users a schematic design viewer which reads in the design data from various schematic design tools. It shows schematic objects, logic symbols, net connections, and other related objects in individual design sheets. By combining objects, users can easily identify the location in the sheet and attributes of the object. Bill of materials (BOM) files can also be extracted from the schematic design data.

PollEx validates BOM, logical system design and PCB schematic data to ensure error-free translation and facilitate the comparison of PCB and schematic revisions using the industry's best ECAD connectivity. Using your own ECAD tool, you can perform logical design verification and ensure proper schematic behavior.

“Having [electronic sensor simulation, SPICE simulation, and data processing] together allows Schneider Electric to use a global approach to optimizing our solutions.”

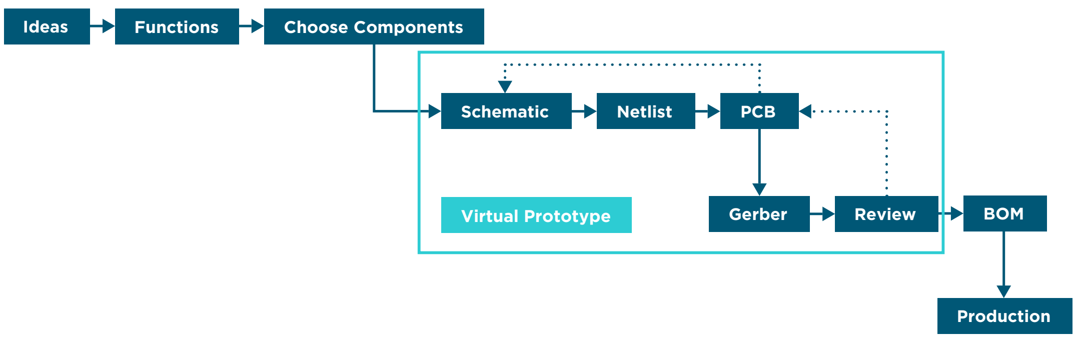
Bertrand Du Peloux, Schneider Electric

Schneider Electric uses Altair simulation tools to design reliable and versatile sensors which treat data for various smart system tasks like remote monitoring and actuation of circuit breakers.

PCB Hardware Design

The most important part of any electronic device is the PCB, which hosts all of the product's functional modules. The typical workflow involves multiple iterative design cycles, but PCB visualization and review tools help address design issues and shorten overall process time.

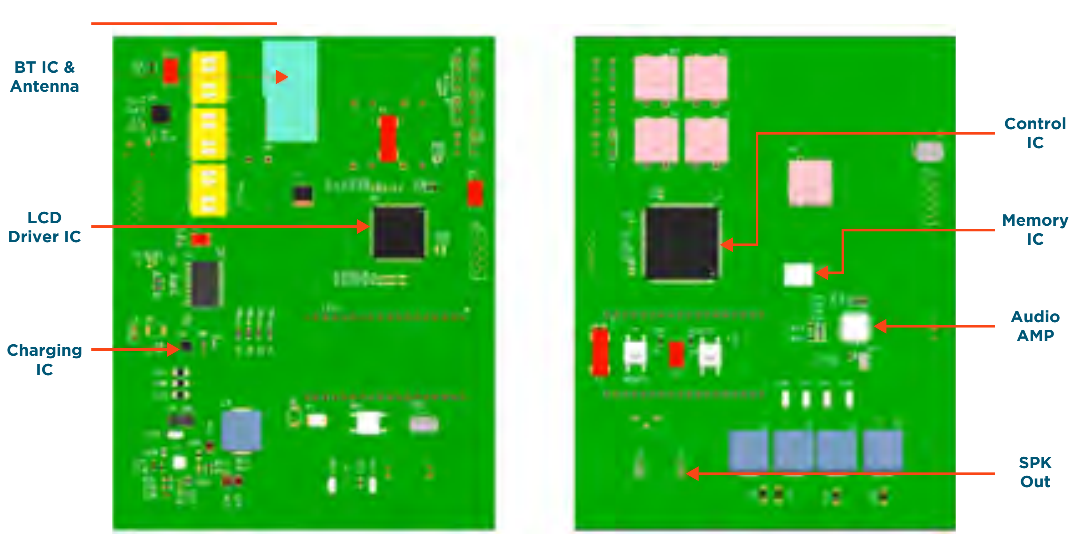
Typical Workflow of a PCB Design



The PollEx design for electrical engineering tool detects electrical issues via verification earlier during the design phase. Pollex provides early checks for signal integrity, power integrity, electromagnetic compatibility, and interference vulnerability (EMC/EMI) and ESD protection, ensuring return path routing, balanced differential pairs, and verifying many other essential features.

In the case of a wireless smart speaker, PCB design considerations might include different audio lines, sheilding from audio lines, and thermal behavior of the main ICs, all of which effect the audio quality. Design for electrical and thermal analysis tools can be used to model and optimize the performance of these key factors.

Additionally, satisfaction of specific impedance and safe use of high-speed bus lines are critical for the high-speed performance of the speaker. Signal integety analysis is ideal for ensuring the PCB meets the desired performance targets.



Design Review

Schematic design review is a critical step in the design process of electronics. A challenge of the design review stage is managing multiple EDA vendors and ECAD formats that are typically used at various stages of the design process. Pollex interfaces with all major EDA vendors, making it an easy to use software to collect disparate design elements for global review.

Comparison between PCB-to-PCB and schematic-to-schematic designs are executed in this stage, as well as comparisons across PCB, schematic design, and BOM. Design reviewers query, search, and measure artwork, physical, and composition layer views for PCB objects. Pollex users also have access to part, net, pad stack, and via libraries. Design reviewers can also view the net 2D and 3D display, net topology display, and perform automatic composite net generation and can red-mark features for comment.

Signal integrity, power integrity, and thermal

PollEx signal integrity and power integrity solvers provides early checks for signal integrity and power integrity, ensuring return path routing, balanced differential pairs, and verifying many other essential features.

PollEx investigate signal integrity and thermal PCB problems thanks to intuitive and easy to use solvers for board-level analysis. Included are efficient domain signal integrity solvers with SPICE and IBIS model support for wave propagation delay, reflection, crosstalk, eye diagrams, scattering, admittance, and impedance matrix calculations.

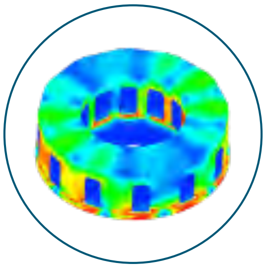
SIMULATING SENSORS AND ACTUATORS

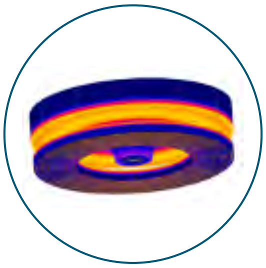
Smart sensors and actuators are strategic components for smart product monitoring and control. No matter whether data is processed at the device level or in the cloud, sensors and actuators have to be accurate, reactive, and energy efficient in order to deliver the performance needed for smart systems.

On top of performance optimization, sensors and actuators also provide challenges for architecture integration. They often need to be miniaturized, and when possible, integrated into the PCB without sacrificing reliability or adding to manufacturing costs. Sensor-PCB integration can be a source of electromagnetic interference, and sensor and actuators will also generate heat. The presence of steel, magnets, and copper will impact product weight and its distribution within the device, which needs to be considered in the simulation of mechanical and thermal performance.

Using electromagnetic simulation technology, device designers can prioritize these key attributes and design, simulate, and optimize the performance of sensor electronics or permanent magnets. EM results can even be used within Design of Experiments (DoE) software for performance optimization.

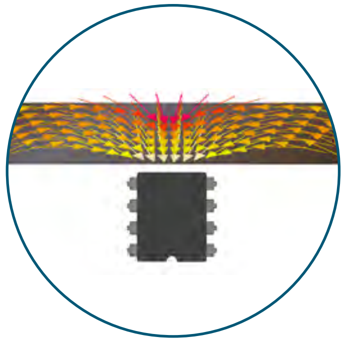
Altair's low-frequency electromagnetic analysis software helps engineers design more compact, more efficient, and more accurate actuators. This tool also makes it possible to perform accurate virtual prototyping of magnetic sensors thanks to advanced modeling techniques considering material non-linearities, eddy currents, circuit coupling and motion with mechanical loads.

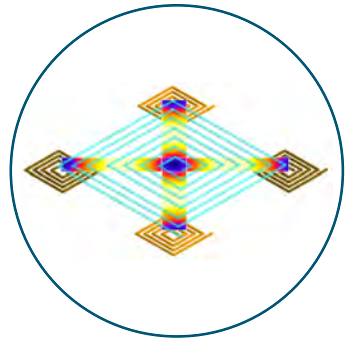


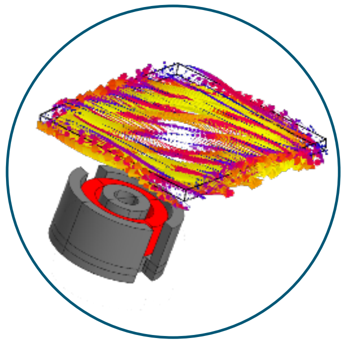


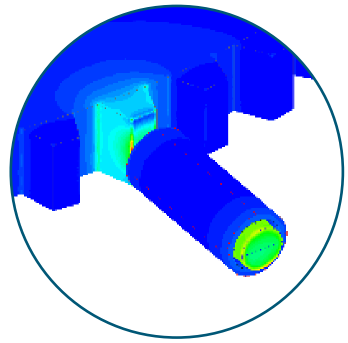
Miniaturization, efficiency, weight, high level of controllability and cost are key criteria to optimize for linear actuators and motors.

A complete study of sensor behavior (electromagnetic, mechanical, and electrical) can also be achieved through simulation. Electromagnetic analysis is carried out to record flux density, currents, losses, current density. On the mechanical side position, speed, force, and torque can also be studied. For electrical sensor performance, Altair's software offers quantities for current, voltage, inductance, and resistance.





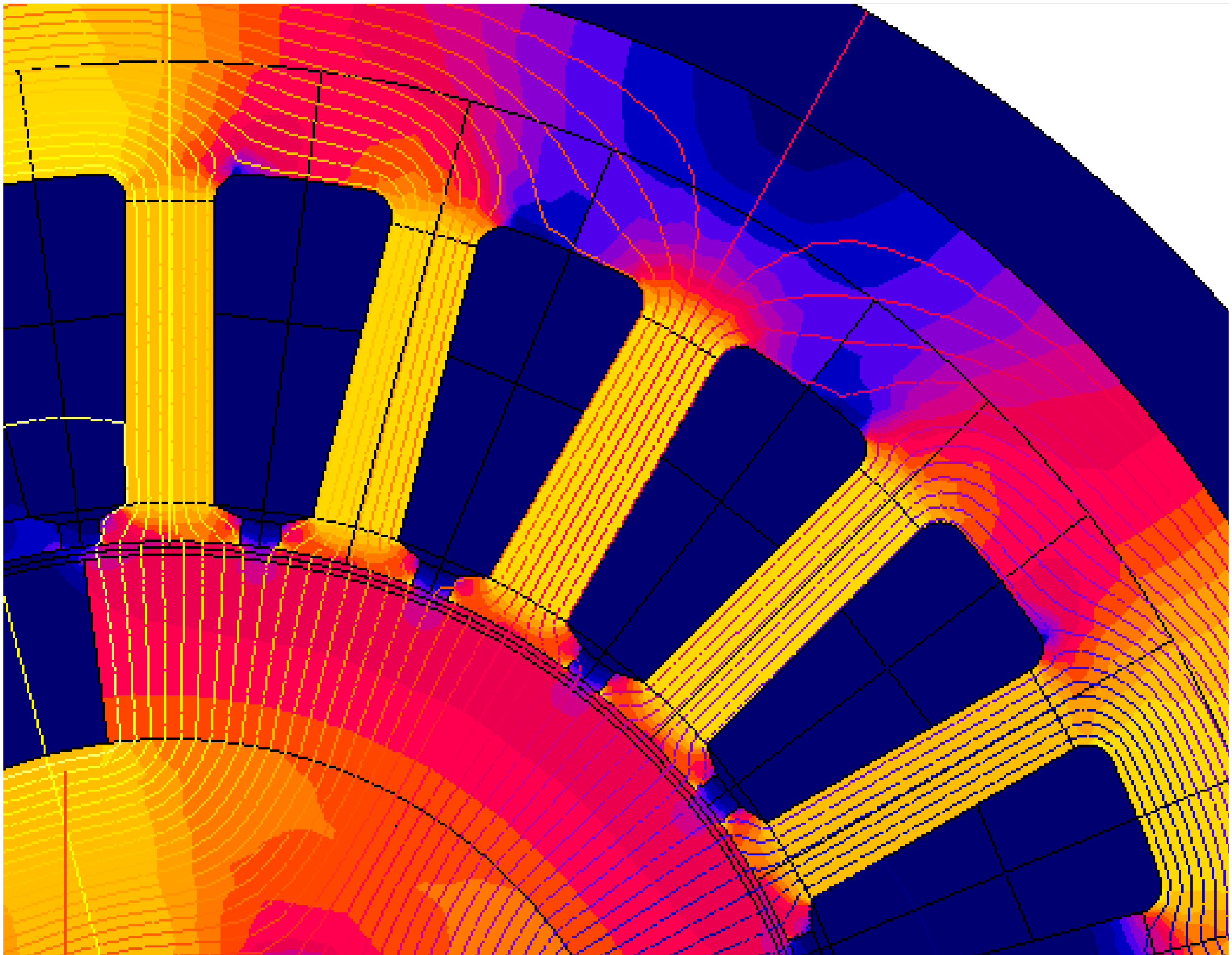




Altair tools enable the design of compact, cost effective, and easily integrated position and speed sensors.

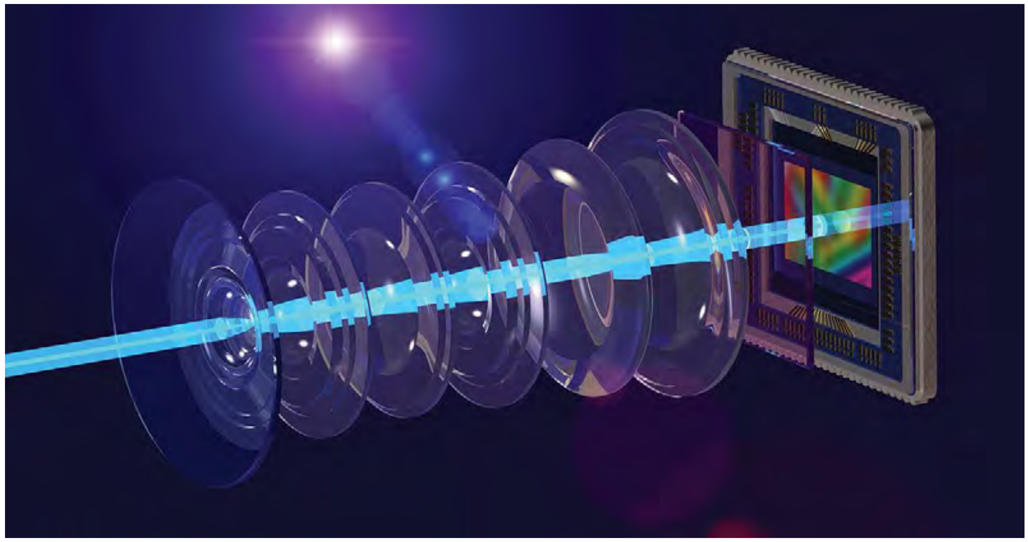
Altair's Model-based development (MBD) tools can help drive faster assessment of system performance by enabling the flexible configuration of sensor systems and simulating the sub-systems and control strategies for each function of the device. Simulating complex products as systems-of-systems allows smart product designers to explore how sensor resolution, accuracy, and precision, as well as the thermal, mechanical, electronic, and electromagnetic output of actuators, may influence the performance of the system as a whole. MBD enables easier integration into a global system and helps to improve energy management by identifying potential energy flow issues and various types of energy loss.

Finally, with advanced functions such as Altair's SPICE simulation technologies, users can consider signal processing and data analysis from the concept level to avoid data noise and treat unnecessarily large data sets prior to transmission.



The simulation-driven design of this medical auto-injector involved modeling of actuators and sensors executing the injector's functions.

Learn More About Electromagnetic, Electric, and Thermal Analysis



Motorola Mobility Simulates Actuators and Camera System to Ensure Optimal Design

Smartphone cameras use voice coil motor (VCM) actuators to translate a lens in three degrees of freedom in order to bring an object to focus on the image plane and to optically stabilize the camera. To ensure optimal design, the Motorola Mobility team used Altair electromagnetic analysis tools to simulate the entire VCM and camera system. This allowed the team to quickly validate designs and ensure that the part compatibility and camera performance met the design targets.

Other devices within the phone, such as speakers, antenna shields, accessory magnets etc. can affect the VCM performance due to magnetic interference. With EM simulation, the team simulated the entire VCM and phone layout, accounting for all possible magnetic interference from other devices.

With Altair EM software, the team simulated the entire VCM and phone layout, accounting for all possible magnetic interference from other devices. Full simulation of a VCM system is a requirement for any new or high-risk design. These simulations take place during part selection and product design phases in order to proactively rule out any issues that may arise.

View the Motorola Customer Story

This simulation shortened design cycles giving the team access to quick and reliable answers. This cut the design time from weeks and months, to days and hours, allowing the Motorola Mobility team to remain agile and quickly iterate on designs. The team can easily check design integrity and detect issues that otherwise would not be found until parts are tooled, which is too late in the development cycle.

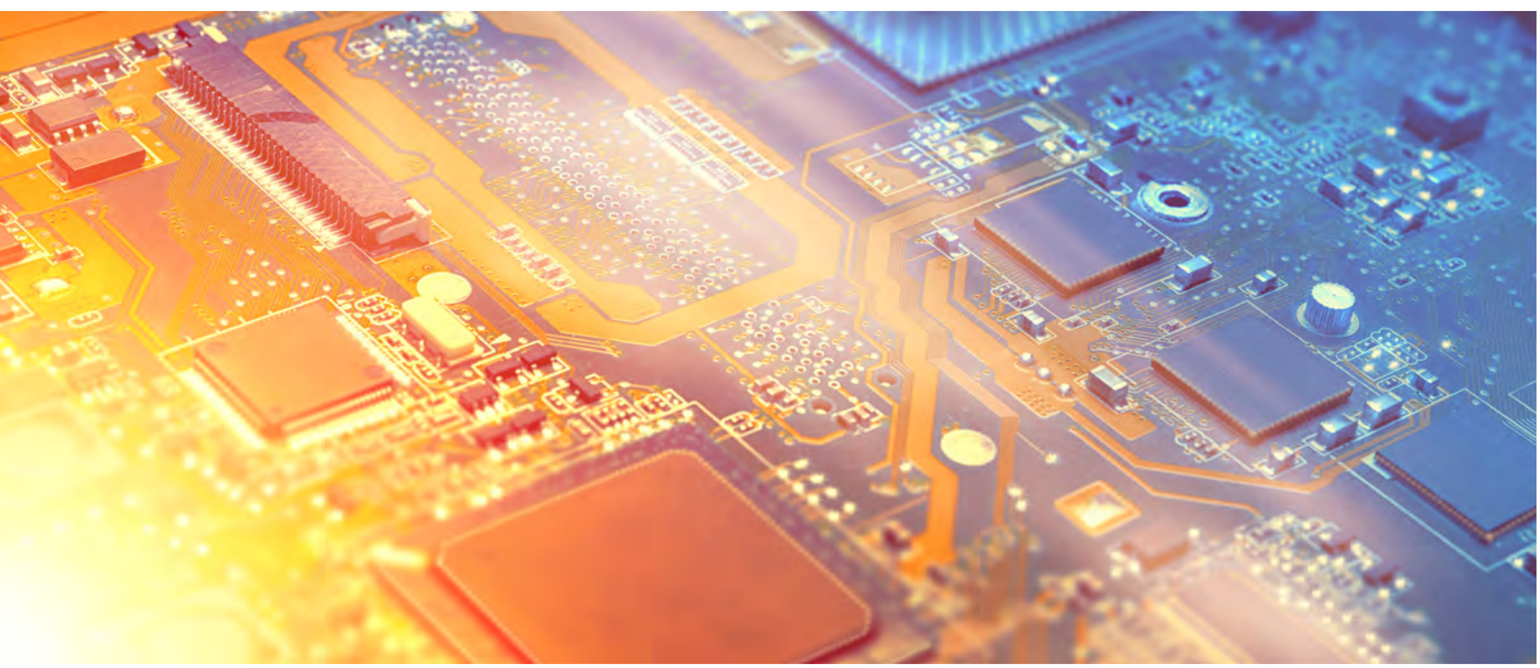
Example simulation of the Motorola One Zoom

EMBEDDED CODE DEVELOPMENT

Firmware Development with Embedded System Design
Visual environment software is essential to the smart product development process, allowing users to avoid the tedious and sometimes error-prone process of manually writing code for embedded systems. Instead, software can automatically generate code directly from your system diagram.

To develop complex embedded systems like sensor and actuator controls, vision systems, and IoT devices, you need software for model-based firmware development. Altair's tools let you design, analyze, and simulate your embedded system using block diagrams and state charts, then automatically generate compact and optimized code to run on an extensive selection of microcontrollers from Texas Instruments™, STMicroelectronics®, Arduino®, Raspberry Pi™, and others. Hardware-in-the-Loop testing is fully supported using a high-speed bidirectional communication link for data collection and real-time tuning.

Learn more about Embedded System Development

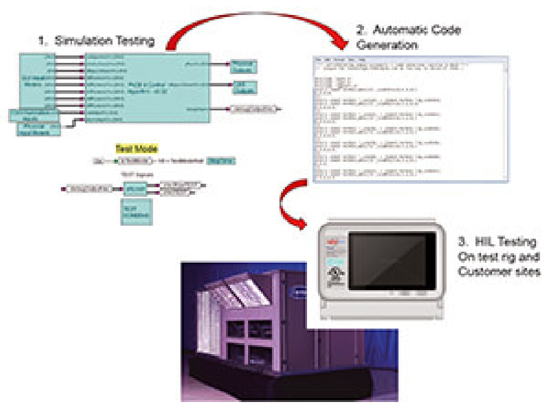


PaceControls Uses MBD to Eliminate HVACR Control System Defects

PaceControls, a leading technology developer and manufacturer of cloud-based Internet of Things (IoT) solutions for the HVACR industry, took a model-based design approach for their next-generation HVACR equipment control. By leveraging Altair's embedded system design software, they deploy over 19,000 smart-grid installations without a single significant reported defect.

The PaceControls technology resides between the thermostat and the HVACR equipment, accepting the thermostat control signal and other signals to produce optimized control signals that minimize energy usage of the HVACR equipment. Additionally, real-time estimates of energy savings are calculated and communicated to the cloud and customers.

[View the PaceControls Customer Story]



Altair provided the tools to support an end-to-end model-based design framework consisting of simulation and Hardware in the Loop (HIL) testing. During the simulation step, the system requirements are represented by design models, which are dynamic block diagram and/or state machine models that display the requirement and the acceptable deviation as a time history signal with maximum and minimum boundary signals. Design models are linked to their requirements and embedded in the models. Next, dynamic models of the HVACR systems are created followed by the design, analysis, and modeling of the energy and demand optimization control algorithms. The combined "controls + plant" model goes through an iterative "analysis + redesign + simulation" process until its performance lies within the acceptable range for each of the design models. Embed block diagrams and state charts, the analysis toolbox, filtering, and optimization functions are used extensively during the simulation step.

During the HIL testing step, Altair firmware tools automatically generate C code for the controller model. The code is then compiled with support libraries as an Android application where it executes on the PACE Node utilizing a cloud-connected Qualcomm Snapdragon microcontroller. The product is then tested in a desktop setting to ensure sensor scaling, latency, order of execution, initialization, CPU utilization, and accuracy are being calculated correctly. In the desktop setting the plant is replaced by a general purpose I/O board controlled by a design model producing test signals for sensors and recording actuator signals from the microcontroller. Once desktop testing is complete, the PACE Node system is connected to an actual HVACR system and performance is re-evaluated subject to the design models.

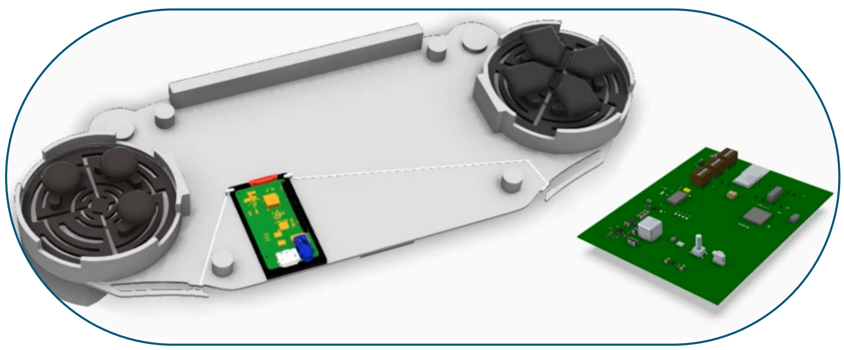
For PaceControls, Altair's embedded system design tools fully support the key elements of their MBD process including requirement capture, control system analysis and design, filtering, optimization, simulation testing, automatic code generation, and HIL testing.

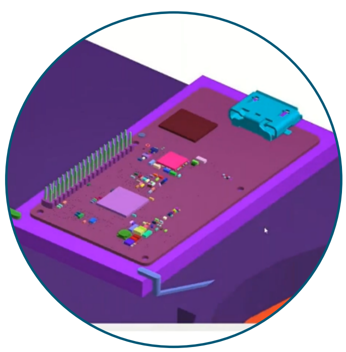
MECHANICAL AND THERMAL PERFORMANCE

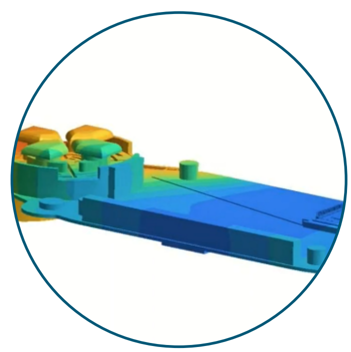
Structural Analysis in the Early Design Stage

Rapid design iteration is key to early stage evaluation of a design's feasibility. Consumer electronics need to withstand abusive loads both during use as well as during storage, shipping, and in the retail setting. Solving structural load cases on PCBs, however, can be a time consuming in traditional CAE tools due to the pre-processing requirements on these intricate geometries.

The structural analysis solver available within the Altair Inspire™ design, analysis, and optimization suite offers a way for designers to get structural analysis insights on complex assemblies in seconds or minutes without CAD geometry cleanup or meshing and assembly work. On the game controller below, multiple design variants of this 250-part assembly were imported and analyzed in seconds to compare structural and thermal deformations.



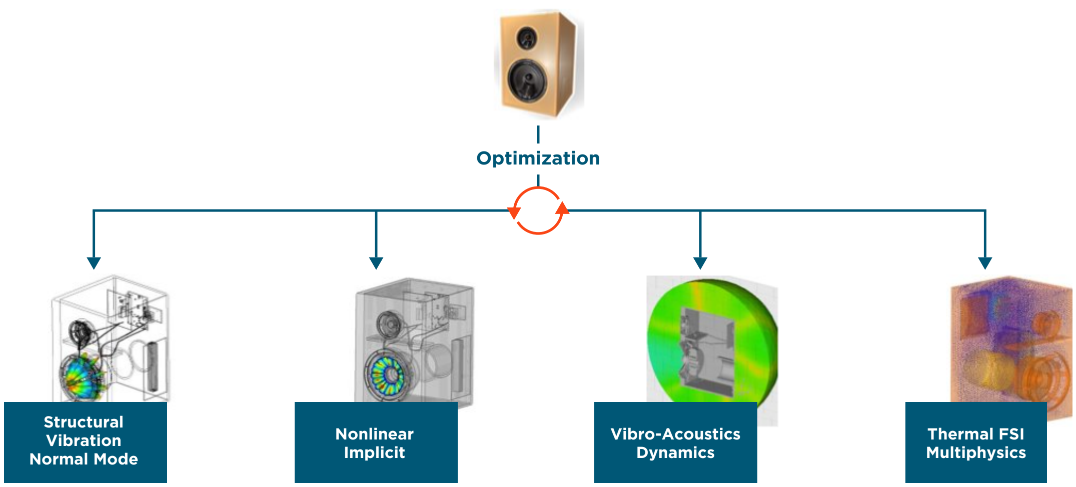




Structural analysis of a gaming controller and its PCB using SimSolid requires no meshing or geometry modification.

Deeper Mechanical Design Insights with Multiphysics

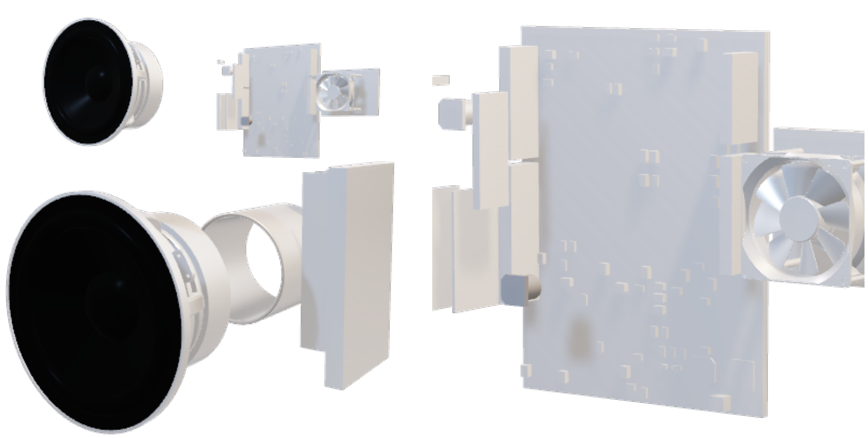
Designing with Altair SimLab™ allows CAE analysts to perform multiple physics simulations using a single shared model. This multiphysics platform enables users to automate modeling tasks and perform thermal, structural, and acoustics analysis within one unified platform. Rather than go through the tedious and error-prone process of preparing the model for each solver run individually, SimLab's single model multi-attribute multiphysics process delivers optimization-ready results 40% faster than the traditional approach.



Stress and Modal Analysis

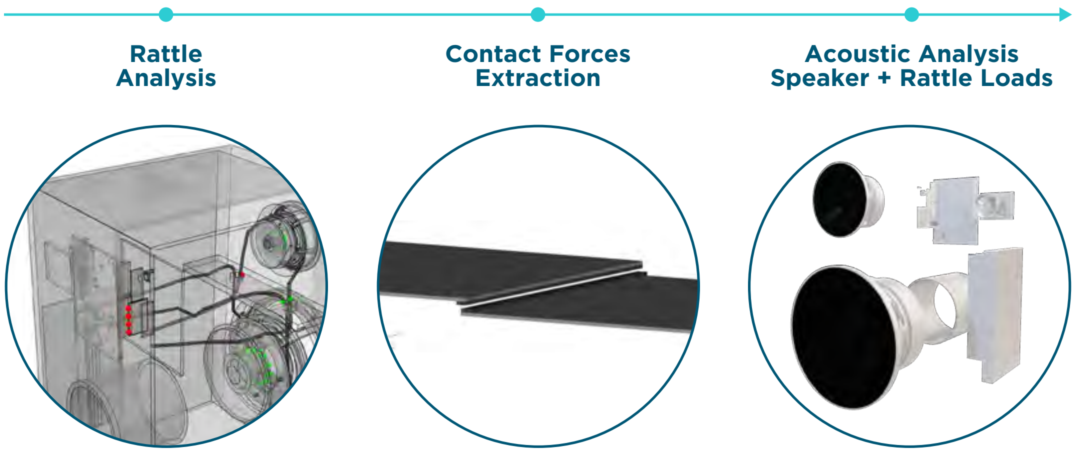
To determine the vibration characteristics of the model, modal analyses can be carried out. SimLab provides the functionality to perform frequency, transient, and squeak and rattle analyses during simulation.

In this smart speaker example, a frequency analysis was applied to the speaker membrane in order to observe the vibration levels at different locations of the speaker assembly and diagnose any causes of failure. Once results were analyzed, the speaker design was optimized by minimizing acceleration at the PCB measurement point. To do so, 1D topology optimization was applied to improve the connection strategy from the PCB to the cabinet.



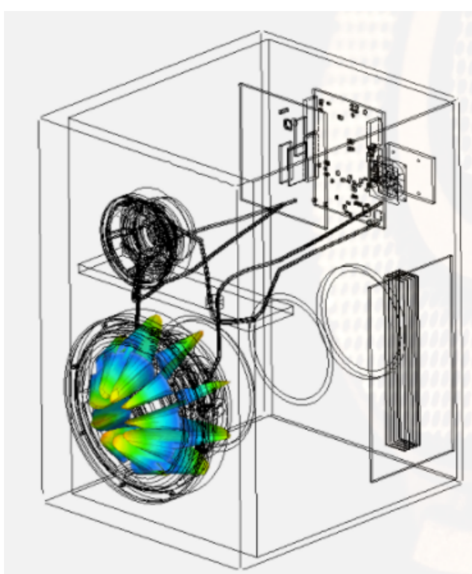
Smart Speaker Assembly and PCB

In addition to speaker aesthetics, sound quality and noise reduction performance are key drivers of the end-product's perceived value and price point. Vibro-acoustic analysis is necessary for understanding what the final product is going to ultimately sound like. SimLab was utilized to test the speaker for rattling and sound pressure levels, then to correct any errors that were found in the overall design.



Vibration

Testing for noise, vibration, and harshness issues during smart product development is a critical step in ensuring that a speaker model will satisfy pre-determined quality targets. By simulating for vibration, product designers can identify causes of unwanted noise caused by vibration and redesign to dampen or eliminate it before the physical testing phase. Vibration also creates heat; a major concern when it comes to sensitive electronics. Full frequency, multiphysics, and acoustic simulation can be performed in SimLab for users to successfully assess and update their designs.

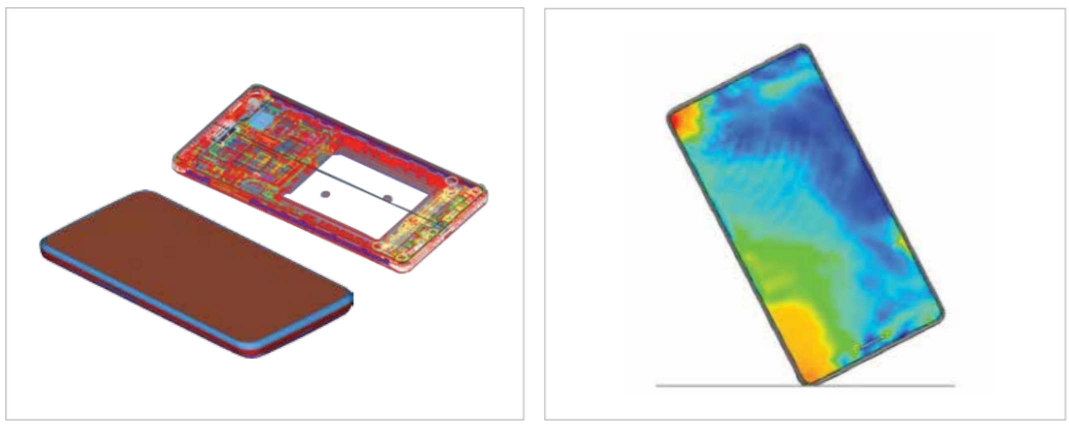


Acoustic Simulation of a Smart Speaker

Drop and Abusive Loads

Impact analysis or drop testing is one of the most important stages of product design and development, and software that can simulate this testing accurately yields dramatic cost and time-to-market benefits for manufacturers.

It is the job of the manufacturer to design and develop products that perform as well as possible when dropped, crushed, or otherwise placed in danger of permanent damage. Drop test simulation software helps manufacturers by speeding up the time to test a product, enabling higher levels of design quality and reducing the need for physical testing. Structural analysis tools can replicate the complexity of the physical environment and materials, simulates the impact or drop event, and provides detailed technical information about how the product performs during this event. Altair's structural analysis software provides a rapidly expanding and efficient set of nonlinear analysis features for drop test simulation, large displacement testing, preload temperature testing, contacts, and non-linear material analysis.



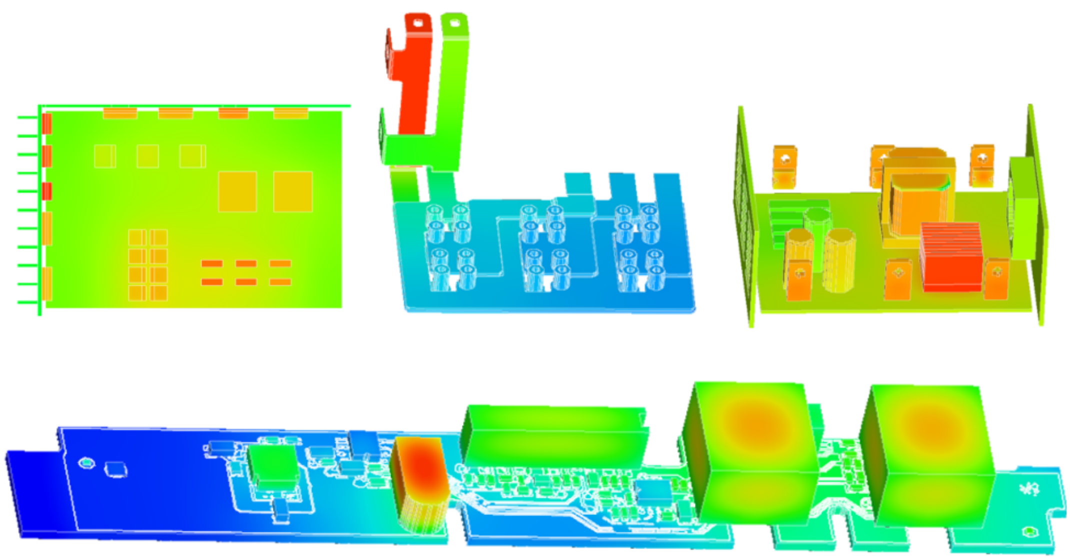
LG Electronics Performs Drop Test Simulation on a Smartphone Design

Thermal

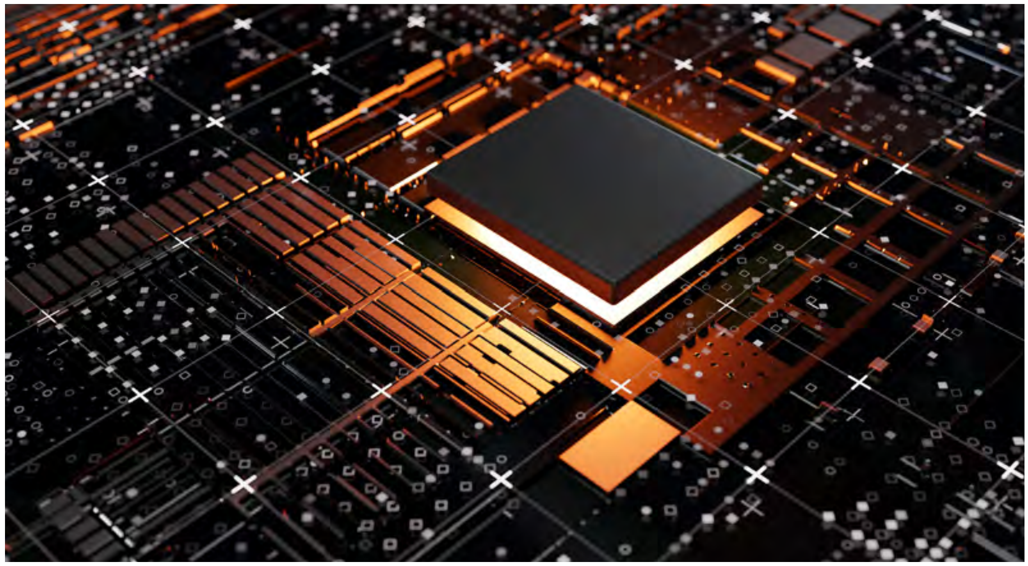
Many factors are considered during a thermal analysis for electronics, from Computational Fluid Dynamics (CFD) to the elimination of thermal effects of the PCB. Thermal flow analysis can be conducted on the design of a smart products to test fluid materials, heat load, inlet flow, fan cooling effects, and other key contributing variables.

For analyst-level users investigating challenging electronics cooling and design applications, Altair offers thermal analysis solutions that are accessible directly within its multiphysics environment. This CFD-based tool is capable of solving problems involving conduction, natural and forced convection, radiation, and conjugate heat transfer, yet it is easy enough to use for a non-CFD expert. This functionality is also available within the Altair Inspire platform for early-stage design feasibility studies.

Thermal analysis studies can be carried out at every level of the electronics design. Altair's tools can simulate the thermal behavior of the semiconductor and PCB level to the assembly, wiring and module levels, all the way to the full system-level operation. This software is especially adept at handling applications such as electronic enclosure systems, forced cooling systems, busbar systems with circuits, and PCB cooling.



Learn More About Thermal/ElectricalAnalysis



Samsung SDI Improves PCB Development with PollEx

Samsung SDI is a top provider of energy and materials for rechargeable batteries for the IT, automotive, energy storage systems (ESS), and electronic material industries.

When they transitioned to the electronic materials business, several challenges surfaced that needed to be addressed. The company had to move from digital display control circuits to battery control circuits, requiring a different approach to new electronic designs and related printed circuit board (PCB) manufacturing technologies.

A strong solution for PCB design review, and verification was needed for existing and new products. Also, after acquiring a key player in the automotive battery pack business, Samsung SDI needed a solution that could setup and deploy PCB design review and verification where the design rules and user environment were centrally managed.

View the Samsung Customer Story

Samsung SDI used Altair PollEx for PCB design review and verification. Paying special attention to the supported design rules for manufacturing (DfM) and design for electrical engineering (DfE), the objective was to manage and enhance the process from design to manufacturing.

PollEx allowed teams of PCB designers, hardware engineers, test engineers and manufacturing engineers to communicate overseas. This solution was accessible to all branch locations but allowed the design rules and verification environmentto be centrally managed.

Samsung SDI engineers now have an environment for PCB verification of existing and new products with different verification requirements. PCB artwork engineers can upload PCB layout designs to a PDM server, including the designs in PollEx's format. All engineers can then review the PCB designs while running PCB verification. Samsung can also detect manufacturing faults and electrical failures early in the design process, and plan to use PollEx for signal and power integrity and for thermal analysis in the future.

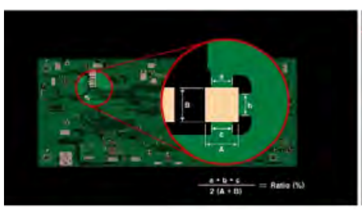
With PollEx, Samsung SDI successfully collaborates from a central solution with PCB design review and verification capabilities. This saves an estimated six million USD a year thanks to a reduction of design iterations from 20 to nine and number of revision checks from six to three.

Assembly and Testing

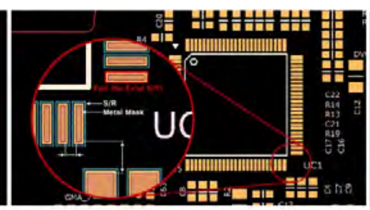
PollEx PCB verification enables significant cost-savings by detecting manufacturing, assembly and electrical defects and faults early in the designs. Manufacturing issues like poorly soldered joints can lead to unreliable signal transfer or total disruption of signal flow, as well as tombstoning, where a surface mount passive component like a resistor or capacitor partially lifts from the pad on one end. Design for manufacturing tools in PollEx highlight potential manufacturing issues and increase production yield using native ECAD formats instead of Gerber files.

Design for assembly features in PollEx ensure easier assembly within tight mechanical constraints, and integrated FEM-based board-level thermal analysis enables teams to understand cooling needs. PollEx helps users to standardize components and create modular designs for faster, easier, and more cost-effective assembly. Engineers leverage PollEx to calculate solder quantity, confirm mask validity, export wave soldering data, and specialty pasting requirements. It is also used for extracting data for mounting machines and simulating component mounting status. Additionally, PollEx can drive de-paneling jig design and export cutting routes, as well as confirm design and manufacturing data alignment, extract test point locations.

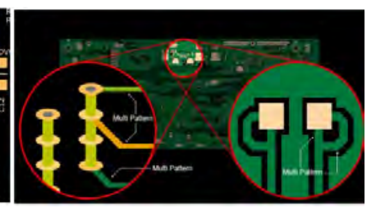
Evaluating design alternatives in a virtual space allows changes to be made to the PCB layout that promote ease of handling and reduces the risk of rework. Feasibility studies can then analyze the cost and design performance of the proposed design layout. Finally, during the layout process, design for manufacturing and assembly constraints can be set to automatically review designs for compliance and verify the optimized design. PollEx provides features to support the entire process of PCB fabrication, assembly, and end-of-line testing.



Cold Soldier / Pad Thermal



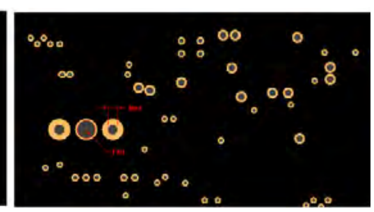
Soldier Mask / Resist



Multi-connection

Via Annular Ring

PTH Annular Ring



Non-standard Drill Size

Examples of PCB manufacturability verification features in PollEx Design for Manufacturing

ANTENNAS AND ON-DEVICE CONNECTIVITY

In an interconnected world, most devices are wireless with several antennas. Along with the high-frequency signals from WiFi and Bluetooth antennas, devices may also include sensors and actuators that emit low-frequency electromagnetic signals, all contributing to potential interference issues. PCBs are densely packed with components, leaving limited space for antennas. The performance of the antenna is also influenced by the adjacent components on the PCB.

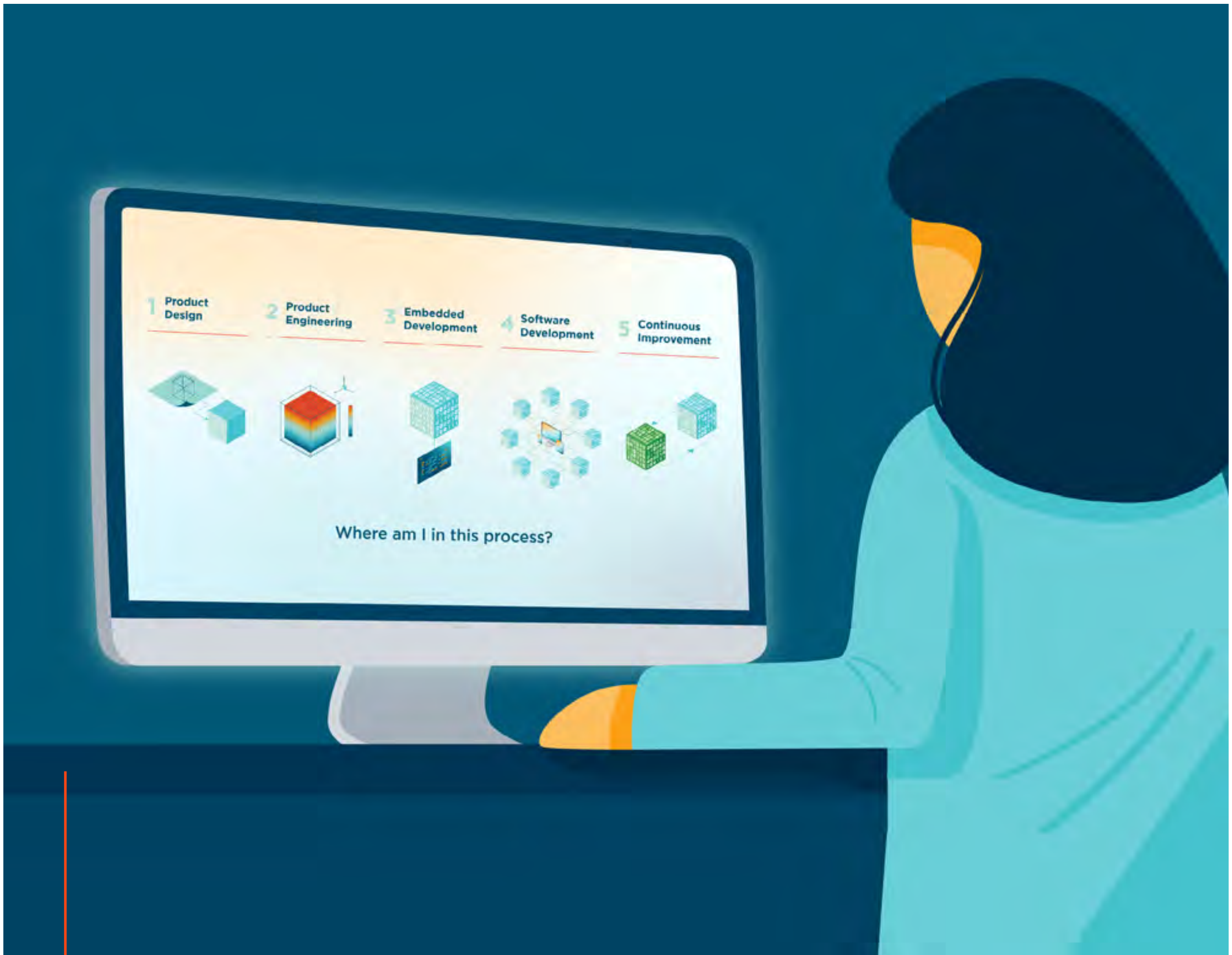
Leveraging PCB simulation software with electromagnetics analysis offers engineers greater insight into the electromagnetic performance of a product and helps avoid common issues like signal interference. Using PollEx with Altair's electromagnetic tools helps users achieve improved connectivity and functionality through robust simulation driven product design and deployment strategies. Signal integrity, power integrity, EMC/EMI, and thermal results can be combined with Altair's other physics simulation tools to optimize performance through machine learning and to reduce modeling time for complex systems.

Electromagnetic Compatibility and Interference

Altair's software also enables designers to validate their products for electromagnetic compatibility, interference vulnerability (EMC/EMI) and ESD protection. Through EMC/EMI validation, designers can ensure that products will function properly in their electromagnetic environment without introducing electromagnetic disturbances that interfere with other systems, while still fulfilling EMC standards and regulations.

Electromagnetic compatibility describes the ability of systems and components to work correctly when they are close together. The increasing number of electronic systems we encounter has increased the number of potential EMC issues. Within EMC, we refer to electromagnetic interferences, which are the undesired emissions of a component or system that can interfere with another system, and to electromagnetic susceptibility or immunity (EMS), when referring to how immune a system or component is to external electromagnetic interferences. Depending on the nature of the electromagnetic signal, we can also refer to radiated or conducted interferences or emissions.
Watch the Webinar

Learn More About Solving Connectivity, Compatibility, and Radar Challenges

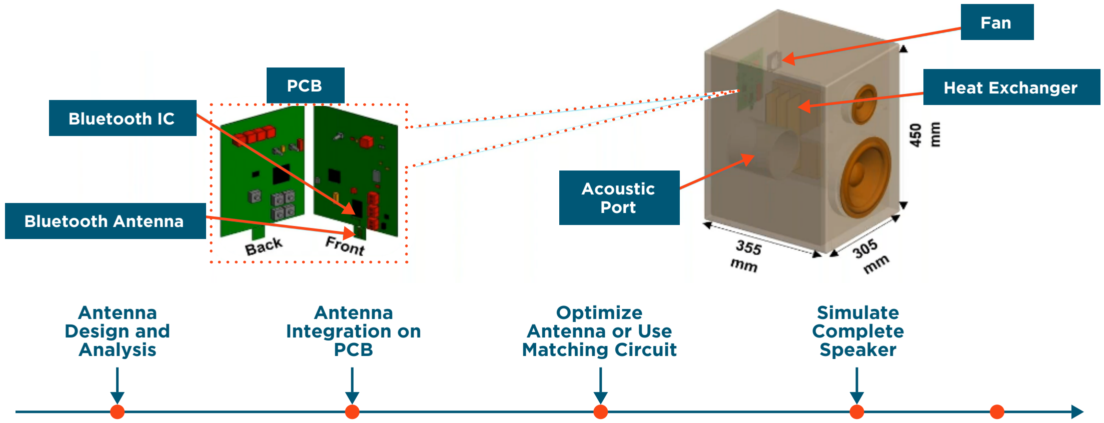


If you want to learn how to design an IoT strategy and effectively connect your smart devices at scale, download the Guide to Smart Product Development: Making the Internet of Things work for your business.

Antenna Design and Placement

The smart speaker model below is used to illustrate the steps for designing an antenna, integrating the antenna with the PCB, and optimizing the antenna placement within the product's packaging space.

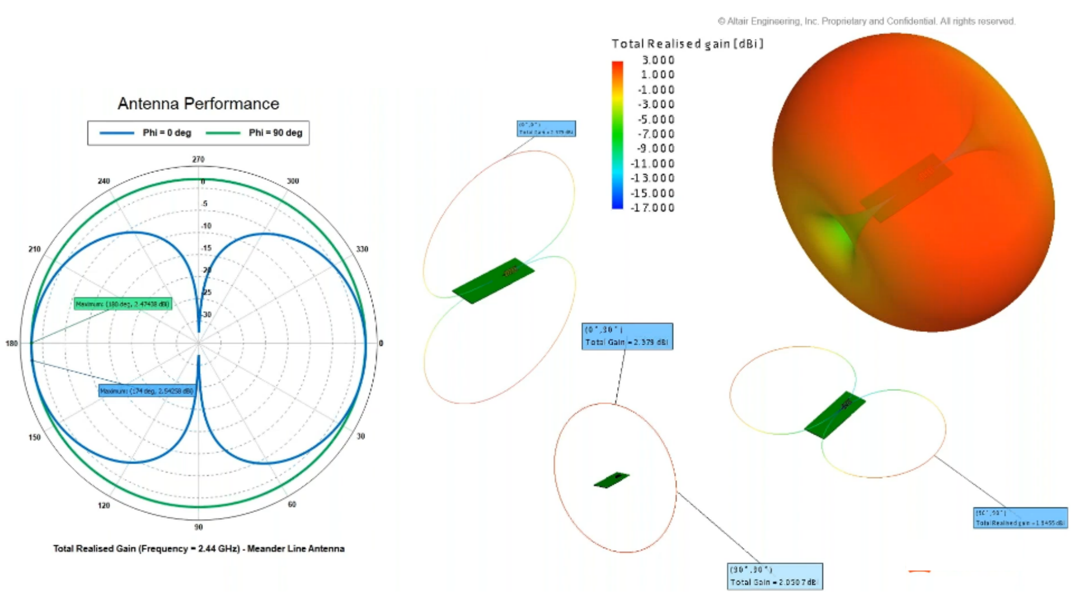
Altair Speaker Model



1

Antenna Design and Analysis

The first step in the design of the Bluetooth smart speaker antenna is to select and design an antenna based on the product requirements. Determination of the ideal antenna characteristics starts with simulating its performance, including reflection coefficient, radiation pattern for gain, surface current, and antenna thermal analysis. These simulations help to validate that the antenna is producing expected signal patterns, identify and selectively optimize performance at particular frequencies, and help foresee antenna-generated heat which aids in the planning of cooling system design and ventilation.



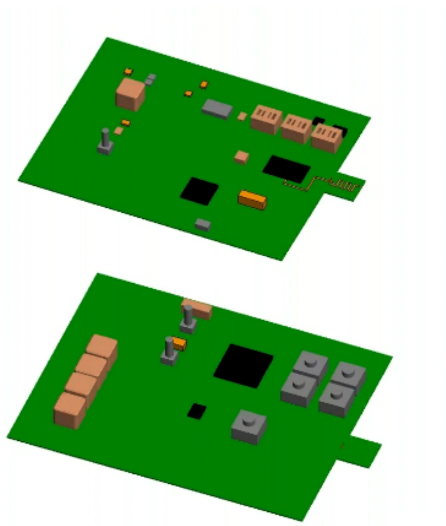
2

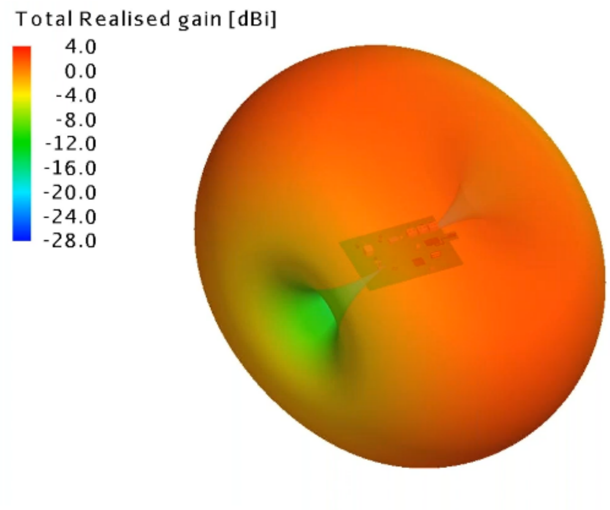
Antenna Integration on PCB

Once the PCB design is imported, the antenna can be integrated at a location near the Bluetooth IC. A trace connects the antenna to the required pin of the IC. Components on the PCB are then assigned material properties, and finally, the integrated antenna performance is re-evaluated.

Engineers often observe antenna performance degradation and changes to the radiation pattern at the integration stage, which necessitates a closer interrogation of the design to meet performance standards.

Restoring performance of an integrated antenna can be achieved through optimization. By setting EM performance goals and a variable range, optimization algorithms can suggest design modifications to bring performance back within desired levels. Machine learning can be leveraged to further enhance the optimization process. Another option is to automatically generate a matching circuit maximize the power transfer or minimize signal reflection.



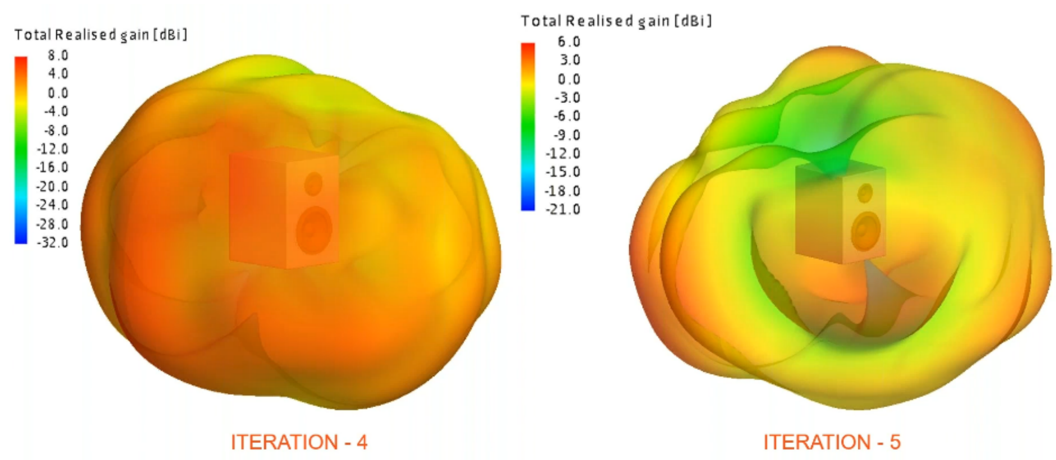


3

Optimize Antenna Placement

It is important to carefully design an antenna, but the antenna placement can also significantly contribute to the overall performance of a device. Simulation tools allow you to optimize the placement in its actual environment and observe the overall performance.

The antenna and PCB were placed with the other components inside the speaker. A parametric sweep was then utilized to automate the testing of performance at multiple locations and orientations to determine the ideal placement within the product packaging.



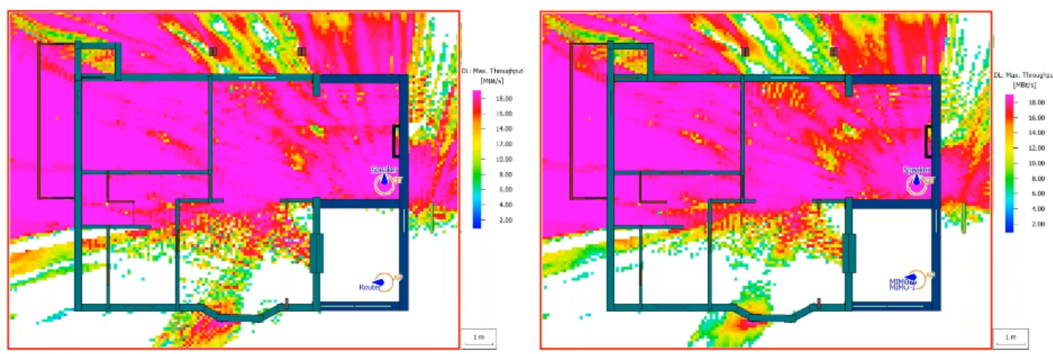
4 Check for Coexistence and Interference Issues

With coverage, propagation, and network analysis software, engineers can examine how the device's antenna signals will interact with other electromagnetic signals in its environment. Just in a household alone, there could be Bluetooth and WiFi signals from phones, TVs, speakers, and computers, LTE signals from phones and tablets, and increasingly, Zigbee signals that are often used in smart devices like lighting, thermostats, and security systems. Careful planning is necessary to avoid interference issues that might severely hamper the performance and perceived quality of your smart device.

Wireless electronic devices often support both Bluetooth and Wi-Fi connectivity. The 2.4 GHz Wi-Fi frequency band is very close to the Bluetooth operating frequency, so the coexistence of these two technologies within the same device can often lead to interference issues.

Altair can also analyze the connectivity of a device in its environment, such as RFID tags in a warehouse, devices in a town, or cars in landscape.

Watch Solve Coexistence and Interference Issues in Smart Devices Using Altair EM Solution



802.11b interfering with Bluetooth   802.11n interfering with Bluetooth

5 Simulate Complete Speaker

The advantage Altair provides to antenna designers is that all EM tools are available within one product suite, offering seamless transition between development steps. When antenna design, PCB integration, placement, and interference factors have been modeled and optimized, the final step is to simulate the complete speaker to validate all performance factors. Through leveraging a simulation-driven design process, product designers can identify potential mismatch loss and other signal issues early in the design process rather than rely on costly physical testing and redesign to flag and resolve EM issues.

Learn More About Solving Connectivity, Compatibility, and Radar Challenges

WORKING WITH ALTAIR

Altair's simulation-driven design solutions for electronic systems deliver a smarter approach to electronics product development, addressing challenges and infusing optimization into all aspects of the development process from PCB design to packaging and manufacturing feasibility. Combined with Altair's mechanical and multiphysics optimization tools, data analytics, and advanced IoT technology, users have a comprehensive package of solutions to develop innovative, high-quality smart products faster and more cost-efficiently.

Electronics

More efficient PCB design review, verification, analysis, & manufacture.

Electrical

Simulate and optimize wireless connectivity, EMC and radar electronics.

Mechanical

Automate structural stress, vibration, & drop test performance.

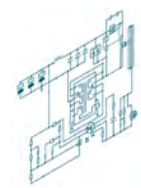
Thermal

Thermal analysis of electronics without advanced CFD knowledge.

Mechatronics

Accelerate the design of motors, sensors, & actuators with simulation.

Circuit



Circuit simulation with an enhanced proprietary version of SPICE.

Code

Visual firmware development supporting many common microcontroller families.

Efficient HPC Scheduling & Cloud Accessibility

[Learn more about Electronics](#)

The Internet of Things (IoT) has transformed the way companies do business. New product lines, recurring revenue streams, more efficient operations, higher quality, and faster time-to-market are all within reach with the introduction of smart interconnections between systems and assets. Altair has the knowledge and technology to help you realize your Smart Product Development vision from beginning to end – from ideation, to optimization, to launch and operation.

If you want to learn how to design an IoT strategy and effectively connect your smart devices at scale, download the Guide to Smart Product Development: Making the Internet of Things work for your business.

Altair is a global technology company that provides software and cloud solutions in the areas of product development, high performance computing (HPC) and data analytics. Altair enables organizations across broad industry segments to compete more effectively in a connected world while creating a more sustainable future.

To learn more, please visit www.altair.com