Ansys Nuhertz FilterSolutions

ELECTRONICS

Ansys Nuhertz FilterSolutions provides automated design, synthesis and optimization of RF, microwave and digital filters in an efficient and straightforward process. FilterSolutions starts with your filter performance specifications, synthesizes both ideal and physical filter layout realizations and automatically sets up filter analysis and optimization in the Ansys HFSS electromagnetic simulator.

Targeting your top 4 pain points:

- **Performing high-performance microwave and mmWave filter design is difficult and requires expert knowledge to synthesize filter layouts.**
- **RF and microwave filters experience electromagnetic (EM) cross coupling, which leads to inaccuracies in traditional circuit modeling approaches.**
- **Poor filter designs and manufacturing tolerances drive the need for manual filter "tuning" by hand on the bench. A good CAE approach can create tuning free designs that work within manufacturing or material tolerances.**
- **High-order filters are difficult to optimize, even with EM software. Creating an accurate first design prototype is essential for fast design optimization.**

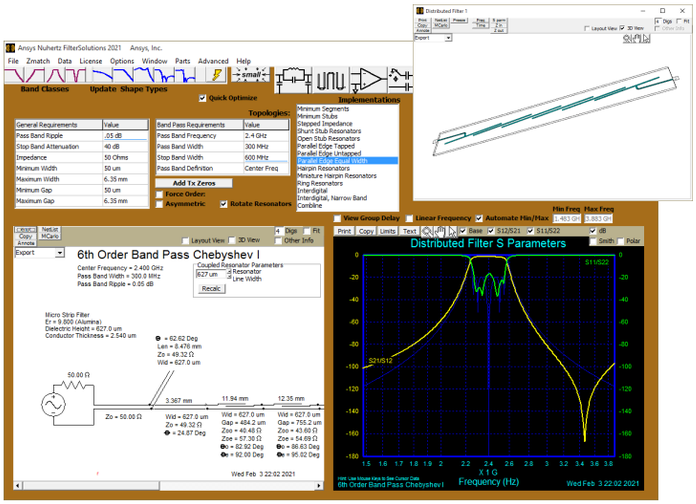
Achieving your top 4 tasks:

Quickly, easily and automatically synthesize a filter that meets your performance requirement.

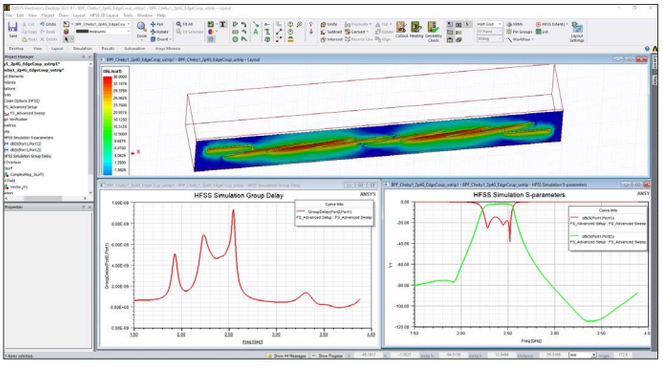
Realize the filter design in schematic and physical layouts for your choice of substrates by harnessing vendor-specific parts and standard value components.

Open the filter design in Ansys HFSS, ready for immediate EM analysis and optimization.

Create digital filters in the form of filter tap coefficients and C-code functions.



Filter design in Ansys Nuhertz FilterSolutions



Electromagnetic simulation of synthesized filter in HFSS

Ansys Nuhertz FilterSolutions provides automatic filter design for:

- **Lumped filters**, presenting synthesized filter schematics that fulfill the filter performance specification. Also provides values for filters realized on PCBs with surface mount or thru-hole discrete components.
- **Distributed (transmission line filters)** - High-performance distributed filters manufactured on microwave or mmWave substrates. These filters are usually realized with transmission lines, open or shorted stubs, vias, coupled lines and cross-coupled transmission line systems. A broad class of microwave and mmWave filters can be realized through precision patterning of conductors on one to three planar substrates.
- **Digital filters** realized in software for digital signal processing (DSP) systems or on microcontrollers. These are software programs, applied to digital signal processing operating on data from digital sampling systems.
- **Zero-inductor analog filters** - Popular at lower frequencies (audio and mid-frequency analog systems), these filters can be realized on PCB process technology with OpAmps in an analog filter format.
- **IC-based filters** in the form of non-programmable digital filters can also be implemented in IC processes utilizing MOSFETS and capacitors to occupy minimum real estate and utilize a switched-capacitor approach.

What differentiates Ansys Nuhertz FilterSolutions?

- Performance specification for Layout-to-EM-Optimization in a single smooth workflow
- Ability to evaluate the widest range of filter topologies (Bessel, Butterworth, Chebyshev I and II, Elliptic, Gaussian, Delay, Hourglass, Legendre, Matched, Raised Cosine, Tubular, Zigzag, Coupled-Resonator and Cross-Coupled Folded Resonator)
- Highly accurate distributed filter layout synthesis based on EM-derived model discontinuities and couplings
- Integrates with HFSS for gold-standard EM analysis accuracy and for EM-based optimization
- Ability to synthesize filter topologies for analog and digital filter topologies; a single tool for creating accurate filters for both analog and digital signal processing (DSP) applications
- Planar filter realizations in the widest available media classes (microstrip, stripline, asymmetric stripline, suspended substrate)

CAPABILITIES

LUMPED (PASSIVE) FILTER MODULE	Synthesizes a lumped component filter (single or double-termination) of a selected filter topology to realize user-specified performance characteristics. Standard value components may be applied, with standard (or non-standard) tolerance values for Monte-Carlo analysis. Components have ideal or finite Q or may be based upon vendor component library models.
DISTRIBUTED FILTER MODULE	The Distributed Filter module synthesizes filter layouts on physics-accurate materials, incorporating transmission lines and hybrid lumped elements. Filter layouts can be realized in a variety of substrate formats, including microstrip, suspended substrate and stripline. Physical layouts (including metallization and substrate material properties) can be realized quickly and accurately. Filter layouts are fully parameterized and may be opened in HFSS for immediate EM analysis; all geometries, materials, ports and analysis setups are automatically created. HFSS designs are fully parameterized and optimization setups are provided, so the designer can proceed directly to design optimization to desired response goals.
ACTIVE FILTER MODULE	Some filter designs call for elimination of inductors and active filter designs with OpAmps can sometimes provide an attractive alternative. The FilterSolutions Active Filter module synthesizes filters to meet user-specified performance requirements in a wide range of filter topologies, such as Thomas, Akerberg-Mossberg, Sallen-Key, Multiple Feedback, Leapfrog, GICs and more. Incorporate OpAmp models from your favorite vendor and include finite Q and gain effects in your active filter designs.
SWITCHED-CAPACITOR FILTER MODULE	Another zero-inductor realization: Switched capacitor filters are generally realized in semiconductor processes where capacitors and switching transistors occupy comparatively small spaces. Switched-capacitor filters may be used to realize digital filters and involve sampling circuit topologies. The Switched-Capacitor Filter module synthesizes designs in IIR and FIR realizations, as well as Bilinear, Matched-Z, Step Invariant, Modified Impulse Invariant and custom Z-transform designs.

DIGITAL FILTER MODULE	For DSP and sampled systems, FilterSolutions takes user-specified performance specifications and a desired topology and synthesizes filter coefficients to realize the digital filter. Digital transformations are provided to Bilinear, Impulse Invariant, Step Invariant, Matched-Z and Finite Impulse Response (FIR) approximation. Filter realizations are provided in the form of the discrete transfer function, filter tap/block coefficients or as C-code ready for incorporation into a DSP code block.
ZMATCH MODULE	Zmatch starts with complex load definitions and synthesizes a matching network for maximum power transfer. Includes both Discrete Frequency and Broadband Match modes. Optimal matching networks are provided in lumped, distributed and hybrid realizations.
FILTER TYPES AVAILABLE (LUMPED AND DISTRIBUTED FILTERS)	Gaussian, Bessel, Butterworth, Legendre, Chebyshev (I and II), Hourglass, Elliptic, Raised Cosine, Matched, Delay
FILTER CLASSES AVAILABLE (LUMPED AND DISTRIBUTED FILTERS)	Lumped Translation, Inductor Translation, Stepped Impedance, Shunt Stub Resonators, Open Stub Resonators, Spaced Stubs, Dual Resonators, Spaced Dual Resonators, Parallel Edge Coupled, Hairpin, Miniature Hairpin, Ring Resonator, Interdigital, Combline
DISTRIBUTED FILTER DESIGN TOPOLOGIES	Lumped Translation, Inductor Translation, Stepped Impedance, Shunt Stub Resonators, Open Stub Resonators, Spaced Stubs, Dual Resonators, Spaced Dual Resonators, Parallel Edge Coupled, Hairpin, Miniature Hairpin, Ring Resonator, Interdigital, Combline
ACTIVE FILTER IMPLEMENTATIONS	Thomas 1 and 2, Sallen & Key, Parallel, Akerberg, Multiple Feedback (MFB), GIC Biquad, GIC Ladder, Leap Frog
DIGITAL FILTER DESIGNS BASED ON THE FOLLOWING DIGITAL TRANSFORMATIONS	Bilinear, Impulse Invariant (IIR), Matched Z, Step Invariant, FIR Approximation. FIR Filter Types: Rectangular, Bartlett, Hanning, Hamming, Blackman, Blackman-Harris, Kaiser, Dolph-Cheby, Remez, Raised Cosine, Root Raised Cosine, Cosine Filter, Sine Filter, Matched Filter, Delay Filter

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