

# CADENCE AWR DESIGN MAGAZINE

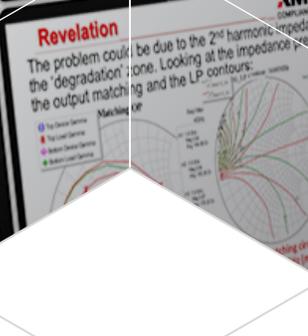
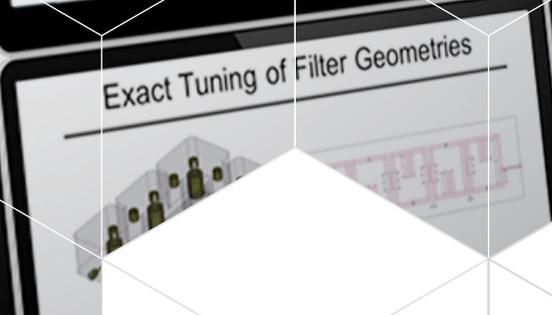
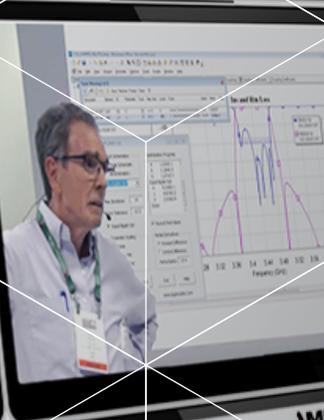
A quarterly publication highlighting Cadence® AWR® RF/microwave design software for product development through white papers, application notes, and success stories.

Volume 20.2

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## Best of ADF Now Available on Demand

The seventh annual RF/Microwave PA Forum, part of the global AWR Design Forum (ADF) event, took place during the 2019 European Microwave Conference (EuMW) in Paris. Scheduled to begin at 10:00am in the nearby Mercure hotel, just a few hundred meters from the convention center, the agenda was stellar and the pre-registered attendee numbers were good.

Yet as the minutes ticked by and the 10:00 hour was approaching, the room was not yet filling to capacity, as the norm from the prior six years. I knew that something was not quite right. Making a long story short, I realized our attendees were literally "Lost in Paris." Who could have imagined that there were three Mercure hotels within the vicinity of the conference center and depending upon which door you'd exit from the convention center, a short walk would find you at any one of them?

Fortunately, our "Lost in Paris" attendees persevered and made it to ADF (perhaps a little later than planned). Luckily for you, however, the "Best of ADF 2019" collection is now available on demand and includes excellent presentations captured at the PA Forum in Paris, as well as from partner companies and customers from one of many ADF events held globally last year.



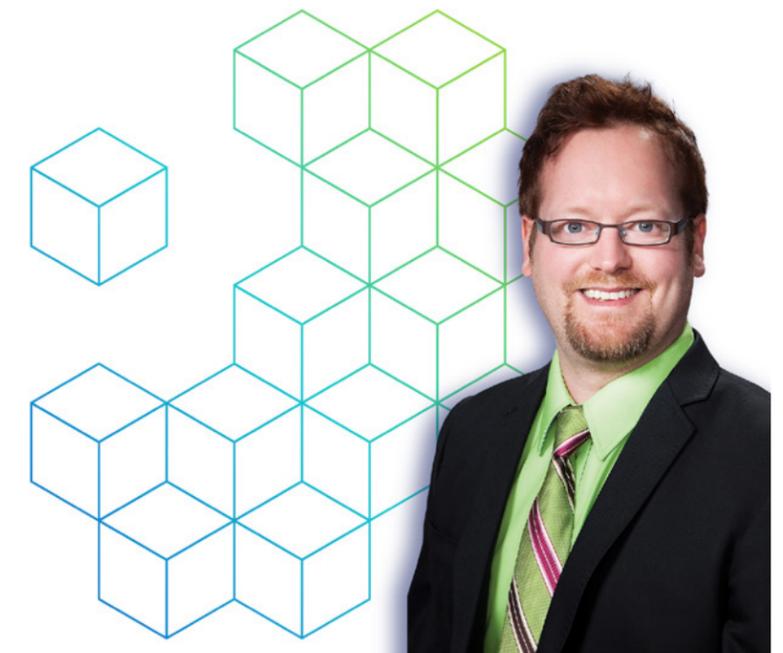
So sit back, relax, grab a beverage of your choice, and enjoy these talks from ADF. Refer to the Best of ADF 2019 article in this issue of AWR Magazine for details.

Start watching at [awr.com/adf](http://awr.com/adf).



*Sit back, relax, grab a beverage of your choice, and enjoy these talks from AWR Design Forum 2019.*

Antti Lautanen, Cadence



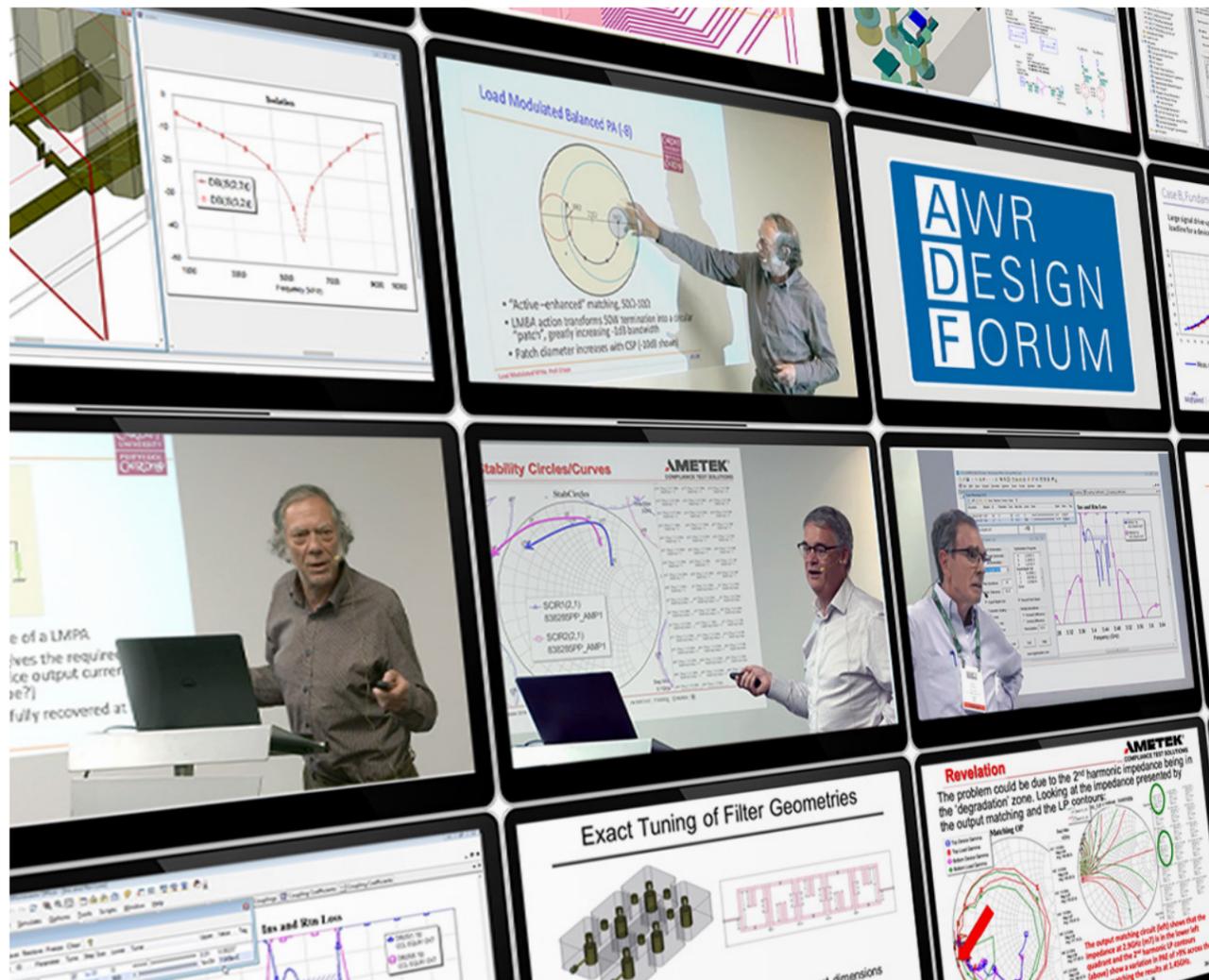
## Best of ADF Now Available On-Demand

For those who missed the live AWR Design Forum (ADF) 2019 tour and/or want to learn more about Cadence AWR Design Environment® software, a video collection of the best presentations from customers, partners, and academia is now available for on-demand viewing.

The keynote, given by noted power amplifier expert Dr. Steve Cripps, a distinguished research professor at Cardiff University in Wales, discusses some of the potential benefits and possible hazards of a new approach to PA design.

The Best of ADF 2019 collection is organized into five tracks addressing various aspects of RF/microwave design and highlights presentations from Dr. Steve Cripps, Cardiff University, key industry experts Dr. Zoya Popovic, University of Colorado, Dr. Dominic FitzPatrick, Ametek-CTS, and Dan Swanson, DGS Associates, as well as prominent companies such as Wolfspeed, Arralis, United Monolithic Semiconductors (UMS), AMCAD, OMMIC, and Focus Microwaves.

Start watching at [awr.com/adf](http://awr.com/adf).



### Track 1: Keynote and Industry Insights

- ▶ Active and Passive Matching in RF PAs  
*Dr. Steve C. Cripps, Cardiff University*
- ▶ Instability in Wide Bandwidth High PAs  
*Dr. Dominic FitzPatrick, Ametek-CTS*
- ▶ Enhanced Design Flow for Cavity Combine Filters  
*Dan Swanson, DGS Associates*
- ▶ RF/Microwave Design in Teaching  
*Dr. Zoya Popovic, University of Colorado*

### Track 2: Semiconductor Technology and Modeling

- ▶ Wolfspeed RF Device Modeling  
*Dr. Yueying Liu, Wolfspeed, A Cree Company*
- ▶ Gallium Nitride-on-Silicon Carbide at High Frequencies  
*Eric Leclerc, UMS*
- ▶ 5G High-Power and Low-Noise Applications  
*Julien Poulain, OMMIC*
- ▶ Coupled Effect Between Antenna Arrays and Front Ends  
*Wissam Saabe, AMCAD Engineering*

### Track 3: PA and Front-End Design

- ▶ HPA Design for Satellite Communications  
*Thomas Young, Arralis and David Vye, Cadence*
- ▶ MMIC PA Design  
*David Vye, Cadence*
- ▶ Input and Output Controlled High-Efficiency PAs  
*Vince Mallette, Focus Microwaves*
- ▶ Doherty PA Design from Load-Pull Derived Enhanced Polyharmonic Distortion (EPHD) Models  
*David Vye, Cadence*

### Track 4: EM Analysis and Design Optimization

- ▶ Best Practices for EM Simulation  
*Dr. John Dunn, Cadence*
- ▶ Tips and Tricks for Silicon RFIC Designs  
*Dr. John Dunn, Cadence*
- ▶ Designing a Narrowband 28GHz Bandpass Filter for 5G  
*David Vye, Cadence*

### Track 5: Communication/Radar System Simulation

- ▶ Phased-Array Antenna Simulation for 5G  
*Steve Tucker, Cadence*
- ▶ RF Link Budget Analysis Using VSS  
*Joel Kirshman, Cadence*
- ▶ Phase Noise Modeling Using VSS  
*Joel Kirshman, Cadence*



# Introducing AWR Design Environment V15

Engineering teams addressing performance, integration, and cost/space goals face time-to-market pressures while striving to meet increasingly complex product requirements. Version 15 (V15) of the Cadence AWR Design Environment platform offers new and enhanced technologies that provide greater design efficiency and first-pass success to engineering teams developing or integrating III-V ICs, multi-technology modules, and PCB assemblies for 5G, automotive, and aerospace/defense applications.

Engineering productivity is improved with new analyses, faster and higher-capacity simulation technologies, time-saving design automation, and 5G NR compliant testbenches that support PA and antenna/array design, EM modeling, and RF/microwave integration across heterogeneous technologies.

| AWR Design Environment V15 Highlights          |  |                                      |   |  |
|--|--|--------------------------------------|---|--|
| Environment/Automation                         | Circuit Simulation                               | EM Simulation                        | System Simulation                                 | Physical Design/Layout                           |
| Load-pull contours on rectangular plots        | Fast, rigorous stability analysis                | Faster, more robust adaptive meshing | Preconfigured 5G NR testbenches libraries         | Real-time DRC compliant iNets routing guides     |
| Template-based measurements                    | Low-frequency load-pull for two-tone excitations | Fast, accurate DC solver             | Phased array MIMO bus support                     | Mixed physical units/grid support                |
| Add/edit optimization goals directly on graphs | Integrated TX-Line calculator/synthesis          | Peak antenna measurements            | PA linearization with digital predistortion (DPD) | Two-click data entry mode                        |
| Edit axes directly on plots                    | Network synthesis with PDK/vendor components     |                                      |   | Resize layout objects with property page editing |
| Color-coded markers                            |  |                                      |   | Gerber file import for EM analysis               |
| Equation grouping                              |  |                                      |   |  |

## The V15 Advantage

AWR Design Environment V15 software offers key new and improved technologies that provide greater design efficiency and first-pass success to engineering teams developing and integrating III-V and Si ICs, multi-technology modules, and PCB assemblies. Engineering productivity is improved with new analyses, faster and higher capacity simulation technologies, time-saving design automation, and 5G NR-compliant testbenches that support PA and antenna/array design, EM modeling, and RF/microwave integration across heterogeneous technologies.

## Design Environment and Automation

New design environment and automation features help individual engineers and engineering teams be more efficient in their design entry, data display, and project management. Designers can adjust optimization goals directly from response plots, route design rule-compliant intelligent nets (iNets) in real-time, import Gerber-based layout designs into AWR Design Environment software for EM analysis, and provide more user capabilities for the design task at hand.

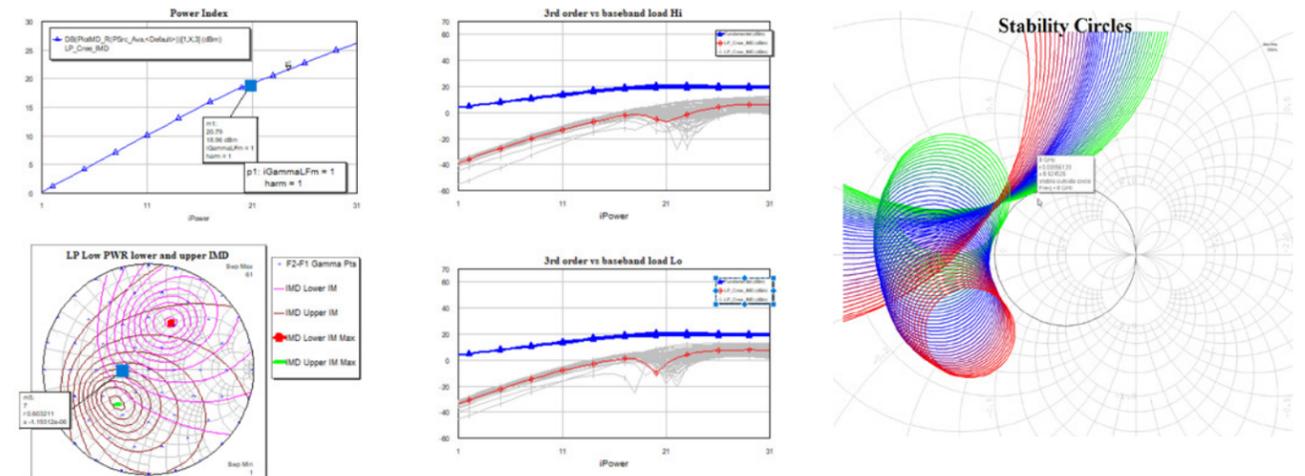
## Synthesis Accelerates RF Designs

The characteristic impedance and electrical length (delay) of transmission lines represent two important design parameters used to control the frequency-dependent circuit response of passive RF/microwave circuits. Using AWR V15 software, designers can now directly synthesize the physical attributes (width, length) of microstrip, stripline, or coplanar waveguide structures for a given substrate based on the desired electrical characteristics.

Likewise, the electrical characteristics can be calculated directly from the physical properties of the single or edge-coupled transmission line placed in the schematic. Synthesis of circuit model parameters provides vital data for generating accurate layout of these transmission lines without having to invoke the transmission line calculator and manually transfer the results into the transmission line property dialog box.

## PA Simulation and Design Support

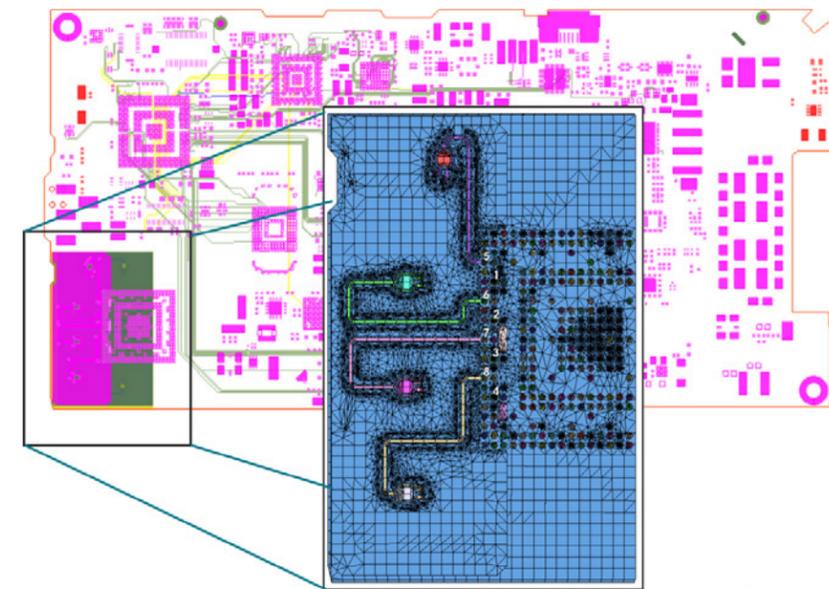
V15 of AWR software allows designers to optimize PA linearity performance through video band load-pull analysis of power amplifiers (PAs) operating under two-tone excitations. Designers can plot intermodulation (IMD) and third-order intercept point (IP3) results as a function of (F2-F1) impedance, directly investigating IMD products over swept input power. Load-pull analysis also supports impedance tuning at the 4th and 5th harmonics as well as the ability to generate contours on rectangular plots for enhanced visualization of performance versus load impedance.



Video-band load pull supports low-frequency impedance optimization to reduce IMD product (left) and loop gain envelope provides fast and rigorous nonlinear stability analysis and optimization (right)

## EM Simulation and Antennas

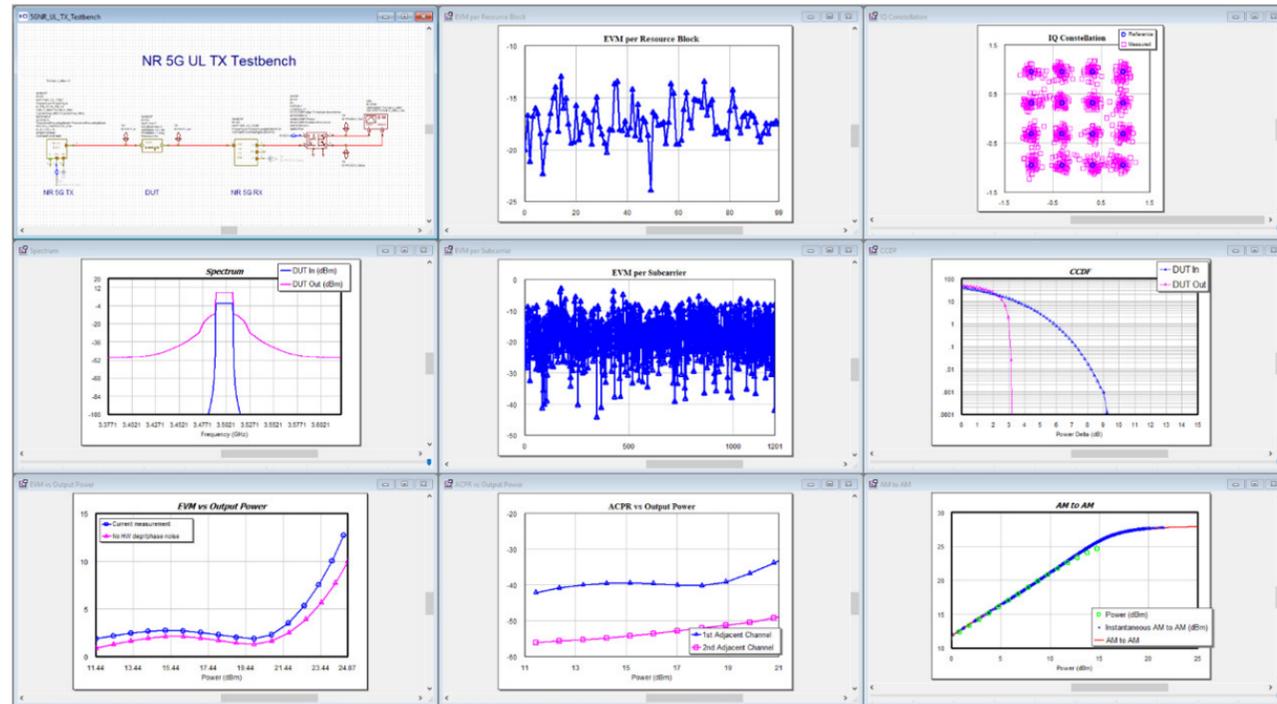
To enhance the speed and capacity of EM analysis for IC, package, and board structures, AWR AXIEM meshing and solver technologies have undergone several key improvements, resulting in improved mesh quality for faster simulation run times and the ability to solve larger problems with a reduced mesh. AWR Design Environment V15 software can now detect and remove problematic mesh facets automatically with robust healing of high aspect ratio facets (HARF).



Improved meshing and EM solver tackles large structures, faster

## 5G NR Library and DPD Models

The 5G NR library offers easy-to-configure signal sources and receivers that can be used to evaluate RF components and/or RF links using system-level measurements. New testbenches accelerate the component design and evaluation process with preconfigured 5G NR transmit (TX) and receive (RX) blocks and measurements supporting TX/RX functionality for both downlink and uplink.



5G NR libraries and test models for TX/RX device and RF link validation

## Conclusion

AWR Design Environment V15 software brings new and enhanced RF/microwave design and simulation to the Cadence portfolio of EDA solutions. Advanced design automation optimizes engineering throughput and productivity by reducing manual design tasks and supporting tool interoperability.

New circuit simulation capabilities address fast and rigorous nonlinear stability analysis for multi-stage and balanced amplifiers, and video-band load pull to optimize low-frequency impedance terminations for reduced intermodulation distortion. Network synthesis supports impedance network development using vendor components and PDKs, and a new integrated transmission-line calculator and synthesis capabilities launched directly from schematic.

Robust simulation engines solve large structures more quickly using EM analysis with enhanced meshing and smart geometry handling for chip, package, and board characterization. Preconfigured, 5G NR-compliant testbenches provide signal sources and measurements for PA and RF link validation.

Learn more about AWR Design Environment V15 at [awr.com/whatsnew](http://awr.com/whatsnew).

# Design Smarter with AWR Software

The new Cadence AWR Design Environment platform V15 delivers greater design efficiency and simulation performance to develop MMICs, modules, and RF PCBs for 5G, automotive, and aerospace/defense applications.

Discover more at [cadence.com/go/awr](http://cadence.com/go/awr).

## New On-Demand Webinars

### AWR Software V15 Spotlight Webinars

- ▶ Power Amplifier Design in AWR Design Environment V15  
*Dr. John Dunn*
- ▶ Filter Design in AWR Design Environment V15  
*Dr. John Dunn*
- ▶ Phased-Array Antenna Design in AWR Design Environment V15  
*Joel Kirshman*
- ▶ Advanced PA Design Capabilities  
*Chris Bean*
- ▶ Developing PCBs for Wireless Applications  
*Dr. John Dunn and David Vye*
- ▶ 5G Technology Creation from a Customer Perspective  
*Dr. John Dunn*

### Customer Spotlight Webinars

- ▶ RF Amplifier Simulation Using ADI Models  
*Ivan Soc, Analog Devices*
- ▶ mmWave MIMO Radar System Design  
*Dr. Tero Kiuru, VTT*

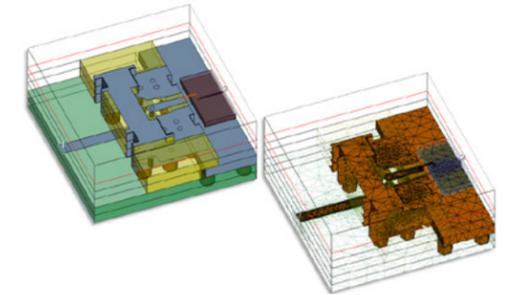
To view more videos and webinars, visit [AWR.TV](http://AWR.TV) and [awr.com/resource-library](http://awr.com/resource-library).



## Technical Articles

### K-Band PA Design for Satcom Applications

K/Ka-band (26.5-40GHz) satellite communications (satcom) systems are popular for global broadband services, offering universal access to faster data rates due to the higher bandwidths available in this frequency spectrum. This article describes the design of the Leonis chipset using the Cadence AWR Design Environment platform. The chipset includes in-phase quadrature (I/Q) and subharmonic mixers, upconverter and downconverter core chips, switches, phase shifters, low-noise amplifiers (LNAs), and PAs. Within this chipset is the company's LE-Ka1330308, a high-power MMIC amplifier. Arralis has successfully demonstrated transceiver architectures for both uplink and downlink communications.



Package model input/output (I/O) port simulation setup and resulting mesh in AWR Analyst™ software

### Together We Can Grow WIM

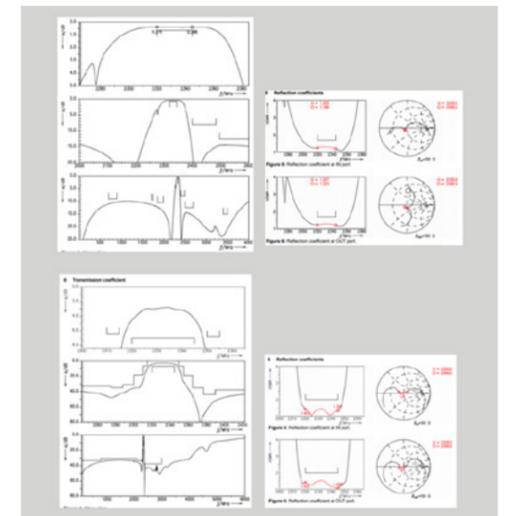
For more than a decade now, Sherry Hess has been active in advocating for the greater involvement of women within the IEEE Microwave Theory and Techniques Society (MTT-S) organization. She sees her work with Women in Microwaves (WIM)/ Women in Engineering (WIE) as a key means for boosting the number of female IEEE Members by increasing the visibility of women in engineering and creating both networking and mentoring opportunities. In this article, Sherry describes her advocacy for the greater involvement of women in the IEEE MTT-S organization. Sherry is now the fourth female voting member of the MTT-S AdCom committee.



NIWeek Women's Leadership Forum Panel: Sherry Hess, Dr. Irene Petrick, and Dr. Sharon L. Wood

### LNA Receiver Design for Integrated Automotive Wireless Systems

Demand for automotive infotainment and telematics services continues to grow, calling for greater integration of antennas and radio front-end electronics housed in the smallest possible footprint and operating in the tightly spaced GPS, cellular, V2X, and satellite digital audio radio service (SDARS) frequency bands. These requirements present numerous design challenges that can be overcome using best practice design techniques, the appropriate filter and semiconductor technology, and design software that supports matching network/filter synthesis and RF-aware circuit simulation.



Input impedance of the two narrowband filters

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