Product Feature

# NI AWR Design Environment V12 Release Enhances Design Flow Productivity for Amplifier, Antenna, and Radar Designers

## The NI AWR Software Philosophy

V12 release of NI AWR Design Environment™ focuses on providing the most comprehensive, powerful, and easy-to-use suite of software design tools for the microwave and radio frequency (RF) communities. The goal of NI AWR software has always been to accelerate the design and product development cycle of high-frequency ICs, RF PCBs, and modules as well as communications and radar systems found within the aerospace/defense, semiconductor, computer, consumer electronics, and telecommunications markets.

NI AWR Design Environment key technologies are all integrated within a single environment. Microwave Office circuit design software is a complete suite of tools featuring state-of-the-art circuit simulators, layout creation, and electromagnetic (EM) simulation. Circuit simulation relies on the best-in-class APLAC frequency and time domain simulators, while EM simulation features AXIEM for planar simulations and Analyst™ for full 3D finite element method problems. Visual System Simulator™ (VSS) is a comprehensive RF system simulation tool, with several features geared toward RF communication and radar systems.

NI AWR Design Environment focuses on three main principles for software development:

- Increased simulation performance in critical customer application areas
- Improving the designer's workflow in one intuitive, comprehensive user environment
- Supporting an open design flow that integrates best-in-class third party tools, enabling more compelling solutions

V12 new features fit perfectly into these three areas. Several new features have been added to enhance the customer experience. Third-party tools have been integrated in the areas of stability analysis through AMCAD STAN and design rule checking and verification of layout (DRC/LVS) through Design Workshop Technologies. Numerous performance enhancements and features have been added, especially in three critical areas: amplifier design, antenna performance in circuits and systems, and radar design.

## V12: Emphasis on Critical Customer Areas: Amplifiers, Antenna Performance, and Radar

Many of NI AWR Design Environment customers design high performance communication and military systems. V12 focuses on enhanced simulation and modeling of two critical components at the circuit level: power amplifiers and antennas. Radar simulation enhancement is a focus at the system level. Amplifiers in communication systems are highly nonlinear, for power efficiency reasons. As such, they are notoriously difficult to design and simulate. V12 incorporates several new features to aid in this process: support for new load pull standards and load pull visualization enhancements, and improved stability analysis capabilities.

Antennas are of course a critical component of any wireless communication system. The interaction of the antenna with the driving circuitry and feed network must be accurately modeled in the design process. V12 now makes this possible thanks to enhancements in radar simulation that focus on modeling phased antenna arrays. Realistic patterns from EM simulation can be included, making the results even more accurate.

Following is a look at each of these areas of focus in more detail.

## Amplifier Design

Load-pull simulation has been a valuable tool for the design of amplifiers for more than a decade now. However, recent advances in data file formats by load pull measurement system vendors such as Maury Microwave and Focus Microwaves have significantly expanded the usefulness of load-pull characterization. These new file formats support a sweep of an independent variable such as input power, DC bias, or temperature, in addition to the swept source or load impedances. The ability to use this newer data within load-pull simulation to determine device characteristic impedances at harmonic frequencies greatly simplifies and speeds the design process. V12 allows the user to control the new-load pull file capabilities in an intuitive manner by adding important load-pull measurements and graphing control features. For example, in Figure 1, the designer can immediately see the various input powers used in the load-pull measurements. By simply moving the marker, all measurements and graphs are updated using the appropriate load-pull data.

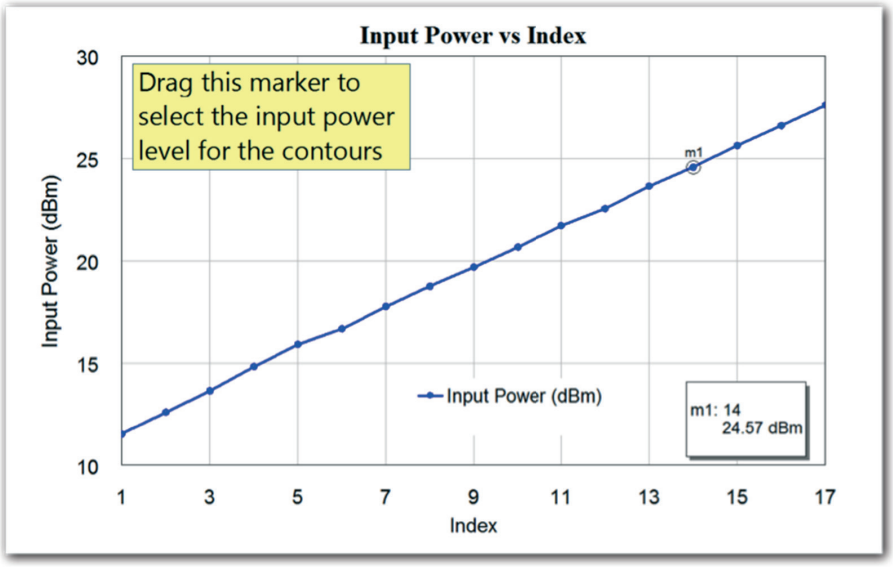


*Figure 1: The designer can select the appropriate load-pull data graphically.*

Figure 2 shows an example of the new measurement capabilities. The red circle is showing acceptable loads to give the requested power-added efficiency and output power. As the input power is changed, as illustrated in Figure 1, the curves and measurements automatically update, as shown in Figure 2.

In addition to the enhancements to load-pull simulations, stability analysis has been expanded within V12 to now include a connection to AMCAD Engineering STAN tool. Stability can be difficult to predict in multi-stage amplifiers, as are commonly used in today's designs. STAN allows the designer to probe internal parts of the circuit for potential stability violations. Potentially disastrous oscillations can thereby be avoided without sacrificing performance.

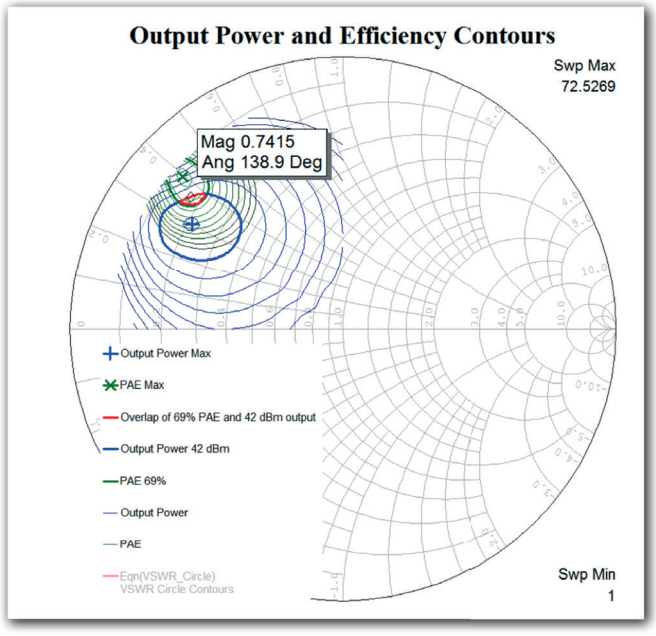


*Figure 2: An example of the new load pull measurement capabilities. The red curve shows acceptable load ranges for a given power efficiency and output power.*

## Antennas in Circuit Simulation

Antennas are a critical component of wireless communications systems. Most antennas have multiple input points, whereby the beam pattern can be controlled by proper excitation of the various inputs. Therefore, it is important to be able to predict the effect the driving circuitry has on the antenna pattern. At the same time, the load the antenna presents to the driving circuit changes as the beam changes. The antenna and circuit are coupled.

V12 has an important new capability to simulate this interaction: in-situ antenna analysis. The left picture in Figure 3 shows an example of a 4 X 4 patch array, which is being scanned by changing the phase and amplitude of the input power to the various patches. By tuning the values of the phase and amplitude to the elements, the beam can be scanned. The right picture in Figure 3 shows the top level of the feed network attached to the S-parameter simulation results from the EM simulation.

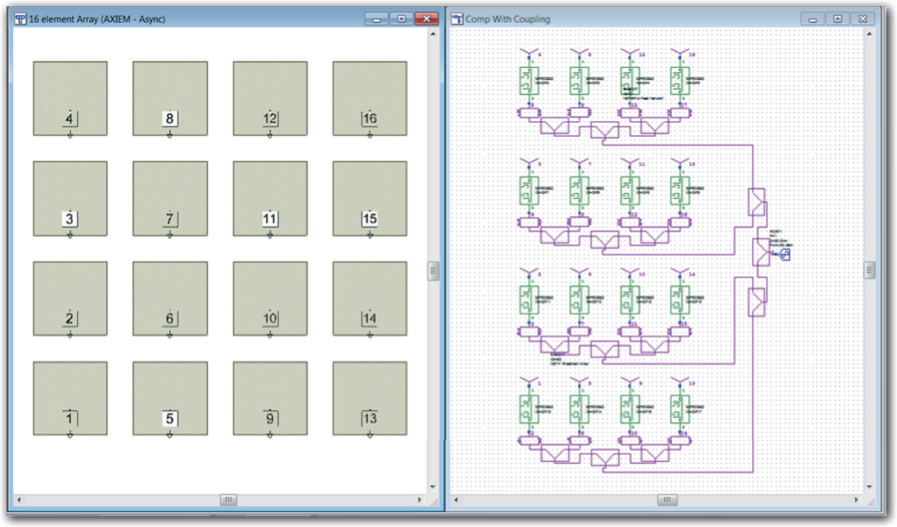


*Figure 3: A 4 X 4 patch array in an EM simulator (AXIEM). The right figure shows the feed network.*

Figure 4 shows the 3D antenna pattern. As the tuner is moved, thereby changing the input power to each element, the beam scans. Optimization is also possible, as anything that can be tuned in Microwave Office can also be optimized. For example, the level of the side lobes of the antenna can be optimized for certain feed network characteristics.

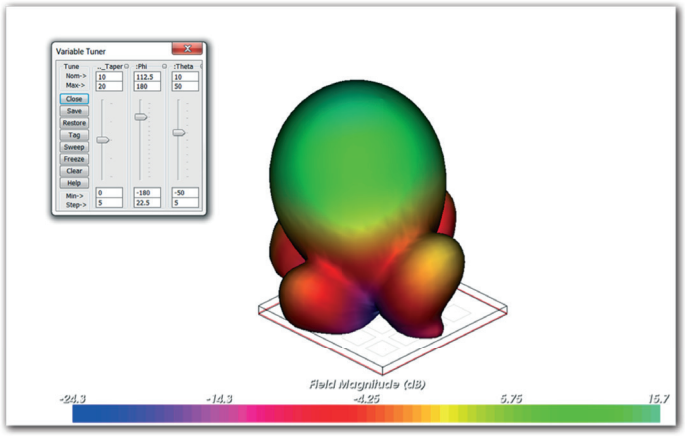


*Figure 4: The antenna pattern for the array. As the tuner is used, the input power and phase are changed to the elements and the beam scans.*

Finally, it should be noted that the antenna patterns can now be brought into VSS, the system simulator, as the actual pattern to use in propagation models in communication systems. The system designer has a more accurate prediction for final system performance.

## Radar Design

V12 advances the radar design capabilities in VSS. An improved phase array model supports the simulation of large arrays with a large variety of feed options and geometry configurations. The entire RF chain of the system can be constructed including amplifiers, mixers, and filters. When the phased array model is inserted into the transmit/receive chain, the entire system can be optimized for optimum performance, as well as performance degradation due to antenna imperfections.

## Productivity Gains through Ease of Use, Speed, and Third-Party Integration

As mentioned previously, simulation enhancements are always an important focus with any new NI AWR software release, and V12 is no exception. EM analysis has been improved on a number of important fronts. The Analyst 3D simulator is significantly faster and takes better advantage of the computer's resources. The APLAC harmonic balance engine has been made more efficient, speeding up simulations requiring optimization and tuning.

Ease-of-use features continue to be improved in V12. In EM, Analyst has now been added to EM extraction. This popular feature allows designers to simulate critical portions of their circuits without having to manually set up the simulation, saving time and reducing the potential for errors. Several nice features have been added to the user environment, including better documentation for schematics, graphs, and layouts, and more flexible ways to organize measurements.

In V12, there are two notable examples of third-party tool integration: STAN, the stability analysis tool from AMCAD and DWT DRC and LVS tools. This enables designers to be able to create their own rules for their module and PCB technologies.

## Conclusion

With the release of V12 NI AWR Design Environment, the tradition of designing software ease of use and powerful simulation capabilities continues. New features are apparent in several application areas— from power amplifier design, to antenna performance, to radar system analysis. New usability features make efficient documentation and organization easier. And finally, by continuing to work with third-party tools when appropriate, NI AWR software products give the designer even more options without leaving the NI AWR Design Environment.

For more details on V12 visit us online at awrcorp.com/v12