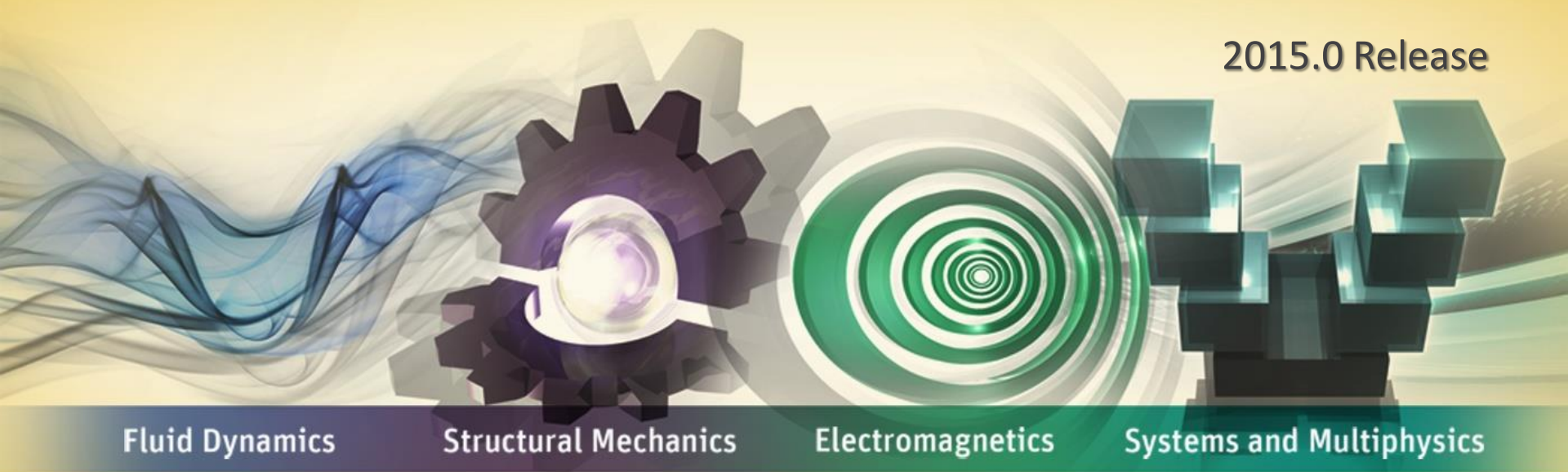


Lecture 5: Dynamic Link

2015.0 Release



Fluid Dynamics

Structural Mechanics

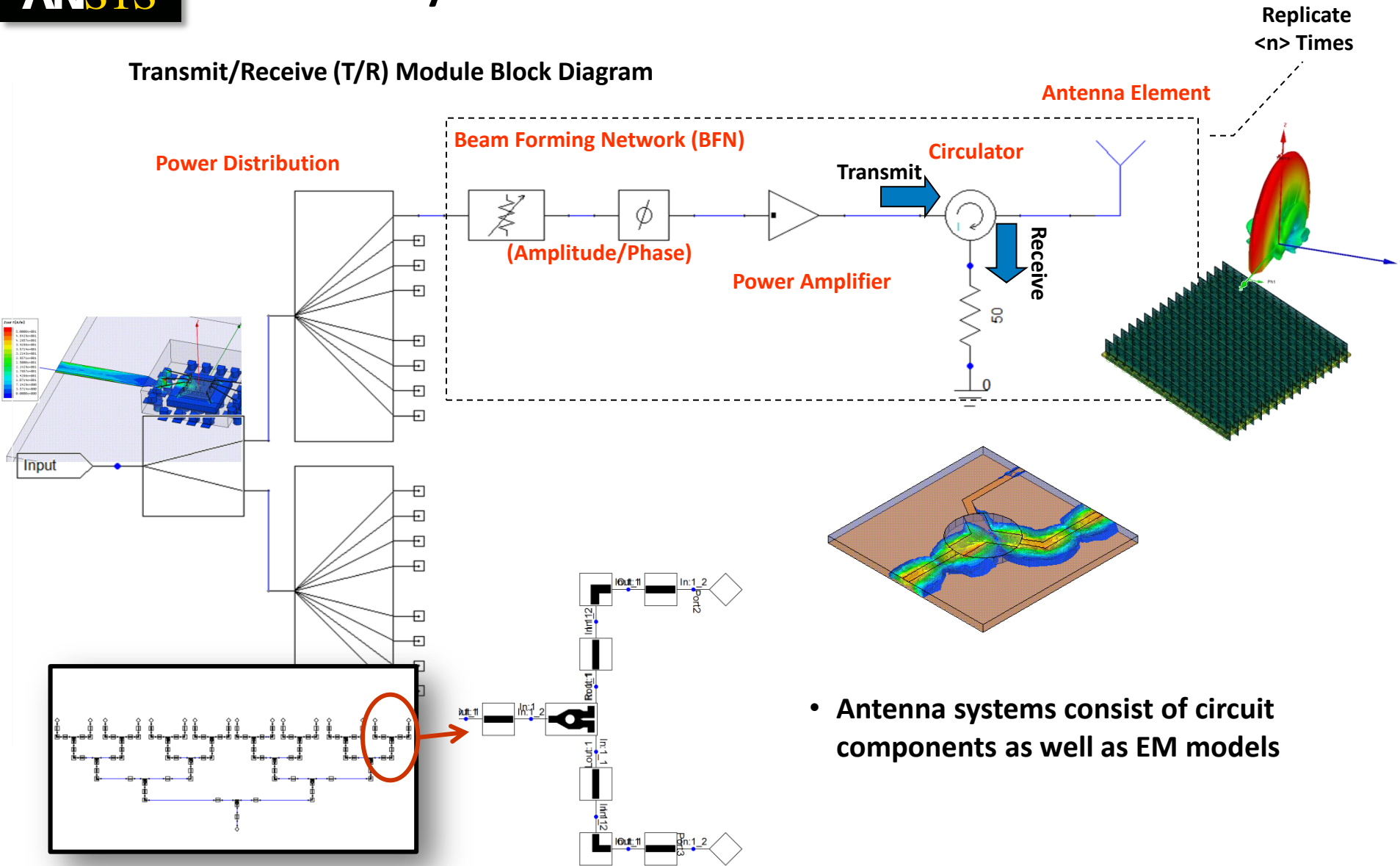
Electromagnetics

Systems and Multiphysics

ANSYS HFSS for Antenna Design

Antenna System Co-Simulation

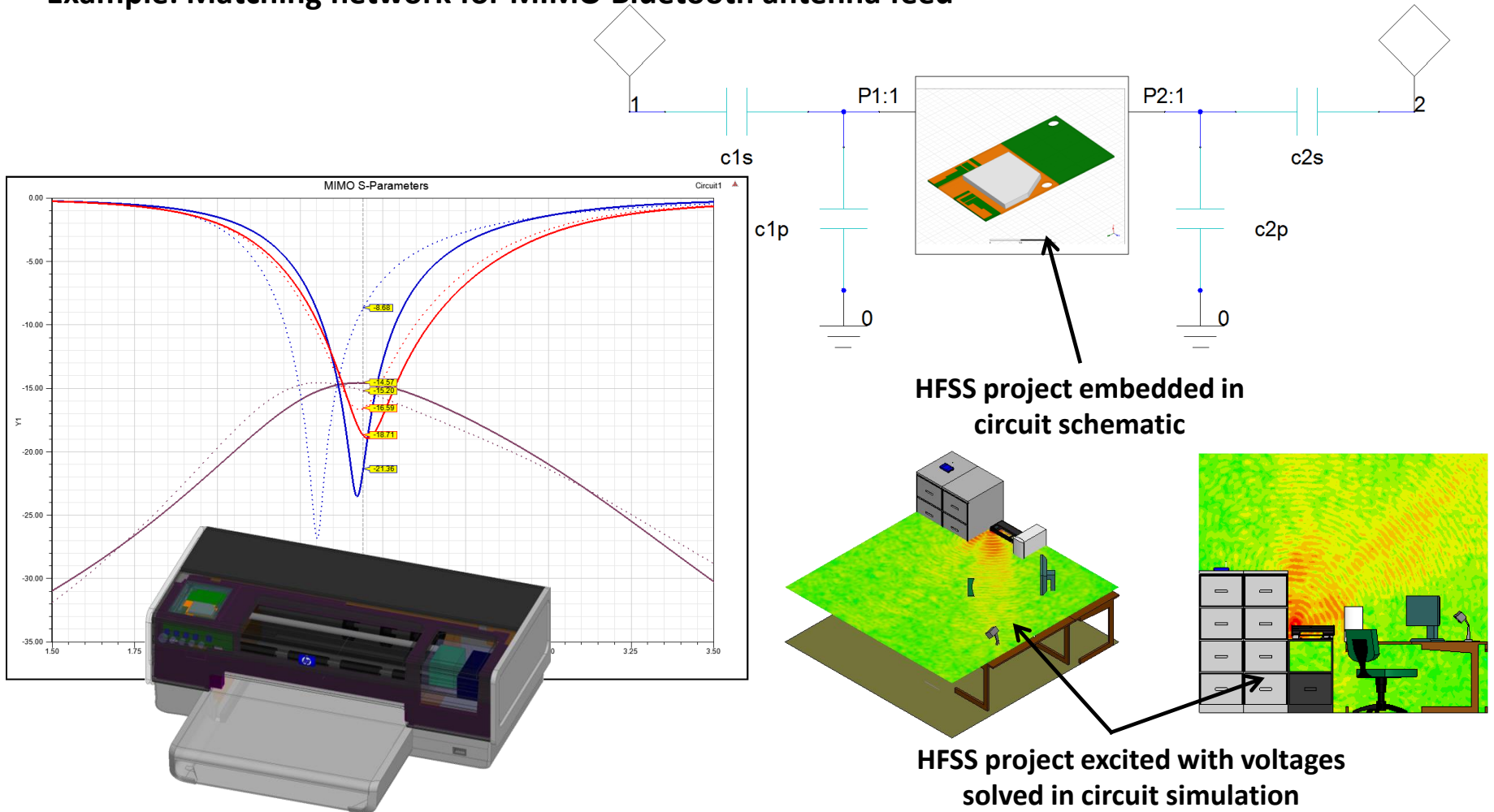
Transmit/Receive (T/R) Module Block Diagram



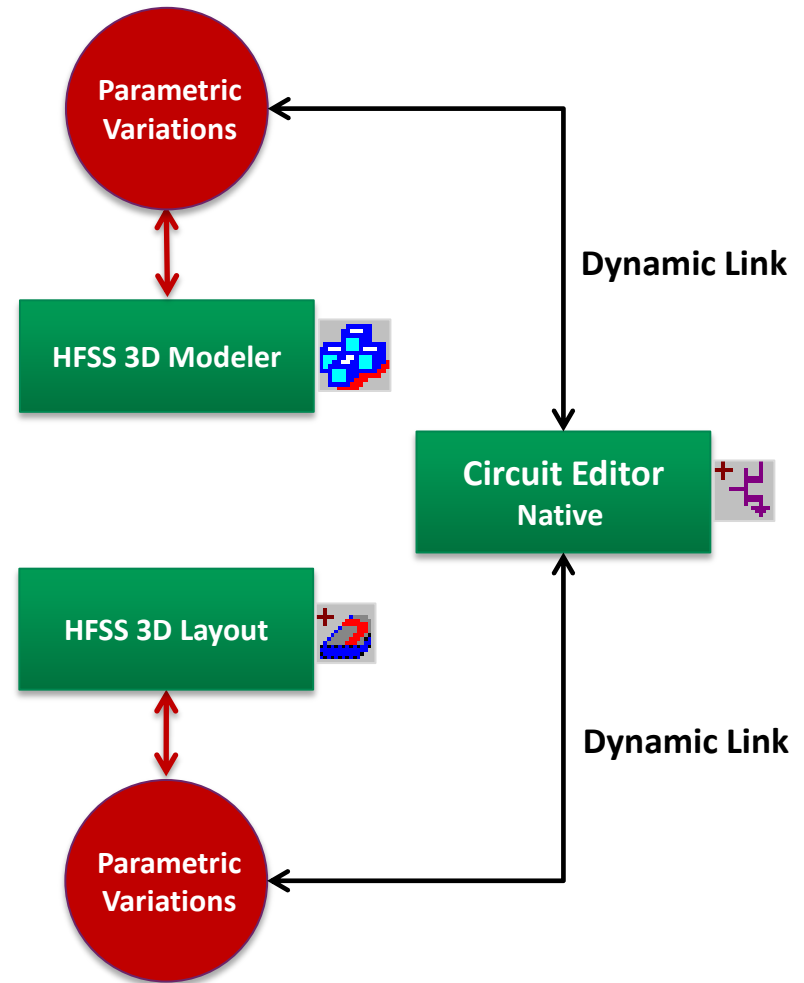
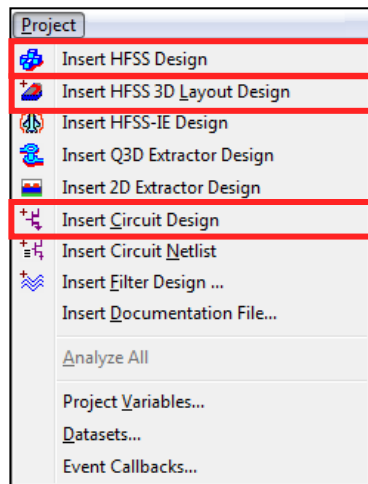
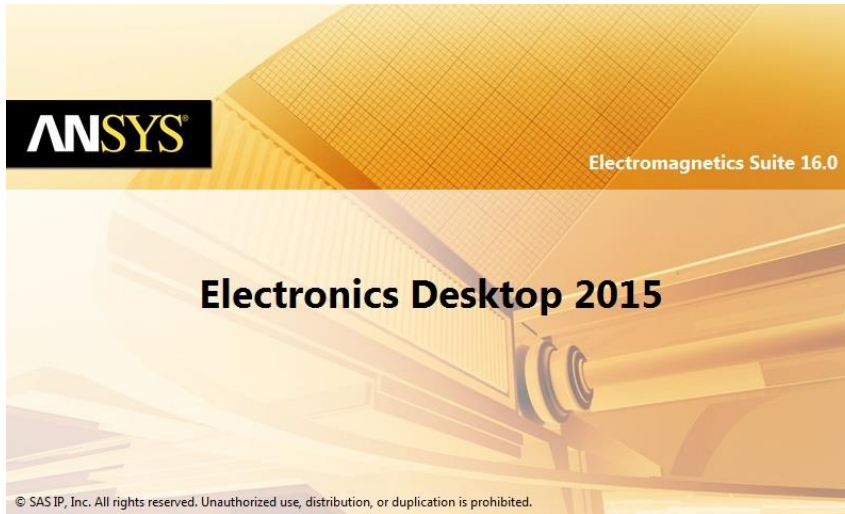
- Antenna systems consist of circuit components as well as EM models

Linear Circuit Simulation

- The HFSS core license enables linear circuit simulation
- Example: Matching network for MIMO Bluetooth antenna feed



- **ANSYS Electronics Desktop 2015.0**
 - Single Desktop Interface for HFSS 3D Modeler or HFSS 3D Layout or Circuit Designs



Enhanced Circuit Capabilities

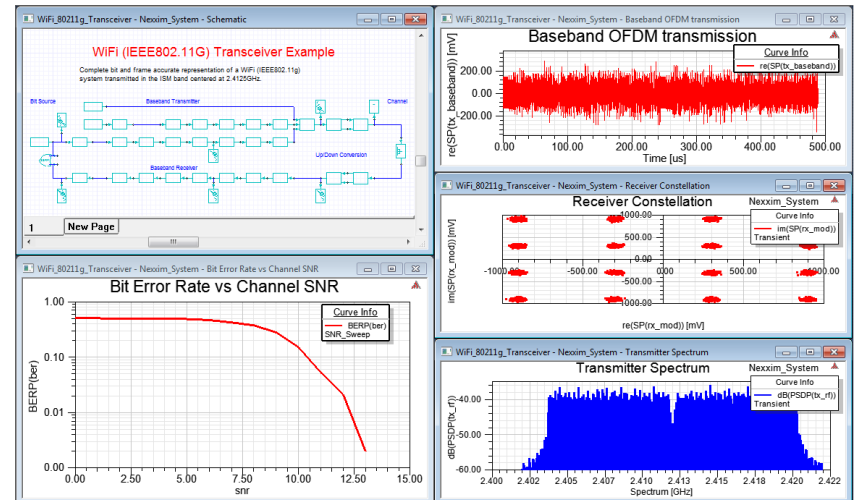
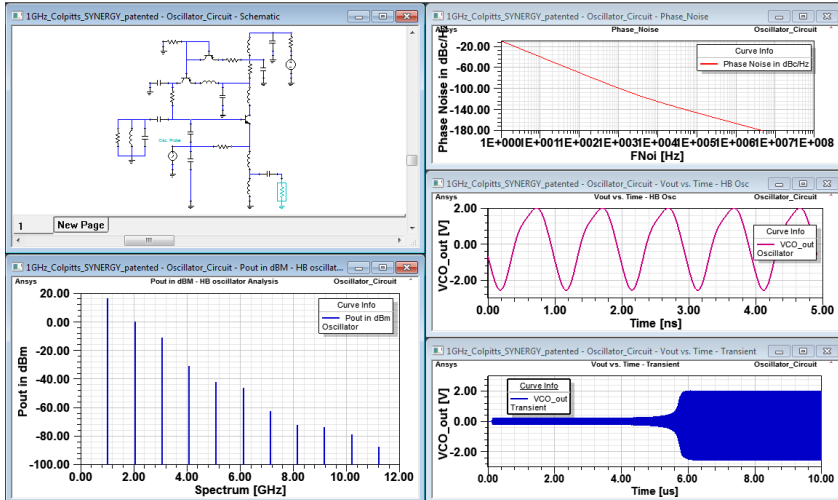
- **Expand the Linear Circuit Capabilities**

- Add-on the **RF Option** to enable: Harmonic Balance, Oscillator Analysis, Load-Pull, DC, Transient Circuit Simulation
- Add-on the **SI Option** to enable: DC, Transient Circuit, 3D HFSS-TR, HSPICE Co-Simulation, QuickEye/VerifEye, IBIS-AMI

Linear Circuit Capabilities

ANSYS RF Option

ANSYS SI Option



- **Accelerate Parametric and Design Optimization**
 - Faster design of passive microwave devices,
 - Rapid optimization, sensitivity and statistical analysis of HFSS components
 - Real time tuning of filters, matching networks, etc.,
 - Fast variational studies of high speed channels.
- **Increased design flow power and flexibility**
 - Pushing of phase and magnitude information back into HFSS through Circuit Interface
 - Support design teams by providing parametric HFSS accuracy to circuit designs
 - Generate customer parametric circuit models from HFSS

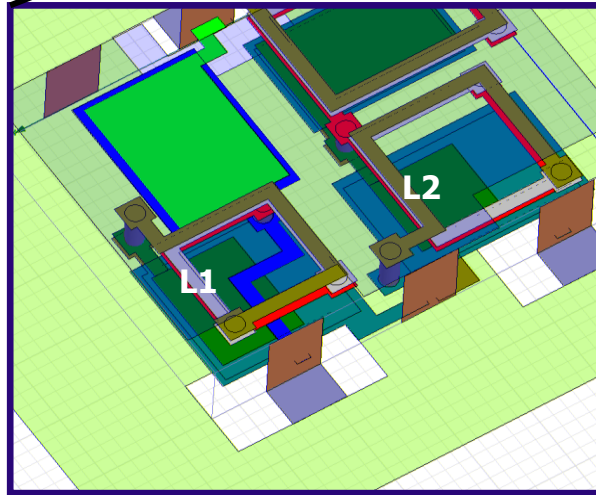
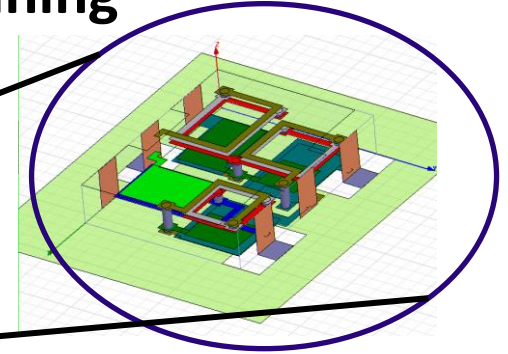
Dynamic Link Example: LTCC Diplexer Tuning

• Procedure

- Model LTCC in HFSS
- Parametrically sweep capacitive plates in model
- Dynamically link HFSS Design into Schematic
- Tune structure

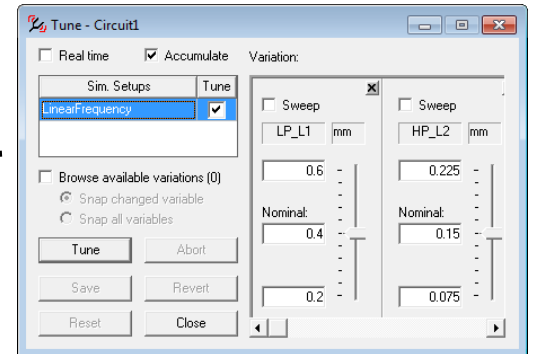
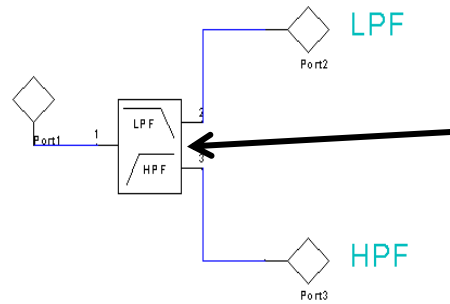
• Benefit

- Diplexer was tuned in real time.
- Increased tuning resolution
- Engineer has visual indication of filter performance while optimizing it.



- Parametric Sweep in HFSS varies the capacitive plate width (outlined in Red)
- Results from HFSS are Dynamically linked to Schematic as parametric circuit model
- Tuning is performed

Tune to desired response using tuning tool



Dynamic Link Example: Resonator Filter Design

- **Nominal Requirements**

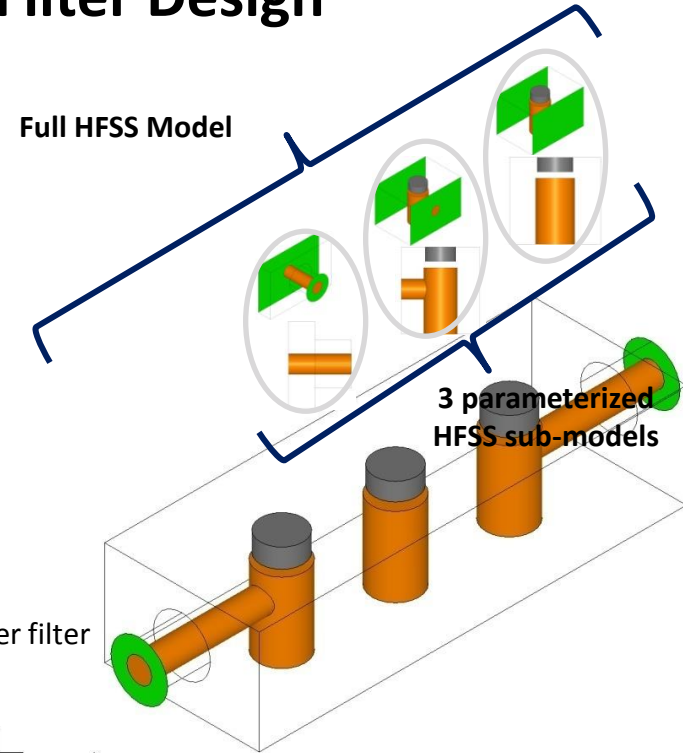
- -20dB bandwidth of 10%
- center frequency of 10.0 GHz

- **Procedure**

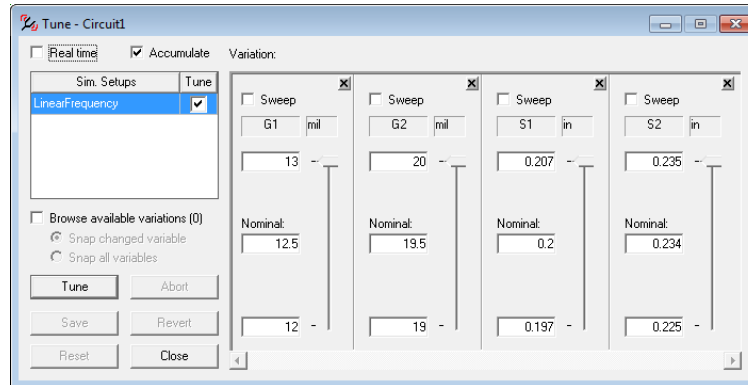
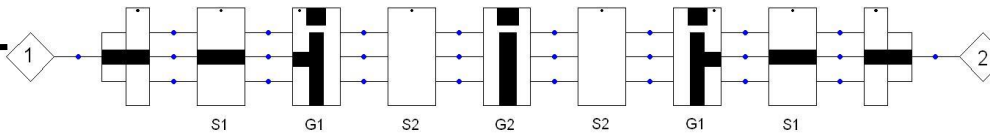
- Break filter into pieces or sub-models
- Parametrically solve each sub-model
- Dynamically link HFSS sub-model results into Schematic
- Tune device performance

- **Benefit**

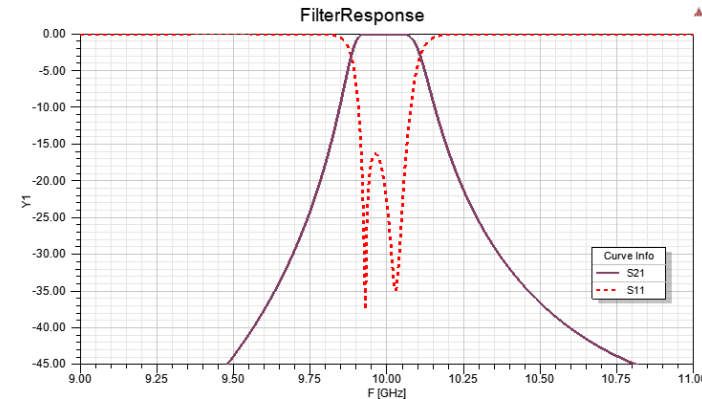
- Model is scalable, circuit design simply adds more sub-models to create higher order filter
- Engineer has visual indication of filter performance while optimizing it.



Fully tuneable Circuit assembly representing above filter



Tuned Filter Response



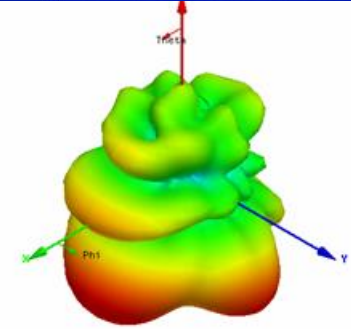
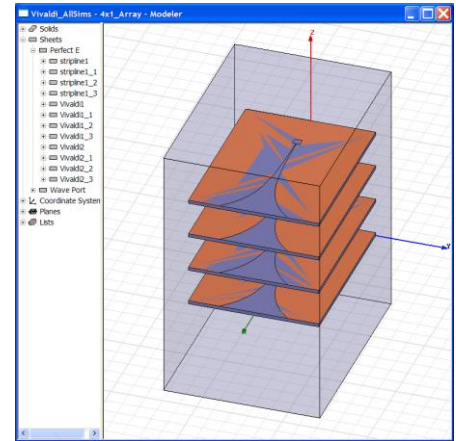
Example: Pushed Excitations

• Procedure

- Simulate 3D HFSS design
- Create system schematic, including active circuitry in Schematic
- Dynamically link HFSS
- Using Nexxim Circuit, solve linear system
- Pushes true magnitudes and phases back into HFSS for far field calculation.

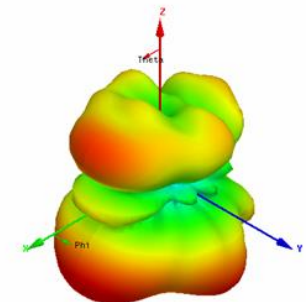
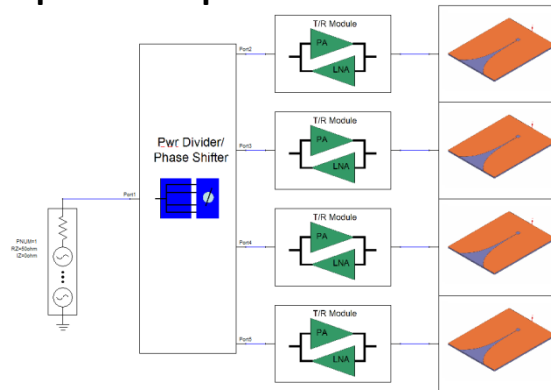
• Benefit

- Obtain a realistic far field pattern based on the actual magnitudes and phases presented to antenna
- Better understanding of what happens in non-ideal excitation scenarios
- Ability to incorporate compensation schemes into design



Baseline (HFSS Only)

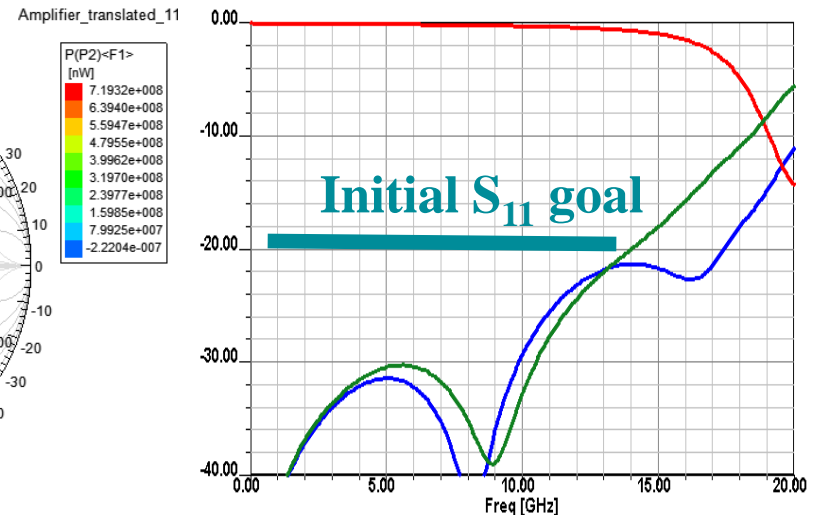
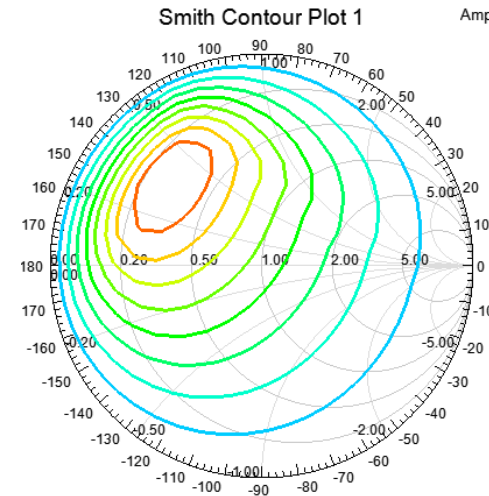
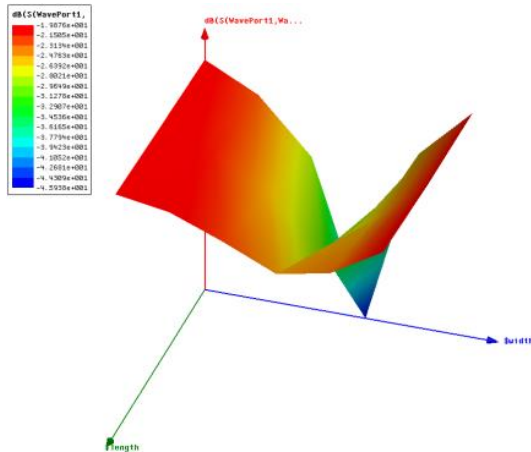
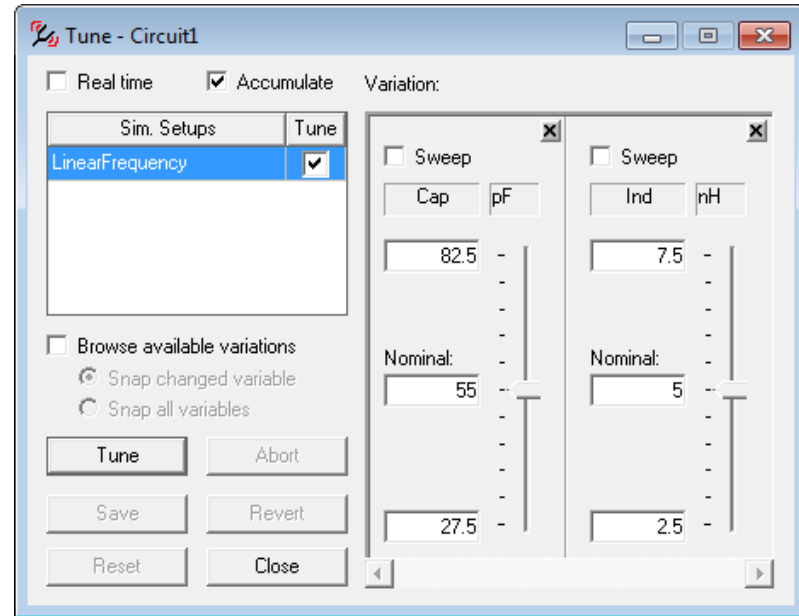
Example: Phase imbalance associated with power amplifier compression in a transmit channel



Compression modeled with HFSS + Circuit

- **Featured Optimetrics Capabilities:**

- Parametric Analysis
- Optimization
- Tuning
- Sensitivity Analysis



Transmission Line Calculator

Microstrip - CPL

Dimensions: W: 1, S: 1, P: 10

Electrical: Z0: 50, K: 10, E: 45, Zo: , Ze:

Units: Dimension: mm, Frequency: GHz, Impedance: Ohm, Electrical Length: Deg, Resistivity: uOhm*cm

Frequency: 1, Analysis, Auto Calculate OFF, Reset All, Synthesis: 1

Substrate: Required: H: 60mil, ER: 4.4, Optional: HU: , TAND: 0.02

Metalization:

Layers	Metal Name	Code	Resistivity	Thickness
Bottom	copper		1.7241E	0.675m
Middle	*None*			
Top	*None*			
RGH	0mil			

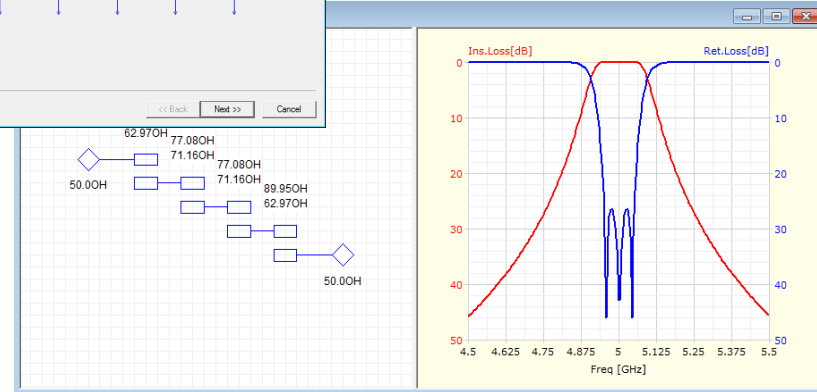
Buttons: Details>>, Place, Close

Filter Design Wizard - Properties

Passband	Topology	Approximation	Prototype	Technology
Lowpass	Ideal Lumped	Maximally Flat	Default	Strip
Highpass	Ideal Distributed	Butterworth		Microstrip
Bandpass	Lumped with Inverters	Linear Phase 0.05 deg error		Suspended microstrip
	Distributed with Inverters	Linear Phase 0.5 deg error		Rectangular bar
	Capacitively Coupled Lines	Gaussian		Stripline
	Capacitively Coupled Resonator	Legendre		Coaxial line
	Tubular	Trans Gaussian to 6-dB		
	Combine - Tapped input	Trans Gaussian to 12-dB		
	Combine - Capacitive input	User defined		
	Combine - Transformer input			
	Interdigital - Tapped input			
	Interdigital - Open oct input			
	Interdigital - Short oct input			
	Edge Coupled			

Buttons: Load Example..., Change Units..., Advanced Specs, Bipole / Corners..., Factors..., Waveguide, << Back, Next >>, Cancel

Filter Synthesis



Load-Pull Utility

Harmonic Balance Analysis, 1-Tone

Name: HB1Tone, Max. Harmonic Number: 10, F1 value: 500MHz, Method: HB, Transient Initial Time: 0.0, Auto Refine Solution: No

Output Quantities: Voltage/Current, Harmonic Combinations: 10F1 F1

Solution Option: Name: (Default Options), Additional:

Sweep Variables:

Name	Sweep/Value
ZRho	LINC 0 1 111
ZAng	LINC 0 6.283185307 13

Buttons: Add..., Remove, Edit, Load Pull, Enable Load Pull, Settings...

Smith Contour Plot 1: A Smith chart showing constant SWR contours (0.50, 1.00, 2.00, 5.00) and constant reflection coefficient contours (0.00, 0.20, 0.50, 1.00, 2.00, 5.00).

Smith Tool: Matching Network Synthesis

Smith Tool

Display: Matching

Buttons: [Circuit symbols for series/parallel inductors/capacitors]

Buttons: New Match, Delete, Export

Parameters: ZRef: 50.00+0.00, GMAX: -17.11dB, FMIN: <NA>, K: 25.72, Circuit: filter_layout, Solution: Linearfrequency, Save report on exit: checked, Freq: 4.5GHz

Smith Chart: SAS IP, Inc. showing a matching network synthesis path on the Smith chart.

Parameters: S1Port: Port, 4.50GHz-5.5, Linearfrequency

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