RF Circuit Analysis
(Using SimSmith)

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Todays Goal

NOT a tutorial: lots of those available.

Demonstrate SimSmith's wide range of capabilities.

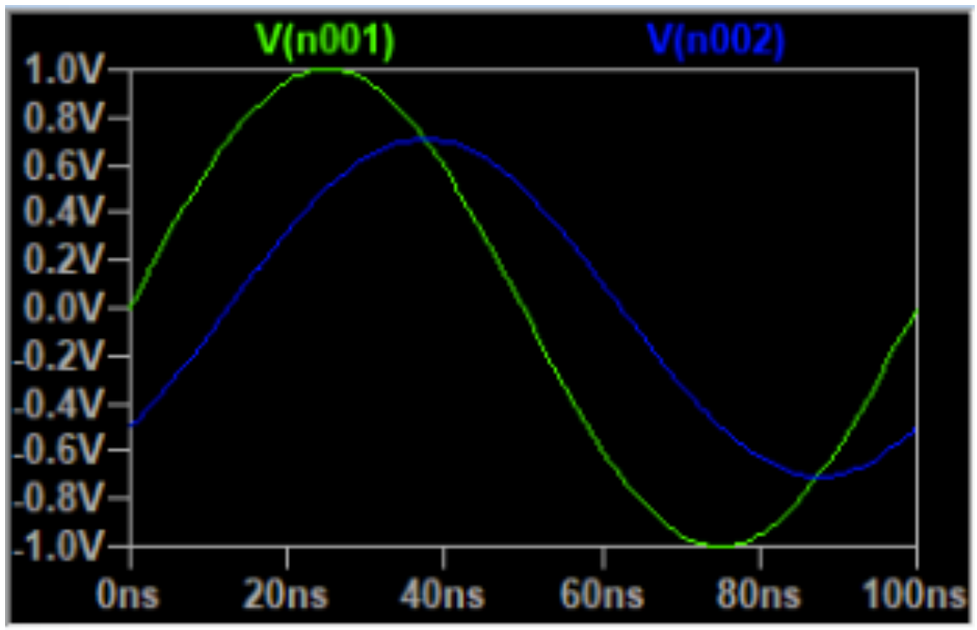
Interest you in using it to explore your own antennas and circuits.

Compare & Contrast

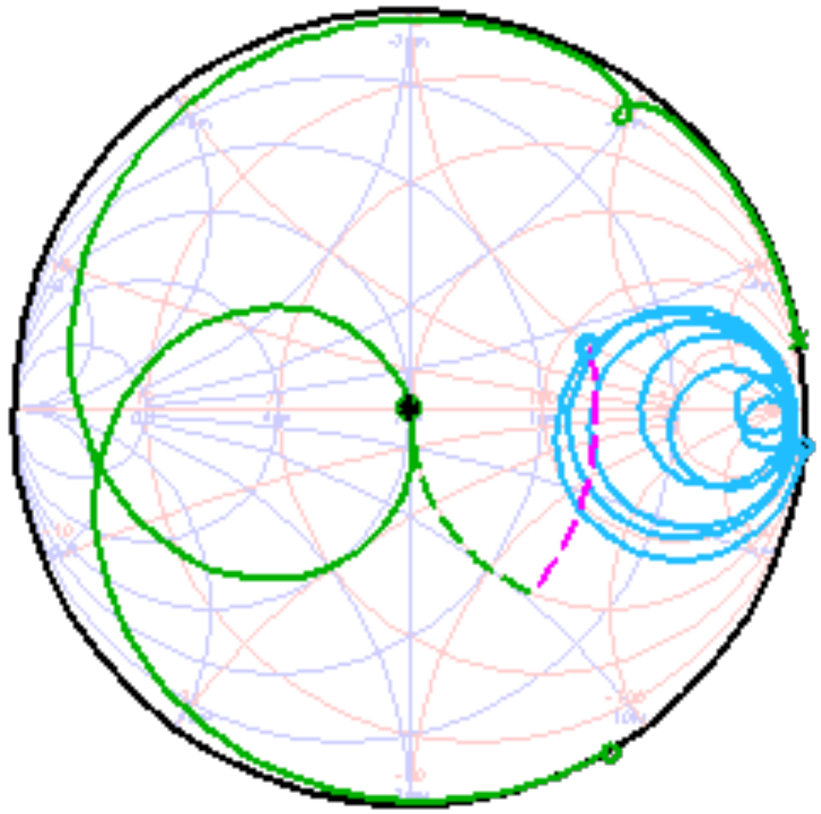
Spice	Smith Chart
Primarily V and I	Primarily V/I and VI
Batch Mode	Interactive
Transient Analysis	Steady State
Does MNA analysis	Does simple algebra

Compare & Contrast

Spice
(waveforms)



Smith Chart
(impedances)



What Sets SimSmith Apart

Interactive:
- Circuit analysis done continuously.
- Mouse tuning of components.

Not limited to Ladder circuits:
- Can analyze arbitrary circuit topology.

Can analyze multiple circuits:
- Multiple instances of SimSmith.
- Multiple circuits in one instance.
- Analyze multiple frequencies.

Can analyze any periodic waveform:
- Square waves, triangle waves, anything!

What Sets SimSmith Apart

Automated circuit elements:
   Generators, matching circuits, duplicates

Powerful plotting:
   Colors, lines, equations, etc.

Scripts:
   Can automate circuit design and analysis
   Describe components as functions

Import device characteristics:
   From vendors, from simulators, from test equipment

Extensive Transmission Line Database

What Sets SimSmith Apart

Sweep Control:
- Any parameter
- Any combinations of parameters
- Component value based ranges

Plot Control:
- Path and Sweep
- Power, Impedance, Voltages, Waveforms

Bidirectional Analysis:
- normal: 'load to generator'
- reverse: 'generator to load'
- inverse: …….. I'll discuss this shortly

basicLC.ssx

Demonstrate circuit editing:
- drag/drop
- copy/paste

PATH:
- changing parameter values
- mouse drag target
- mouse drag load

SWEEP:
- frequency sweep

BOTH:

Butterworth.ssx

Basic Butterworth:

Notice inductor is ‘trap’.

Play with inductance to improve transfer

Set trap frequency to suppress second harmonic.

Lock frequency

makes trap an ‘automatic component’.

Play with inductance again….

TwoFilters.ssx

Play with pair.

TwoFrequencies.ssx

New Circuit.

Set Load to 25 ohms.

add Series Parallel, shunt series.

Set frequencies to 10, 20 and 14.14

play with values to match frequencies

Import Characteristics

ImportSimulation.ssx such as EZNEC or 4NEC2

Others (like ELSIE)

ImportMeasurement.ssx

ImportS2P.ssx

- compare actual inductor to model.
- note equivalent Q!!!!

Scripting

duplex.ssx

non-ladder circuit

automatic assignment of L, C, and R

adding power plot using right click

play with F or H?

Waveforms

norcalWaves.ssx

edit RUSE block.

enable voltage waveforms for C1 and C2

Adjust power.

Matching Range

matchRange.ss

Sweep range of C and L.

Shows how how 50 ohms can be translated.

Inverse: show what impedances can be matched.

Look at diffT.ssx

- play with frequency
- notice ‘not unique solution’
- notice F block describing second capacitor

Matching Techniques

Compare matching techniques:

LC network
Single quarter wave
Double quarter wave

Fixed load:
Double quarter wave clearly better.

Antenna load:
NO SIGNIFICANT DIFFERENCE

Sophisticated Model

RollerCalcs.ssx

Air core: use Wheeler's formula
(look at RUSE block equations).

Shorted out unused turns:
HOW DOES THIS NOT CAUSE PROBLEMS???
Look at coupling factor!

How else can we see this?:
L doesn't grow like N^2!

AC6LA T Network Analysis

ac6laTAnalysis.ssx

Uses a program to ‘cover the Smith chart’.

Uses a program to set inductor values based on measured data of a roller inductor.

Uses a program to ‘tune’ the T network for match.

Displays a variety of results:
- measure of voltages, currents, power as % of max.
- measure of SWR bandwidth.

Mouse Tuning

diffT.ssx

‘control right click’ to set L.ohms

‘right click’ to set parameters values

Turn off sweep, drag tune the target

Wrap Up.

SimSmith:

continuous, real time circuit analysis
analyzes arbitrary circuits
reads load files for components and antennas
mouse driven component value tuning
can use scripts to describe components
and automate processes

Provides a comprehensive circuit analysis system which can be used to design and explore RF circuit behavior.