

Far-Field Approximation Using Near-Field Magnetic Probe Method EM-ISight

Presented by: Daniel Brooks
APREL Inc. Ottawa, Canada.

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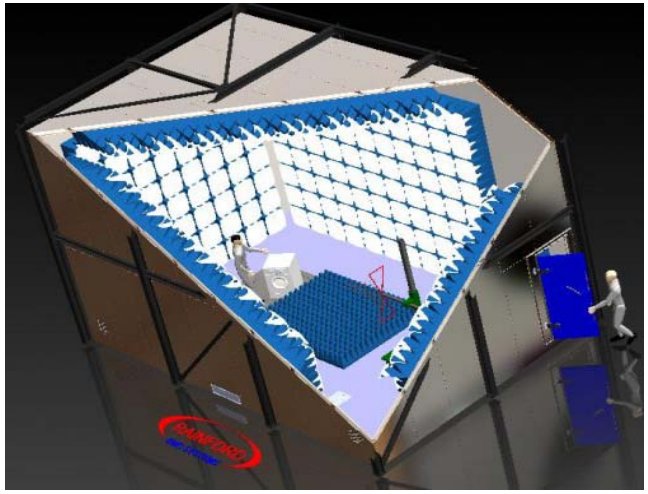
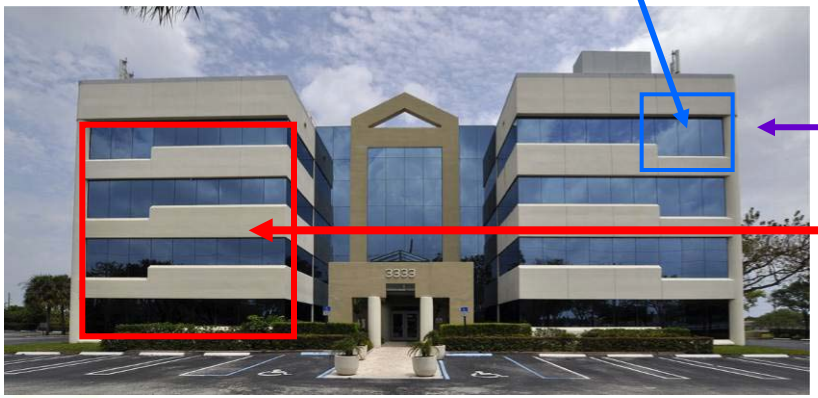
Overview of Presentation

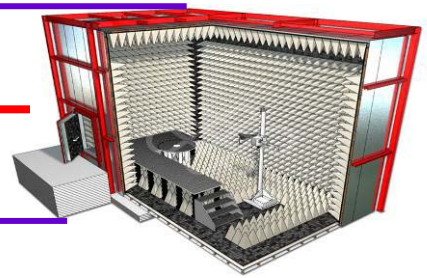
- Challenge – **provide correlation** of near-field with that expected from far-field range measurements.
- Methodology - develop an experimental test using **radiometric principles** to demonstrate evidence of a solution.
- Discovery - **validate (prove)** that the solution works by comparing measurement data with equivalent numerical models.
- Results – How well is the correlation, uncertainty and **repeatability**
- Observations - Near-field magnetic probe method advantages.

Far-Field Approximation

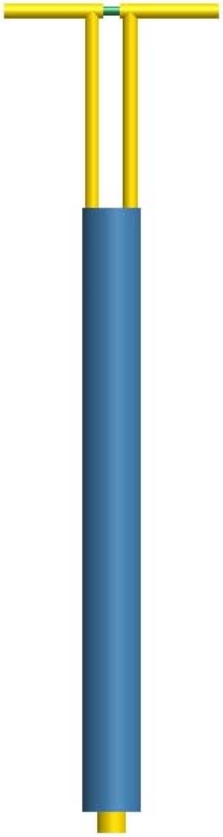


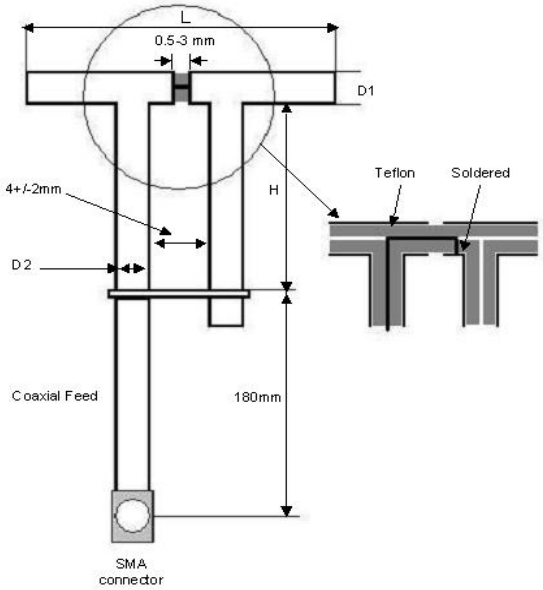


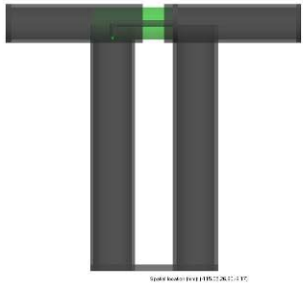
Can be over three stories high

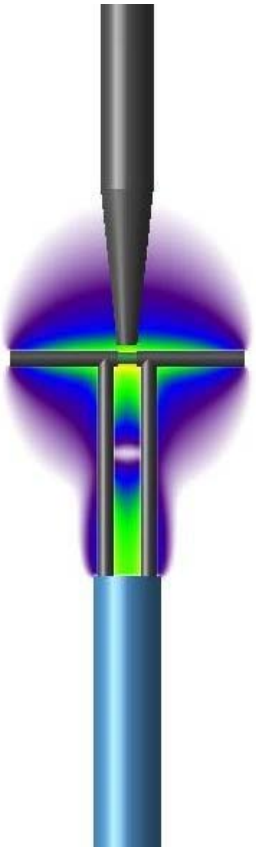


Reference Dipole Antenna used in Range Calibration the Basis for our Test Methodology









Frequency	Z [M]	RL	VSWR	Gain	D = L	RFF
(MHz)	[ohms]	[dB]		(dBi)	[mm]	[mm]
2450.0	54.7+j4.9	-23.9	1.14	2.15	58.0	55.3
5000.0	47.3+j5.4	-24.2	1.13	2.16	29.0	28.2

VNA Measurements of Source Reference Dipole Validates FDTD and SBRT Models
Dipole CW Input Power 1mW (0dBm) for Entire Analysis

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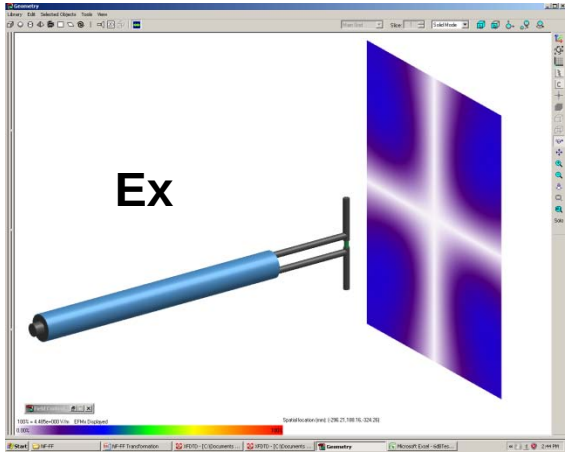
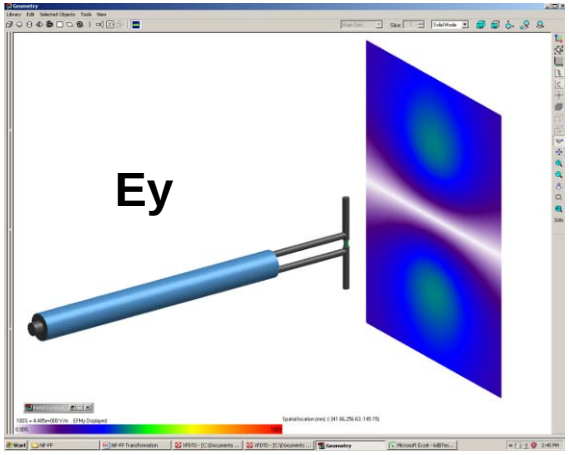
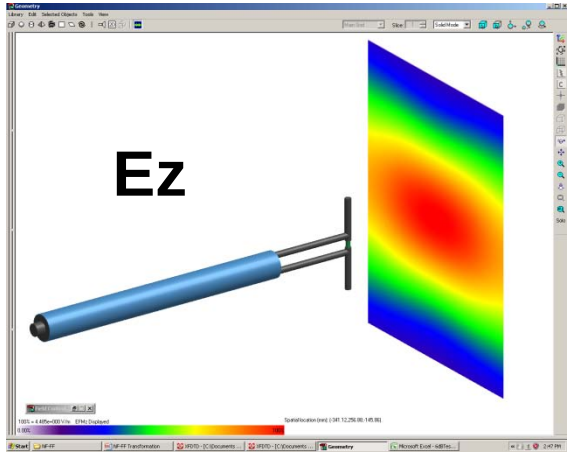
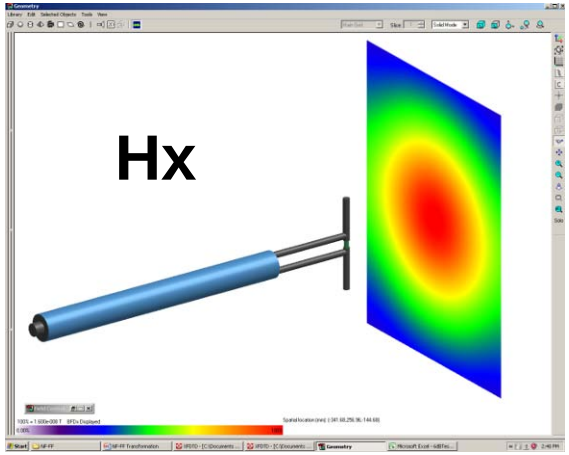
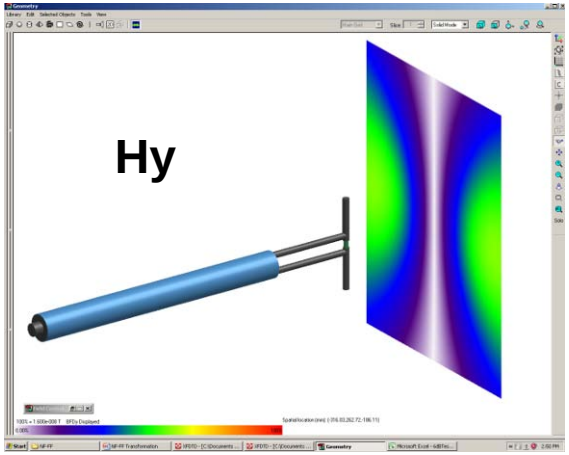
FDTD Model of Reference Dipole Antenna Shows Fidelity of Boresight Fields

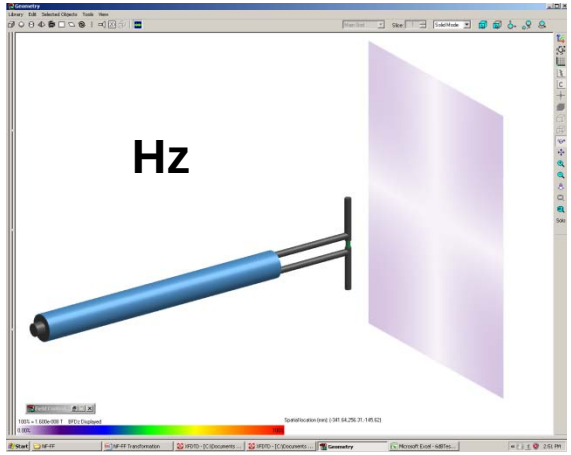






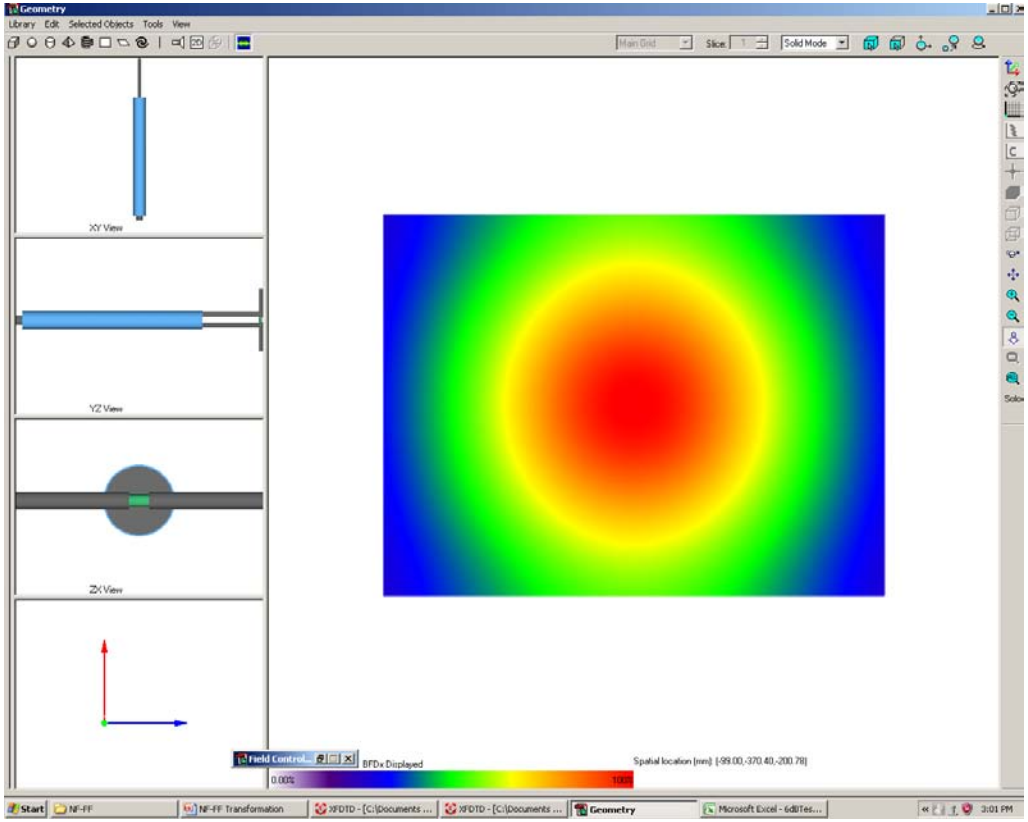






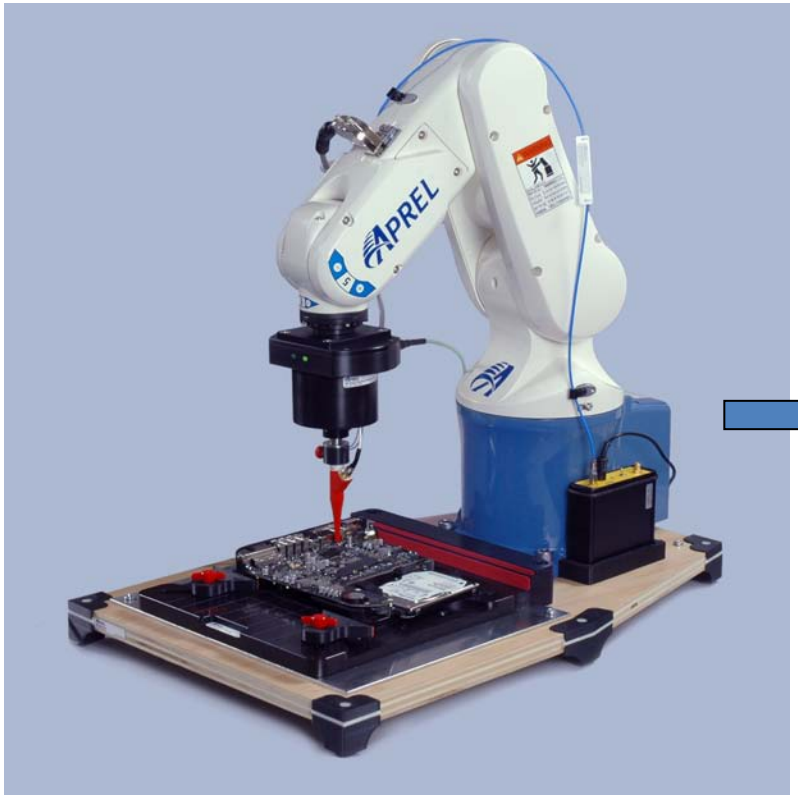
Hx and Ez are Orthonormal Equiphased and unperturbed by other field components

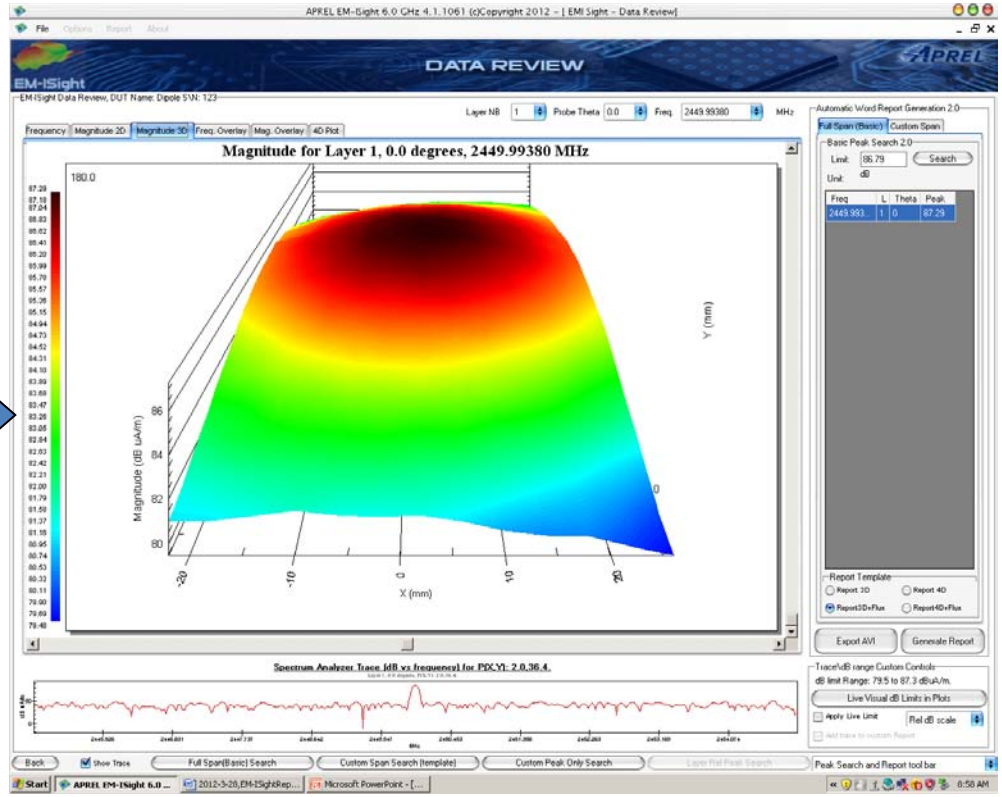
FDTD Numerical and EMIS Surface Scan Measurement of Hx Magnetic Near-Field



Numerical Correlation Stage, Radiating Near-field R=39mm of 2.45GHz Dipole

EM-ISight Volumetric Measurement





Radiating Near-field R=39mm of 2.45GHz Dipole are in Fine Agreement with Numerical

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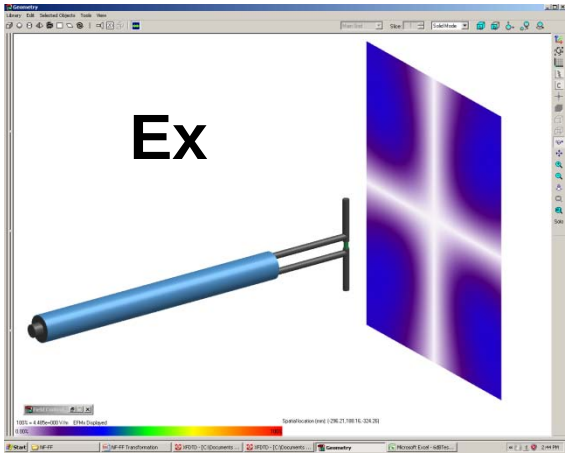
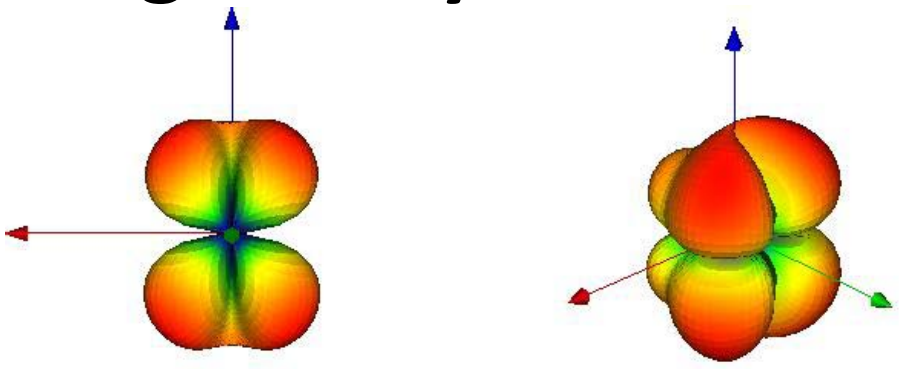
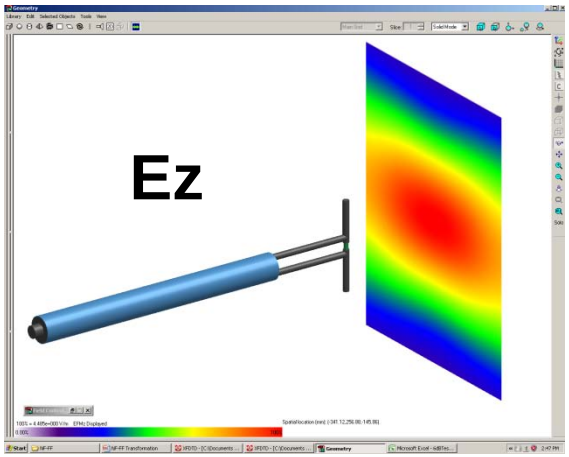
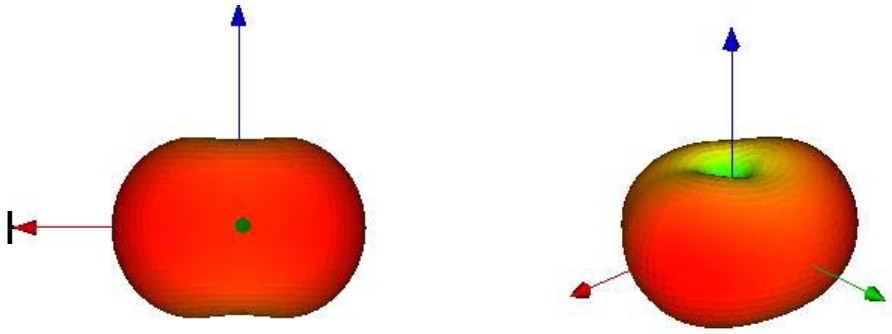
FFT Creates Complex 3D Radiation Pattern for SBRT Range Analysis





Ex (Ephi polarized component)

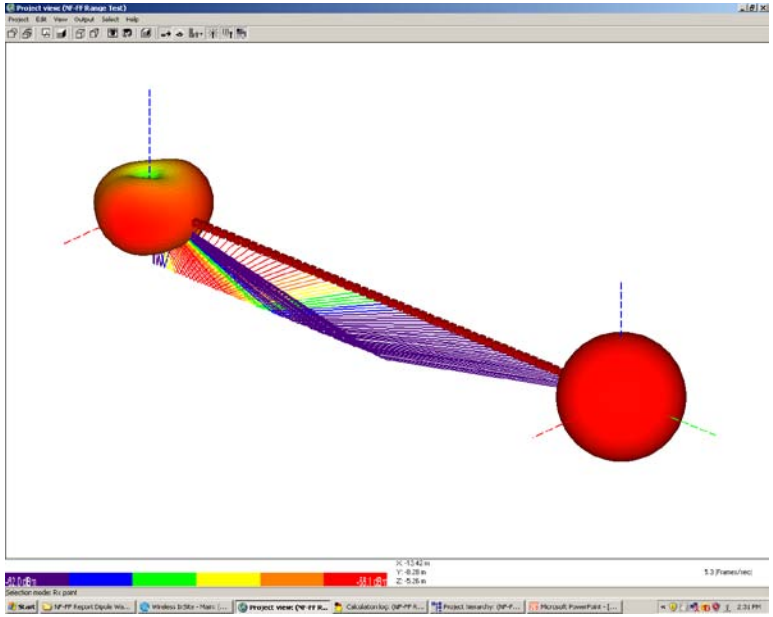




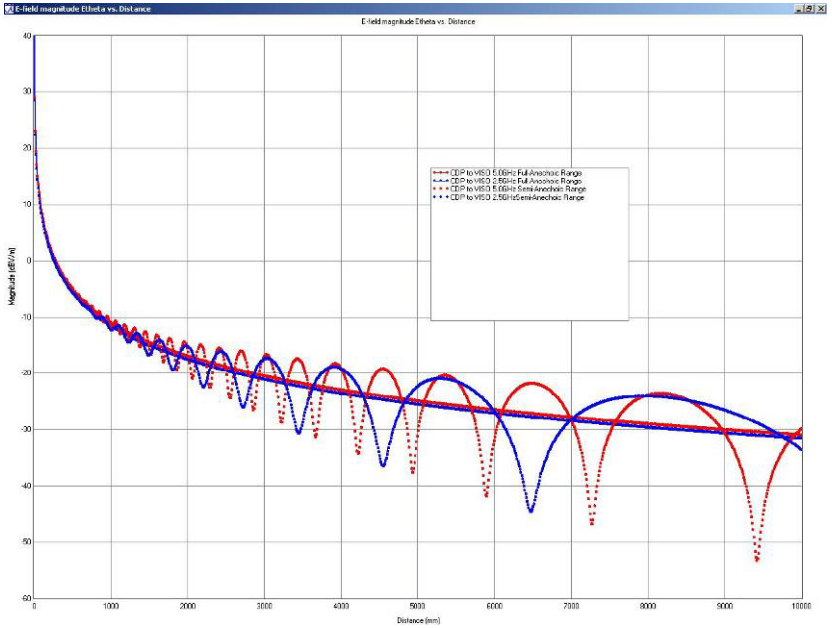
Ez (Etheta polarized component)

Provision for Far-field Range Analysis of Ez (Etheta) Boresight View

SBRT Equivalent 10meter Range Model Spherical Coordinates Y-Axis is Boresight

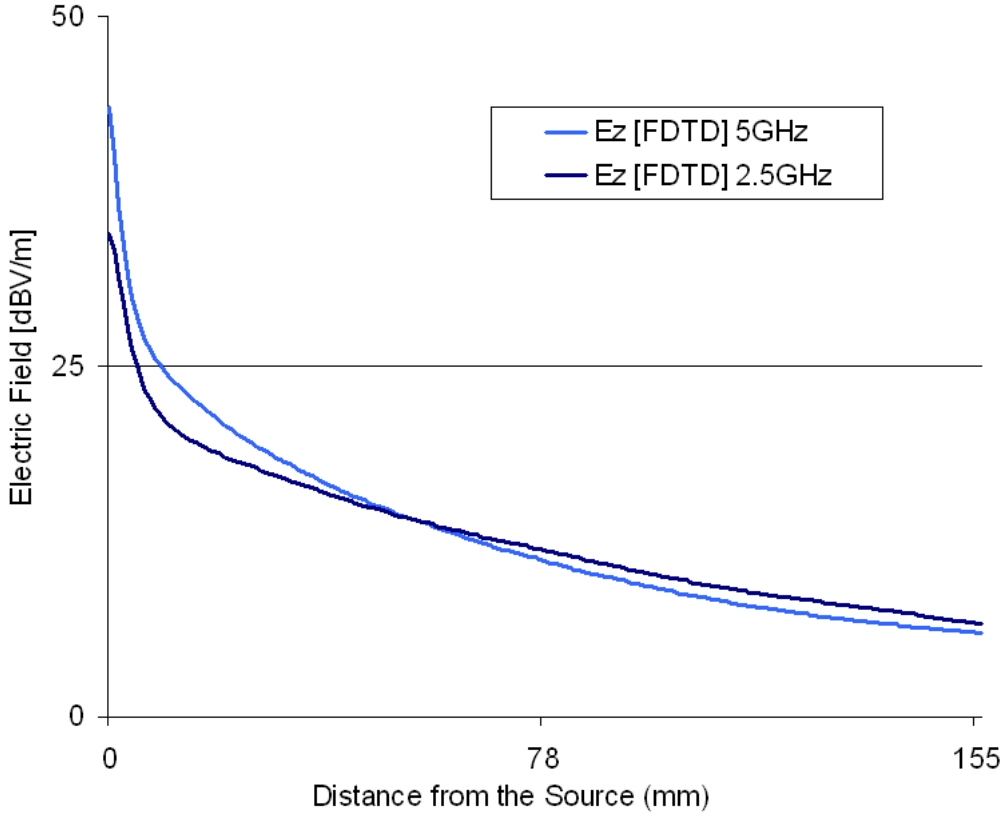


Reference Dipole (Tx) Gain and Directivity Attributes are Intact (Left Side) Vertical Polarized Isotropic Radiators (Rx) Radiation Patterns, QTY 1000



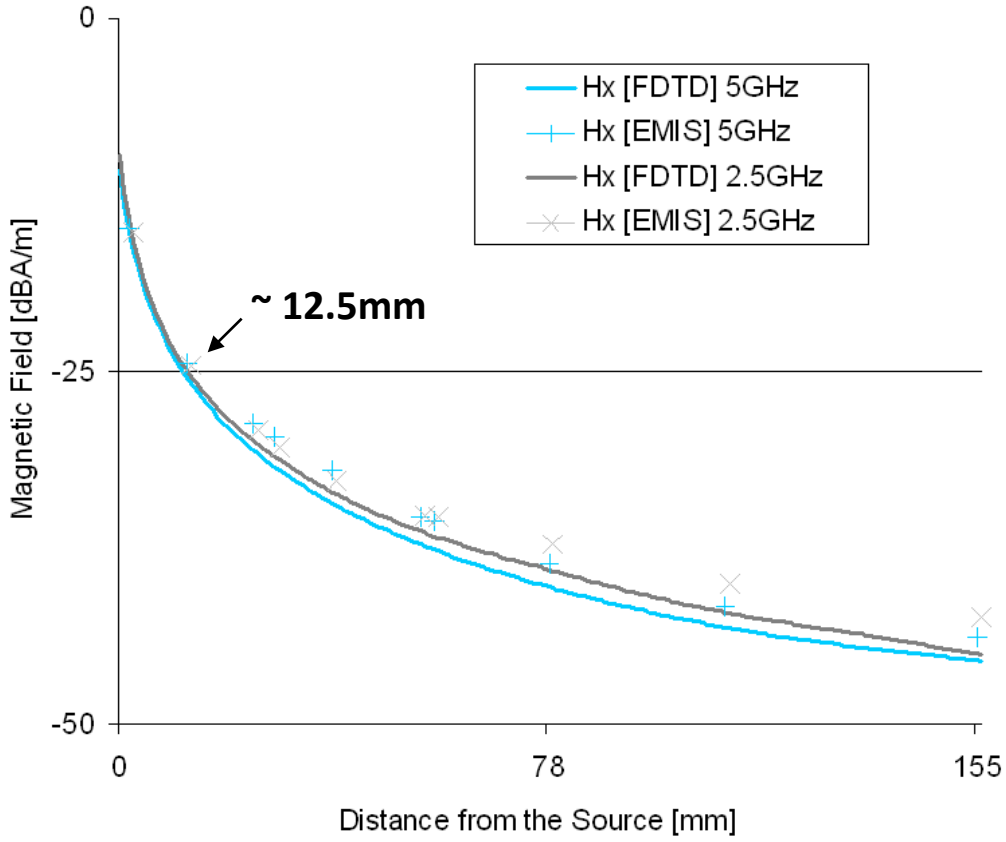
Electric Field Magnitude Results of Full Anechoic (Solid Line) Semi-Anechoic or OATS (Dotted Line) with Ground Reflection Multipath Interference

FDTD Electric Ez Field Analysis of Dipoles Range from R=(2.3 to 156)mm



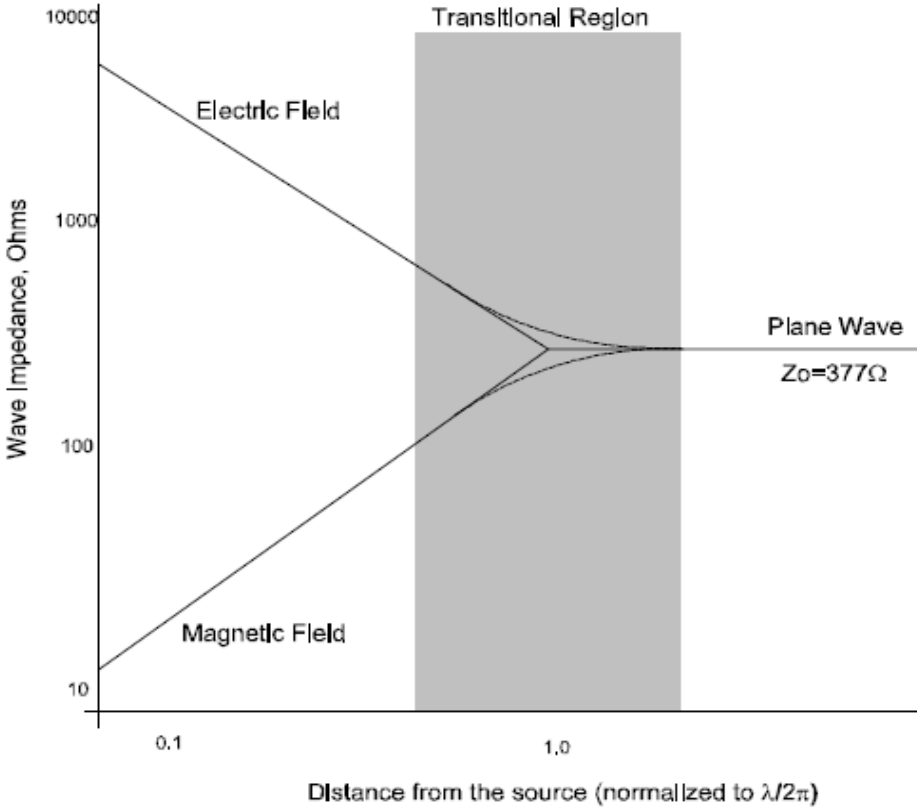
Electric Field Magnitude Numerical

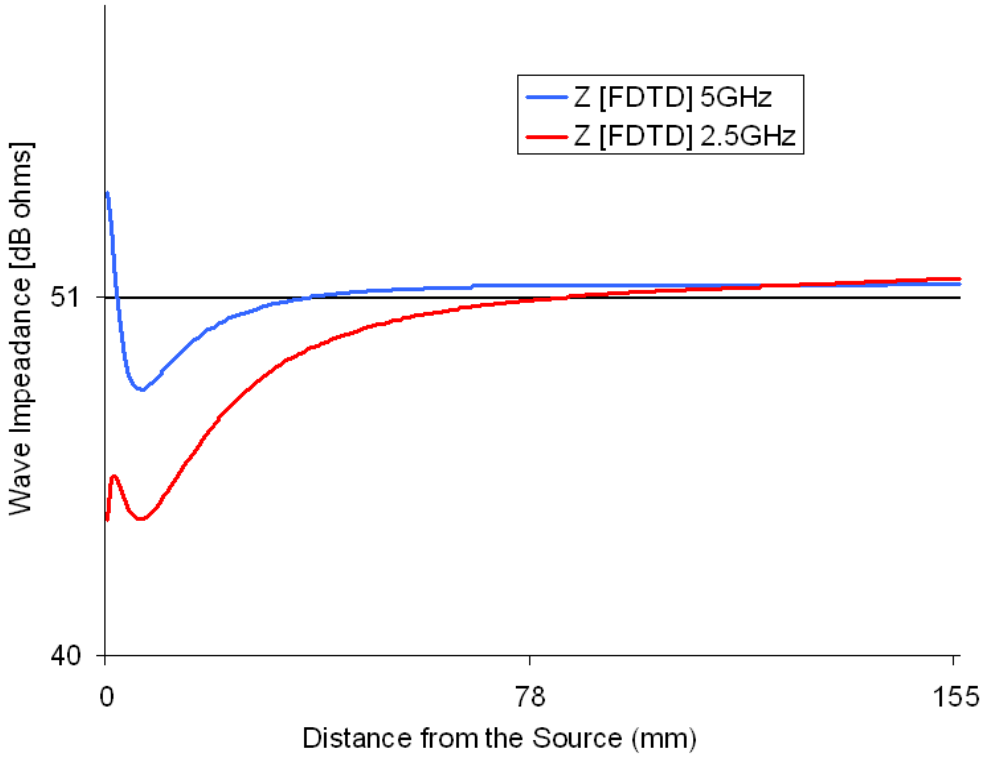
EMIS Magnetic Hx Field Measurements of Dipoles Range from R=(2.3 to 156)mm



EMIS Magnetic Field Magnitude (Hash Marked) Measured
FDTD Magnetic Field Magnitude (Solid Line) Numerical

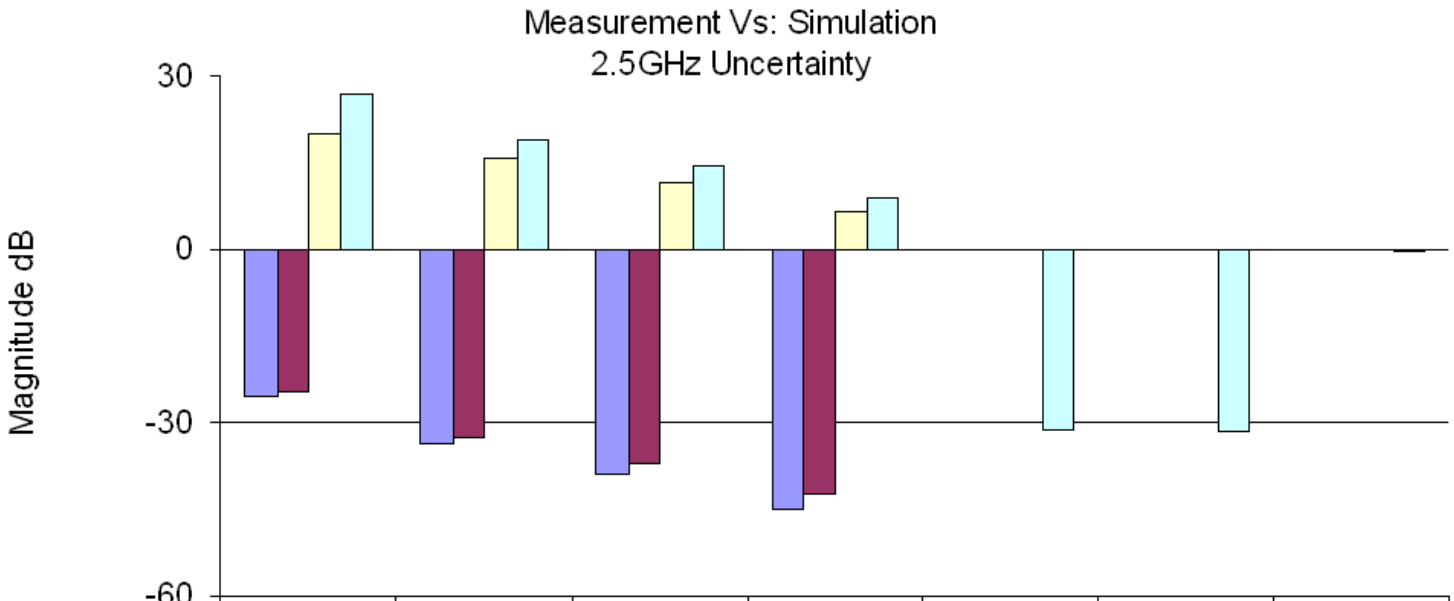
Wave Impedance of Reference Dipole Antenna Field Convergence Profile to Orthonormal





Theoretical and FDTD Models Converge to Z=Ez/Hx=377ohms (51.5dBohms)

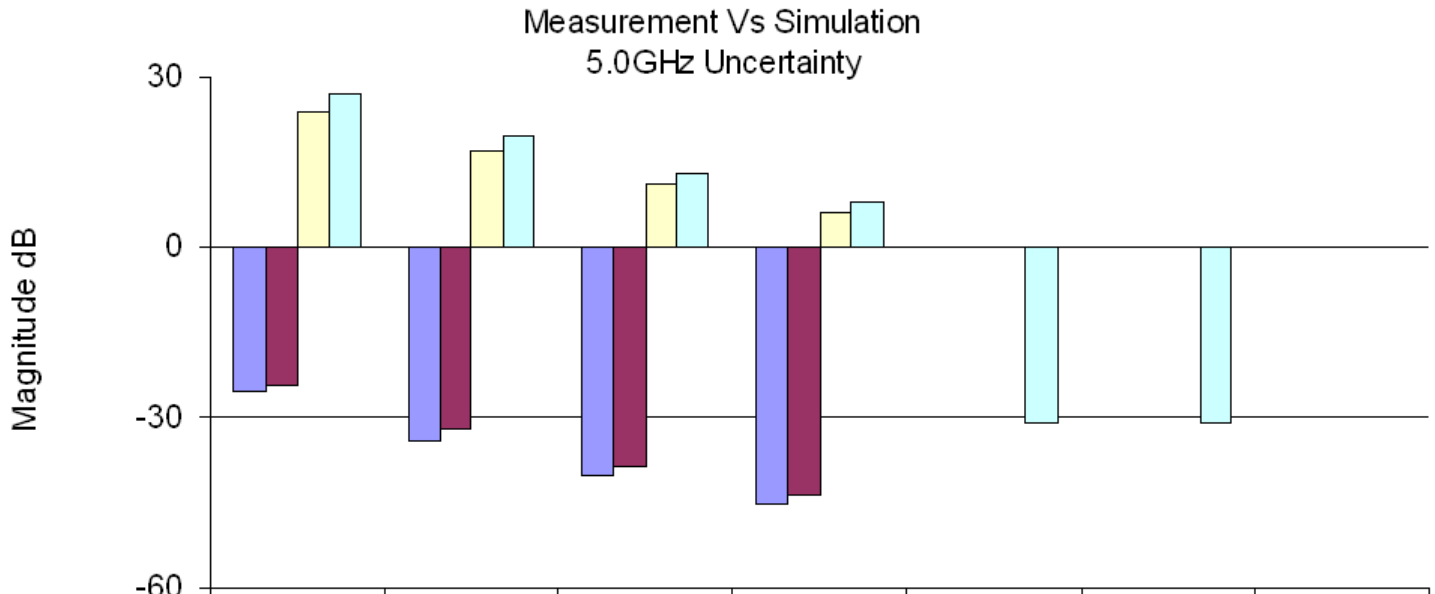
EMIS Measurements Vs: Numerical 2.45GHz



	12.5mm	39mm	78mm	156mm	12.5mm to 10m (FSPL)	10m (SBRT)	10m Uncertainty
A/m FDTD	-25.37	-33.7	-39.12	-45.05			
A/m EMIS	-24.61	-32.71	-37.22	-42.39			
V/m FDTD	20.14	15.9	11.82	6.56			
V/m EMIS	26.89	18.79	14.28	9.11	-31.17	-31.58	-0.41

Magnetic Field converted through +51.5dBohms, then Translated to 10meters by subtracting Amplitude = 20log(10m/Rm)

EMIS Measurements Vs: Numerical 5.0GHz



	12.5mm	39mm	78mm	156mm	12.5mm to 10m (FSPL)	10m (SBRT)	10m Uncertainty
A/m FDTD	-25.4	-34.34	-40.24	-45.41			
A/m EMIS	-24.43	-31.99	-38.64	-43.82			
V/m FDTD	23.69	16.72	11.14	6.01			
V/m EMIS	27.07	19.51	12.86	7.68	-30.99	-30.97	0.02

Magnetic Field converted through +51.5dBohms, then Translated to 10meters by subtracting Amplitude = 20log(10m/Rm)

Results and Observations

- Far-Field Target Numbers are in fine agreement with equivalent 10m Range model.
- Magnetic probe measurement accuracy is better than 1dB at 12.5mm.
- Accuracy of Measurement Increases with decreased distance from source.
- Repeatable Measurements Performed at two frequencies 2.45GHz and 5GHz.
- Scalable Method Applicable for any Range Distance and Frequency.
- Analysis indicates Electric near-field is a less reliable predictor of Far-field.

Summary and Conclusion

Challenge – provide correlation of near-field with that expected from far-field range measurements, Achieved.

Methodology - develop an experimental test using radiometric principles to demonstrate evidence of a solution, Achieved.

Discovery - validate (prove) that the solution works by comparing measurement data with equivalent numerical models Achieved.

Results – How well is the correlation and repeatability Very Fine Agreement.

EM-ISight near-field measurement system is a highly feasible technique to predict the far-field using volumetric measurements, QED.

Special thanks to Bob Hiebert, Robin Jackman, David Huynh, and Tektronix worldwide for their support in Real-Time measurements used in this project.

Thank You

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