

Near Field Measurements of a Dipole Antenna and Specific Absorption Rates in a Flat Phantom

Eric Merideth, David Xia, Nasim Vakili, and Christopher C. Davis

Department of Electrical and Computer Engineering

Part of an International Laboratory Comparison for the Cell Phone Industry. Measurement of the Near-Field Antennas Patterns of a Dipole in Close Proximity to an Absorbing Flat Phantom and Mapping of the Spatial SAR Values

Theoretical Data

Specific Absorption Rate(SAR)

The rate of energy absorption per mass (Watts/kg). Usually averaged over a specified volume (1cm³ or 10cm³)

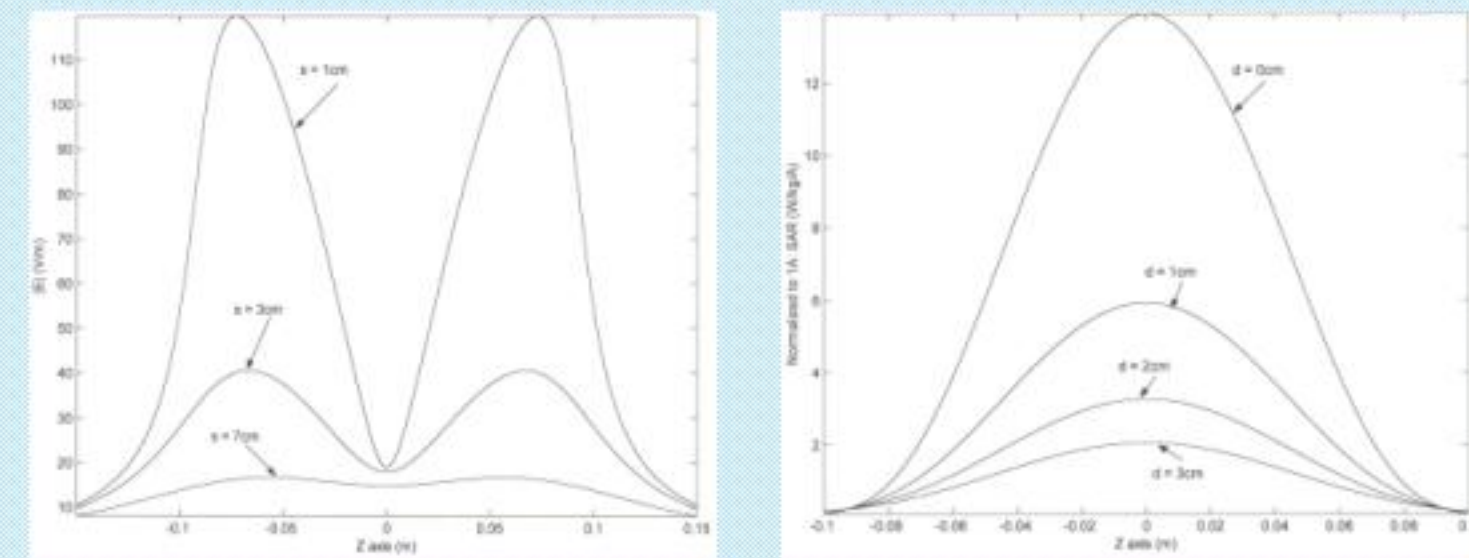
$$SAR = \frac{\sigma |E|^2}{\rho}$$

σ = conductivity of the dielectric medium

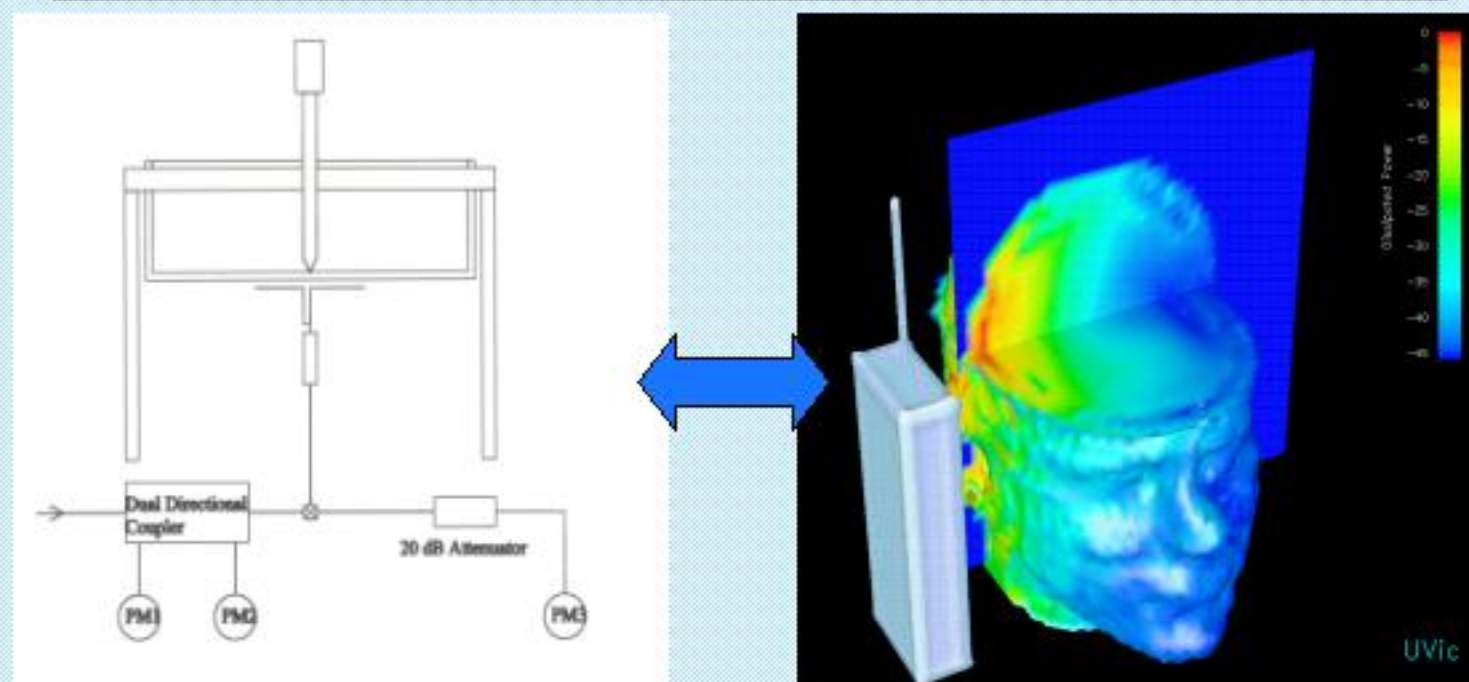
ρ = density of the dielectric medium

$$E = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

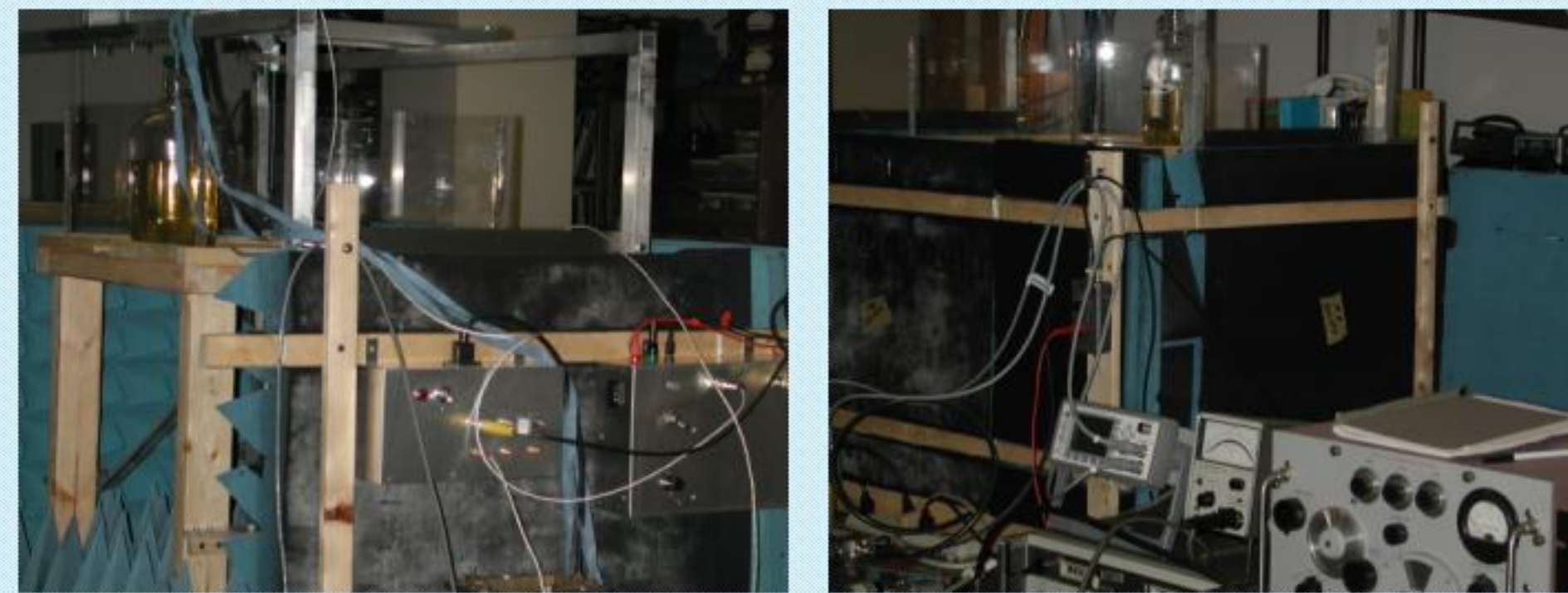
Free space scan over dipole axis: SAR profile along antenna axis at 835MHz (normalized to 1A feed current)



The Ultimate Goal: Characterization of SAR in the Human Head from a Cell Phone

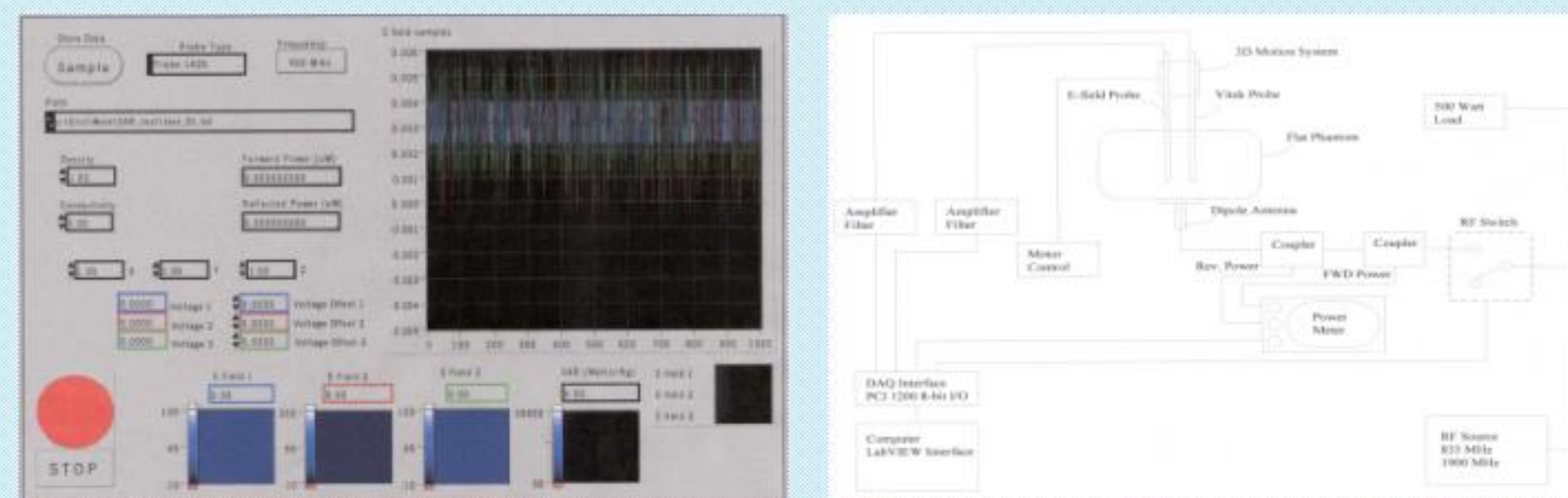


Apparatus



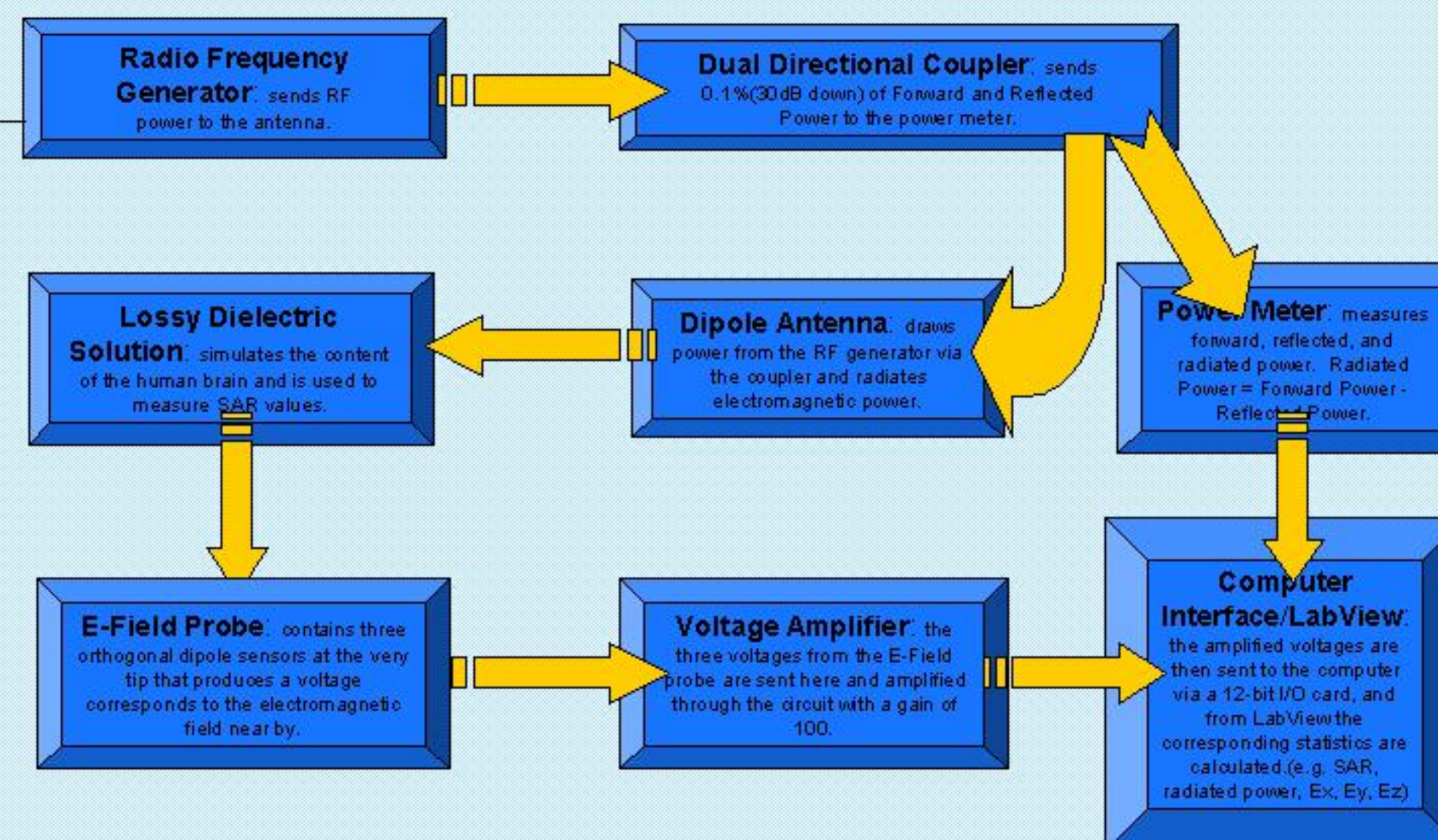
LabView Interface

Apparatus Diagram



Note: The above diagram is for the entire system, which also contains a temperature probe. Only an E-field probe was used in this experiment.

Flow Chart of Major Components

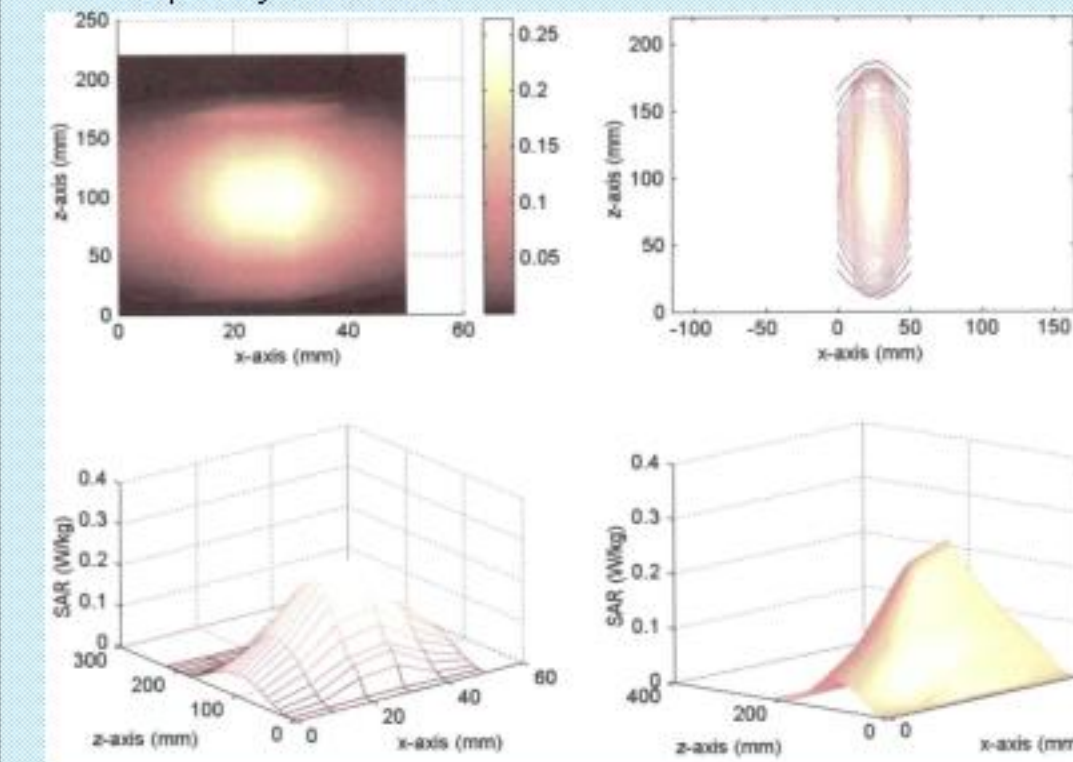


Experimental Data

Area Scans

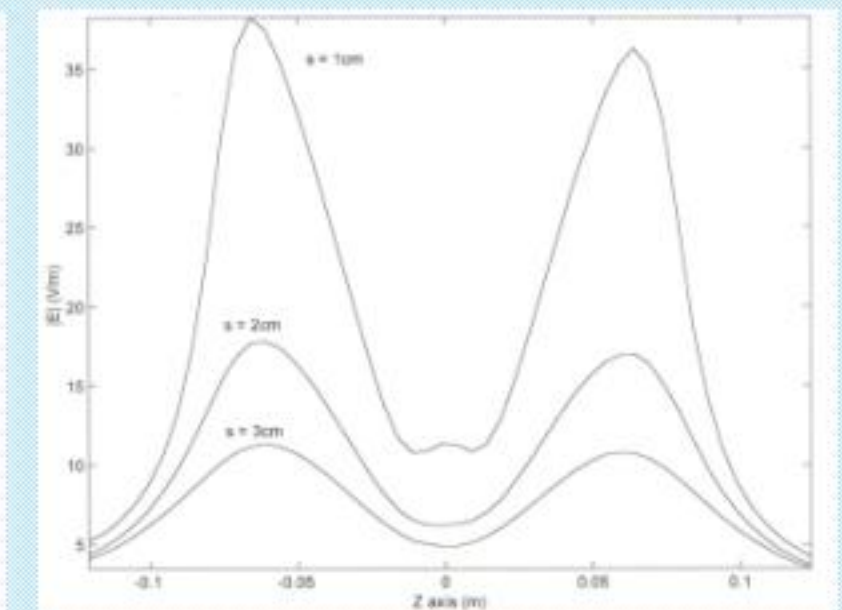
Experimental area scan in lossy solution (scale in W/kg):
Forward Power = 30.1mW
Frequency = 835MHz

Phantom Material conductivity = 0.85(S/m)
Real relative permittivity = 41
s = 15mm d = 5mm



Profile Scans

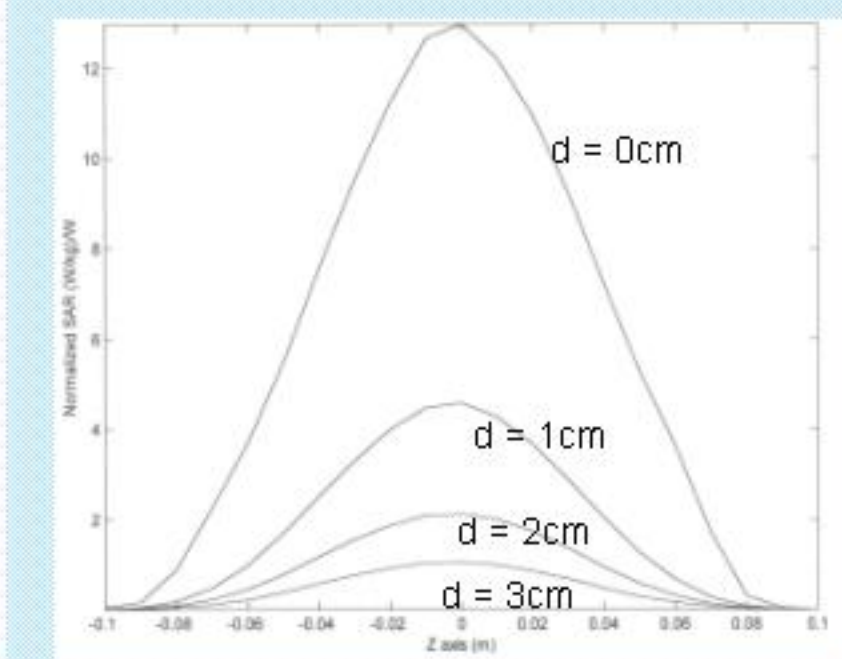
Experimental free space scan over dipole axis:
Forward Power = 30.1mW
Frequency = 835MHz



Composition of Phantom Dielectric Medium

Ingredients	835MHz				TOTAL		
	Formula	Required (kg)	Required (grams)	Required (lb)	Volume (liters)	Mass (kg)	Density (kg/l)
Water	41.45%	0.829			1.632	2.000	1.225
Sugar	56.00%	1.120		2.47			
Salt (NaCl)	1.45%	0.029	29.0	0.06			
HEC	1.00%	0.020	20.0				
di-ethylene glycol	0.00%	0.000	0.0				
Dowlicl-75	0.10%	0.002	2.0				
Total final mass (weight) = 2.0 liters							
Ingredients	900MHz				TOTAL		
	Formula	Required (kg)	Required (grams)	Required (lb)	Volume (liters)	Mass (kg)	Density (kg/l)
Water	40.71%	0.814			1.627	1.998	1.229
Sugar	56.63%	1.133		2.50			
Salt (NaCl)	1.48%	0.030	29.6	0.07			
HEC	0.99%	0.020	19.8				
di-ethylene glycol	0.00%	0.000	0.0				
Dowlicl-75	0.10%	0.002	2.0				

Experimental SAR profile along the axis (normalized to 1W radiated power):
Frequency = 835MHz



Conclusions

- A near-field antenna measurement system has been constructed and EM radiation and SAR measurements made
- The experimental data agree closely with theory

Future Work

- Uncertainty analysis
- Calibration of the entire system
- Anthropometric phantom with actual cell phones