



## Development of Radio Frequency Antenna Radiation Simulation Software

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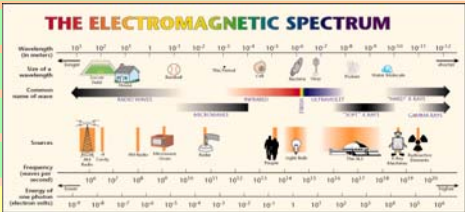
## OUTLINES

1. BACKGROUND
2. OBJECTIVES
3. METHODS
4. RESULTS
5. SUMMARY
6. FUTURE WORK

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## BACKGROUND

### ELECTROMAGNETIC SPECTRUM




**NIR**  
Non-ionizing radiation  
Low level energy <12.4 eV, Wavelength > 100nm, Frequency < 3000 THz

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## BACKGROUND

### Source of NIR

**Natural sources: SUN**



**Man made source:**  
Telecommunication, broadcasting, surveillance, defense and security,  
Electricity & Transmission Line,  
Consumer product,  
Medical fields,  
Manufacturing and process industries



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## BACKGROUND

### EMF in Home

- Bulb ( 15 V/m at 30cm)
- Induction Cooker ( 6V/m at 40cm)
- Computer ( 4 V/m at 50cm)
- Microwave oven ( 3 V/m at 40cm)
- Wi-Fi router ( 1.8 V/m at 40cm)
- Cordless phone ( 0.3V/m at 40cm)



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## BACKGROUND

### Antenna and Radio frequency

An antenna is a device used to transform an RF signal, traveling on a conductor, into an electromagnetic wave in free space and vice versa. They can be thought of as a transmitter or/and transducer device.

Antennas are a very important component of communication systems, however, these radiation exposures to human being have radiation hazard risk.

Several Type of Antennas


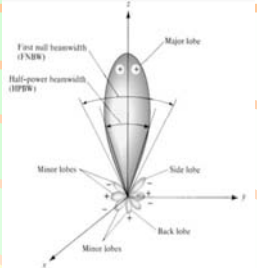


Various location of Antennas

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## BACKGROUND

### Antenna and Radiation Pattern


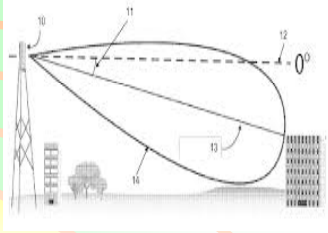
Radiation pattern of Antennas

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7

## BACKGROUND

### Radiation Pattern for Sectorial antennas

They are widely used in cellular telephony infrastructure.


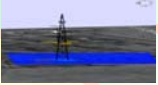
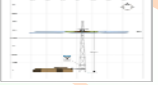
Installation of Antennas
Radiation pattern of Antennas in their location

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## BACKGROUND

### IXUS Software

IXUS software basically is software to manage the base station and modeling as well as simulation for base station radiation. The IXUS 3D Modeller is a desktop application for building base station models quickly and easily. The IXUS EMF compliance calculator can determine public and occupational non-compliance zones and display them in 3D on the model. The zones can be generated by one or many multi-band base station antennas or other antennas such as antenna installed on rooftop of building, monopole tower, monopole tree, communication tower installed on flat ground for various type of antennas such as lamp pole, miniature, yagi and grid antennas. One can use the dimensions measured during site visits to help create an accurate model of buildings, rooftops, access routes, ladders, lattice masts and many other architectural features.

Various 3D graphical Radiation pattern of Antennas from IXUS software

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9

## OBJECTIVES

- To calculate possible maximum exposure for quick base station assessment, using prediction methods.
- To be used for educational purpose.
- To compare the results of this software with commercial IXUS software.

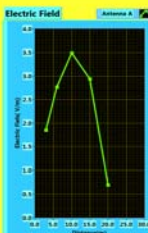
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10

## METHODS

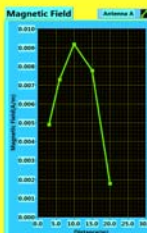
### Antenna EMF Field vs. distance( base station).

ANTENNA EMF FIELD

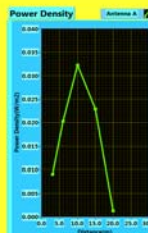
Electric Field



Magnetic Field



Power Density



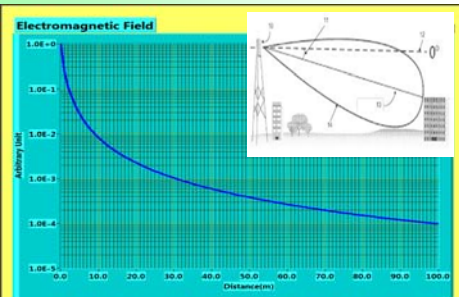
Some data of Antenna EMF Field vs. distance. (A. Mousa, 2011)

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11

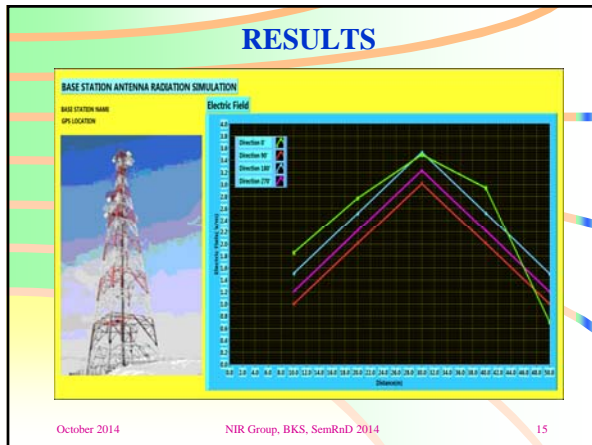
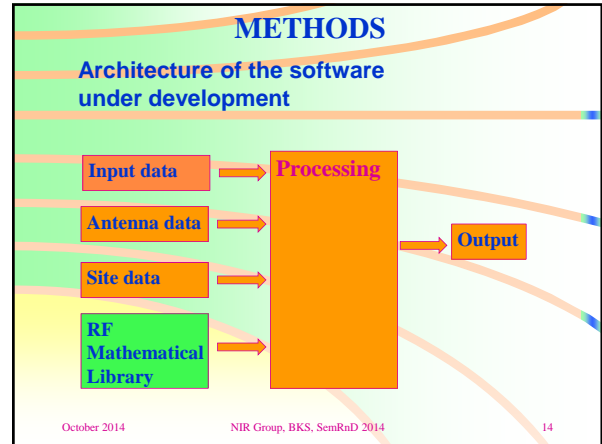
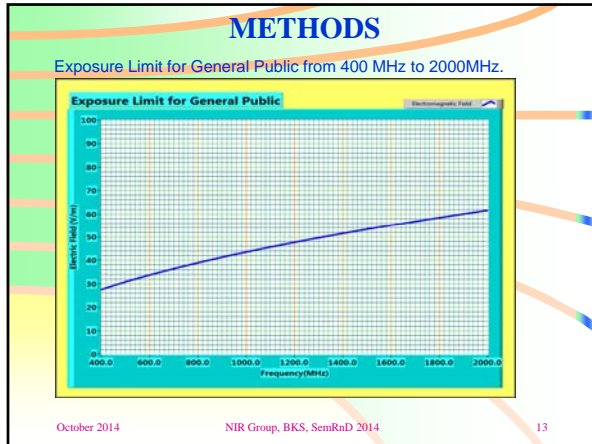
## METHODS

### Maximum Electric Field vs. Distance from source (antenna).

Electromagnetic Field



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12



### SUMMARY

- User Interface**  
No big issue for User Interface using the LabVIEW software.
- Calculation**  
Need improvement in calculation & mathematical modelling & simulation.
- Measurement**  
Need more data from measurement.

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### FUTURE WORK

- Measurement/Assessment/Verification**  
On-site measurement  
Anechoic Chamber requirement
- Research on Application & Safety**  
EMC on nuclear facilities ?
- Future expectation**  
From Safety to Comfort(Non-disturbance)  
How much NIR disturb electronics equipment ?

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### Thank You

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