

Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [MICS Channel Characteristics, Preliminary Results]

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Source: [Kamran Sayrafian] Company [NIST]

Address [100 Bureau Drive, Stop 8920, Gaithersburg, MD 20899]

Voice:[+1 301-975-5479], E-Mail:[ksayrafian@nist.gov]

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Abstract: [This document provides preliminary MICS band channel characteristics. The information is intended for the channel modeling subcommittee of the proposed IEEE 802.15.6 standard]

Purpose: [To present some preliminary data on MICS channel characteristics]

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MICS Channel Characteristics; Preliminary Results

John Hagedorn, Judith Terrill

Math & Computational Science Division

NIST

Wenbin Yang

Advanced Network Tech Division

NIST

Kamran Sayrafian

Information Technology Laboratory

NIST

Kamya Yekeh Yazdandoost, Ryuji Kohno

Medical ICT Institute

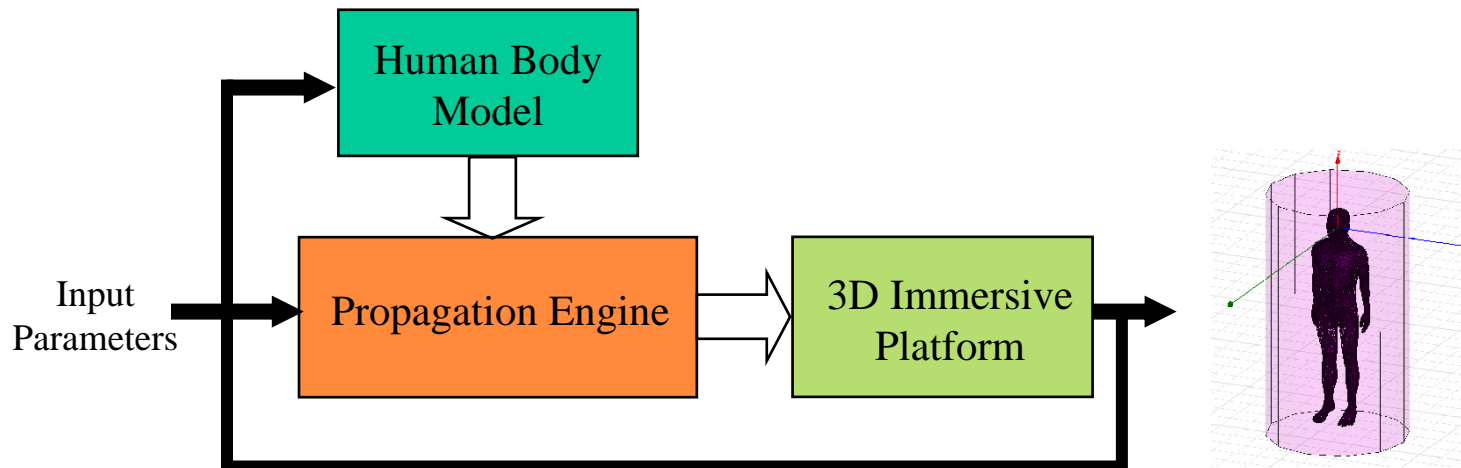
NICT

Medical Implant Communication Service (MICS)

- Allocated frequency 402MHz to 405MHz
 - Total of 3 MHz spectrum
- Unlicensed band allocated for communication between an implanted medical device and an external controller
- Primary reasons for selecting these frequencies are
 - Better propagation characteristics for implants
 - Reasonable sized antenna for implants
 - Worldwide availability
 - Limited threat of interference to primary users

A 3D Immersive Platform to Study MICS Channel

As in-body measurement and experimental study is difficult (if not impossible), a 3D simulation & visualization scheme is proposed to study the propagation characteristics of MICS



System Components

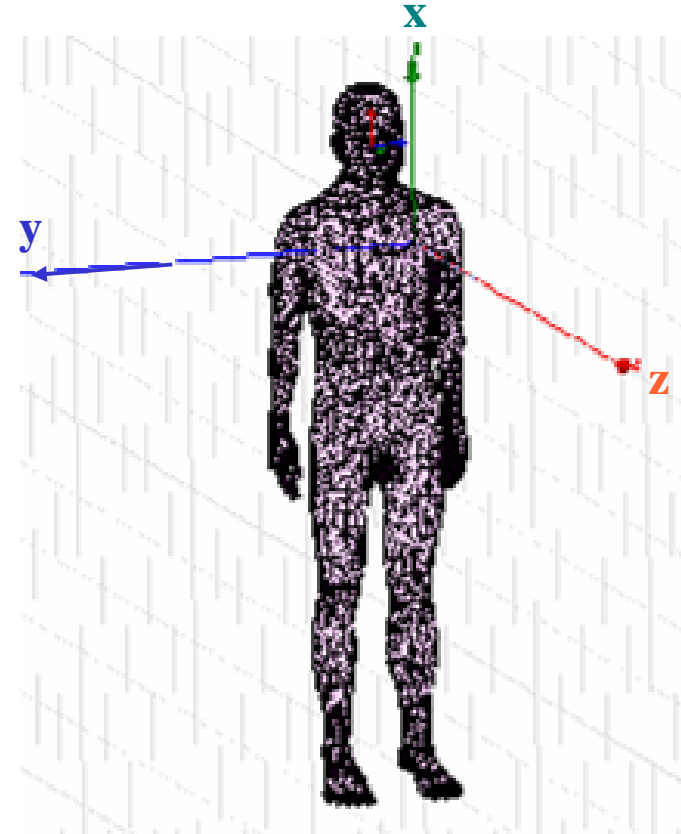
Human Body Model

- Dielectric properties of 300+ parts in a male human body
- Frequency-dependent biological material
- Properties are user-definable if changes are desired
- Accuracy of 2mm

Propagation Engine

- 3D full-wave electromagnetic field simulation (HFSS)
- Capable of calculating a variety of outputs

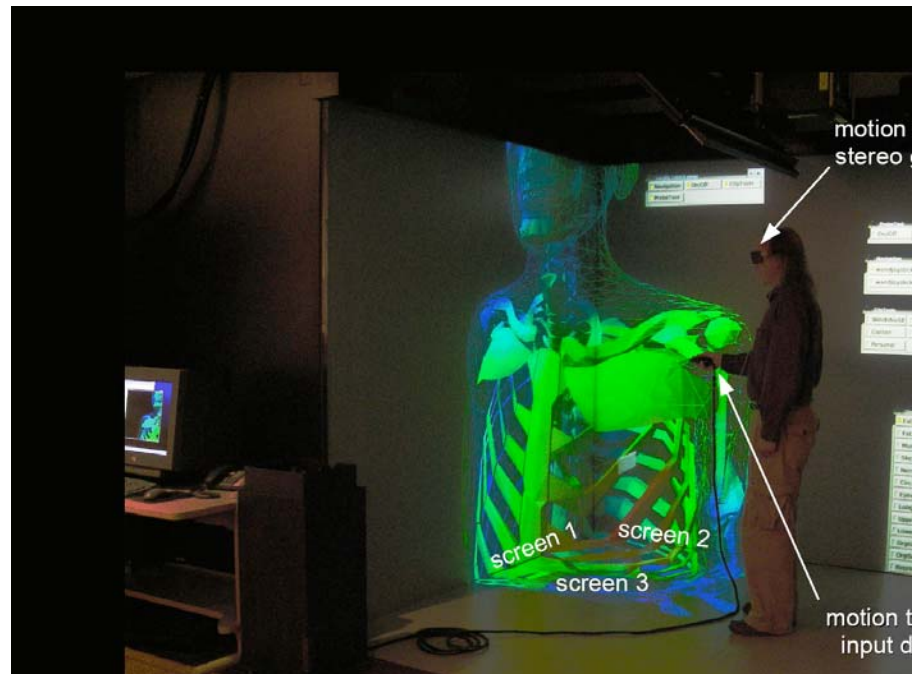
3D Immersive & Visualization Platform



The NIST 3D Immersive Platform

The 3D immersive & visualization platform is a system to present the user a 3D virtual world within which the user can move and interact with the virtual objects

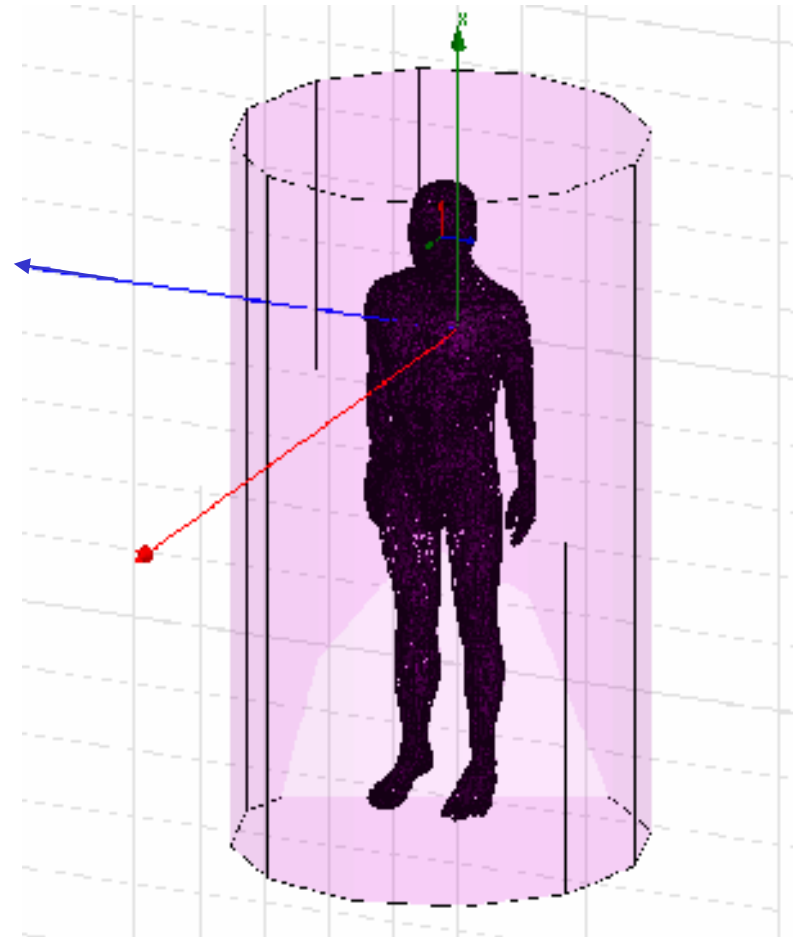
- ❑ Provides views and interaction for a qualitative experience of data
- ❑ Main components of the system are:
 - ❖ Three screens that provide the visual display; a single 3D stereo scene
 - ❖ The motion tracked stereoscope glasses; to update the scene based on the motion of the user
 - ❖ Handheld motion tracked input device to allow interaction with the virtual object(s)



A User in the NIST Immersive Visualization Environment

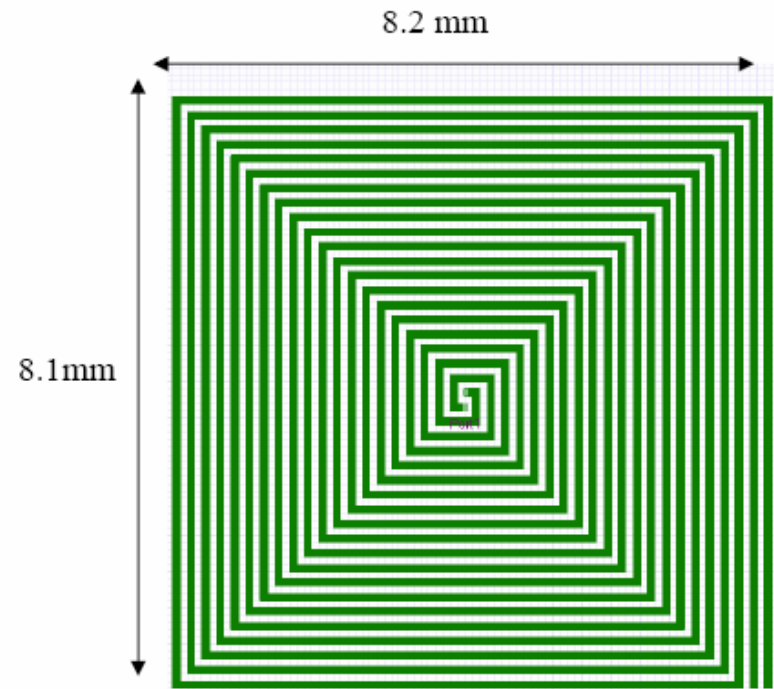
Input Parameters

- Antenna characteristics
- Antenna Location
 - Pacemaker application
- Antenna Orientation
 - Facing toward front side of the body
- Operating Frequency
 - 403.5 MHz
- Transmit Power
- Resolution
 - 2 mm
- Range
 - 50 cm
- Output Parameter
 - Electric field magnitude
 - Magnetic field magnitude
 - SAR

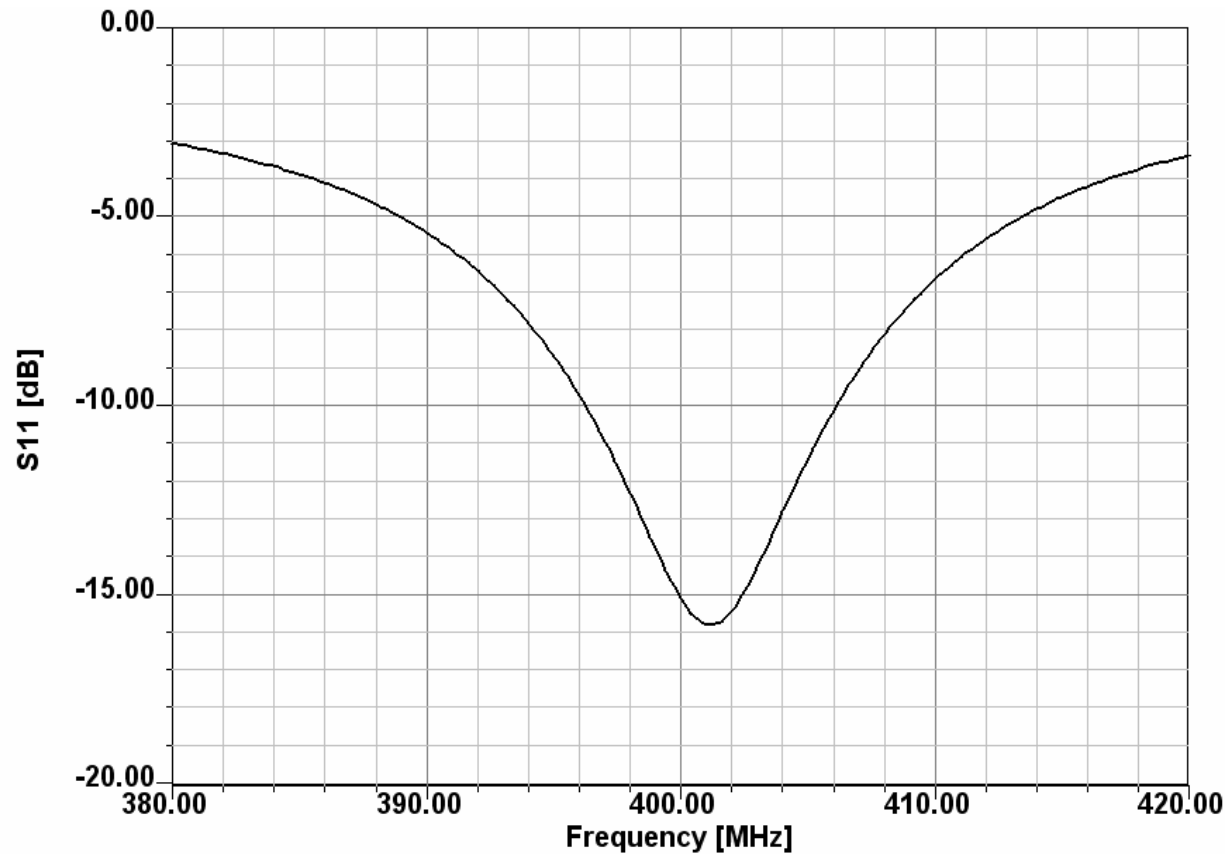


Antenna

- ❑ Size: 8.2 x 8.1 x 1 mm
- ❑ Metallic Layer: Copper, $t=0.036$ mm
- ❑ Substrate: D51 (NTK),
 $\epsilon_r = 30$, $\tan \theta = 0.000038$,
and $t=1$ mm
- ❑ The metallic layer is covered by RH-5, $\epsilon_r = 1.0006$
 $\tan \theta = 0$, $t = 1$ mm

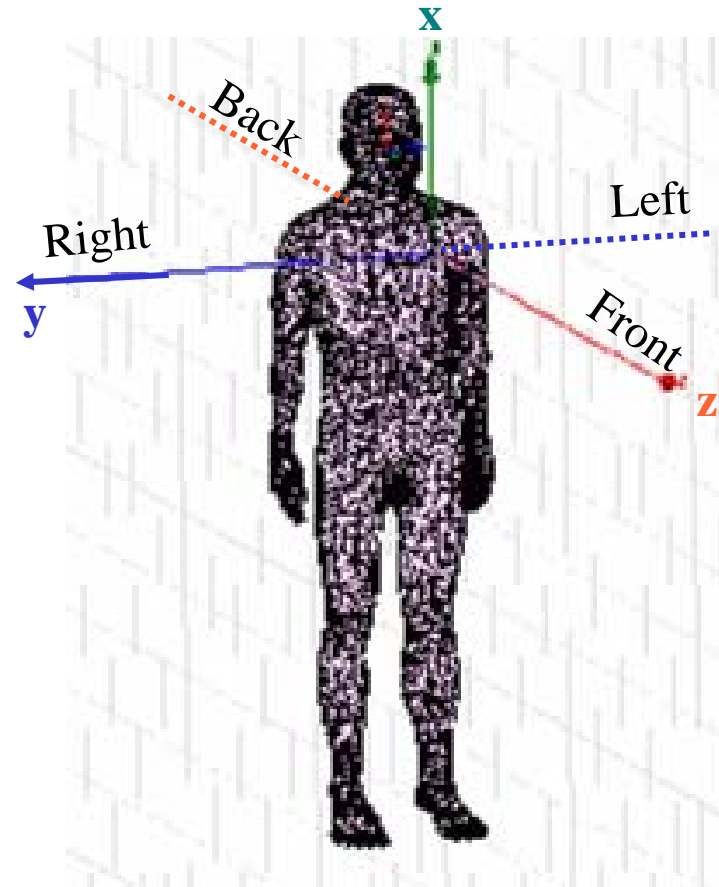


Return Loss of the Antenna

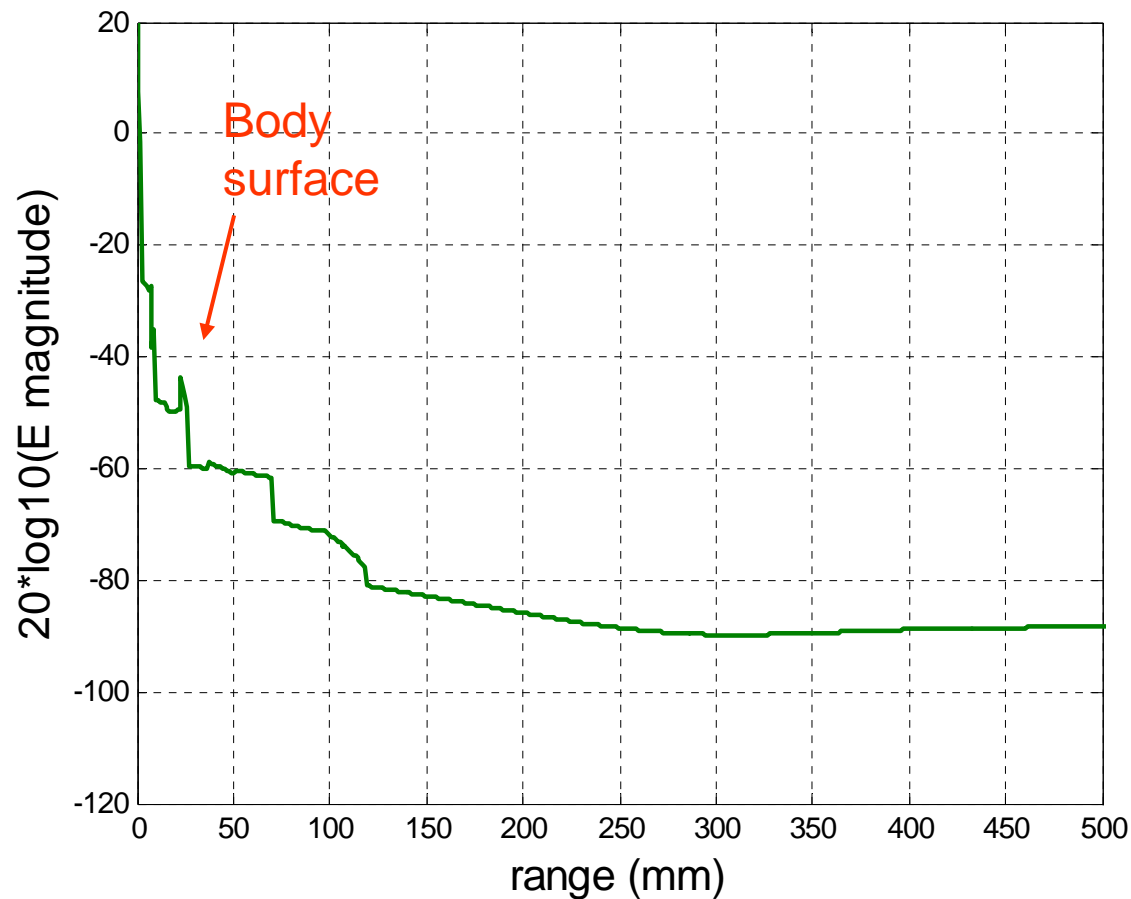


Electric Field Magnitude Along Four Directions

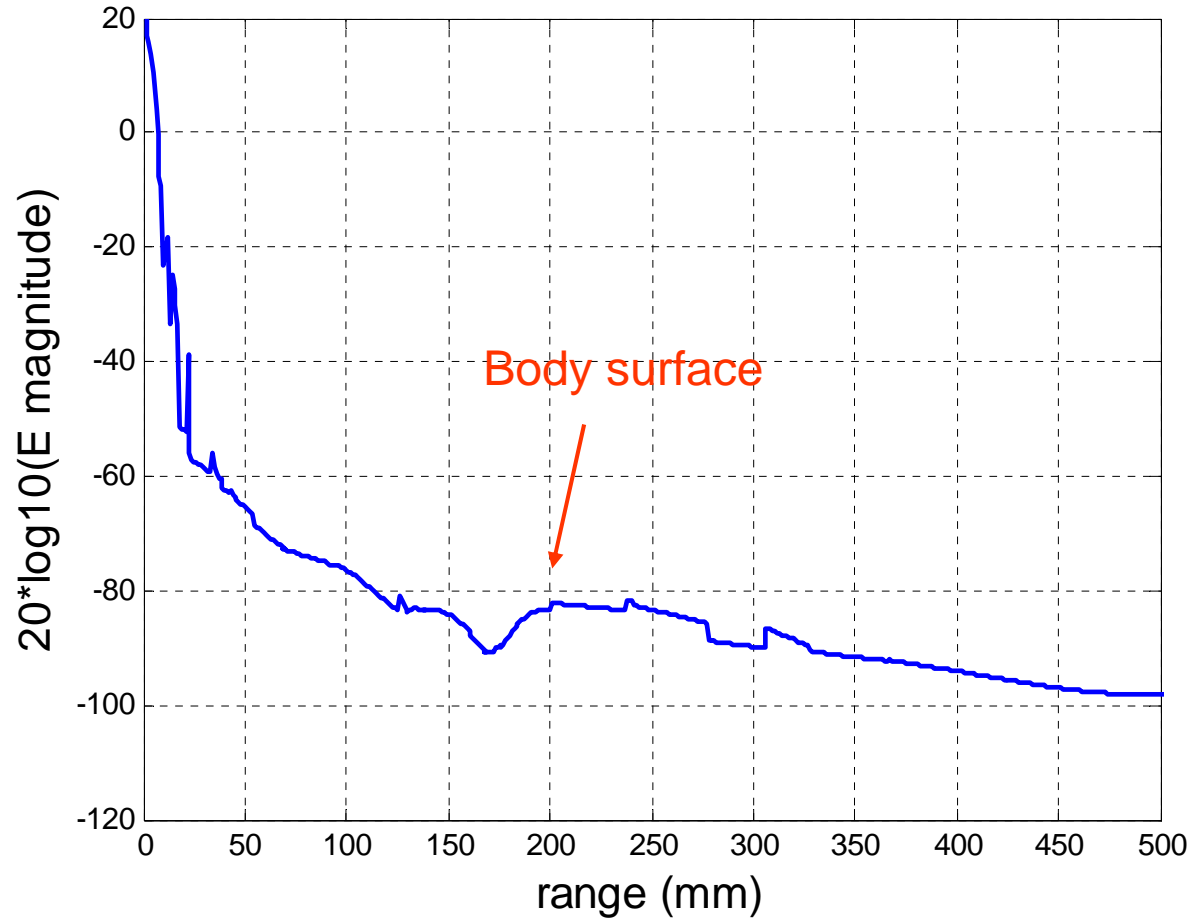
- ❑ Antenna is located at the left Pectoral muscle
- ❑ Frequency is 403.5 MHz
- ❑ We have measured the Magnitude of the E-Field & H-Field along four directions as shown here



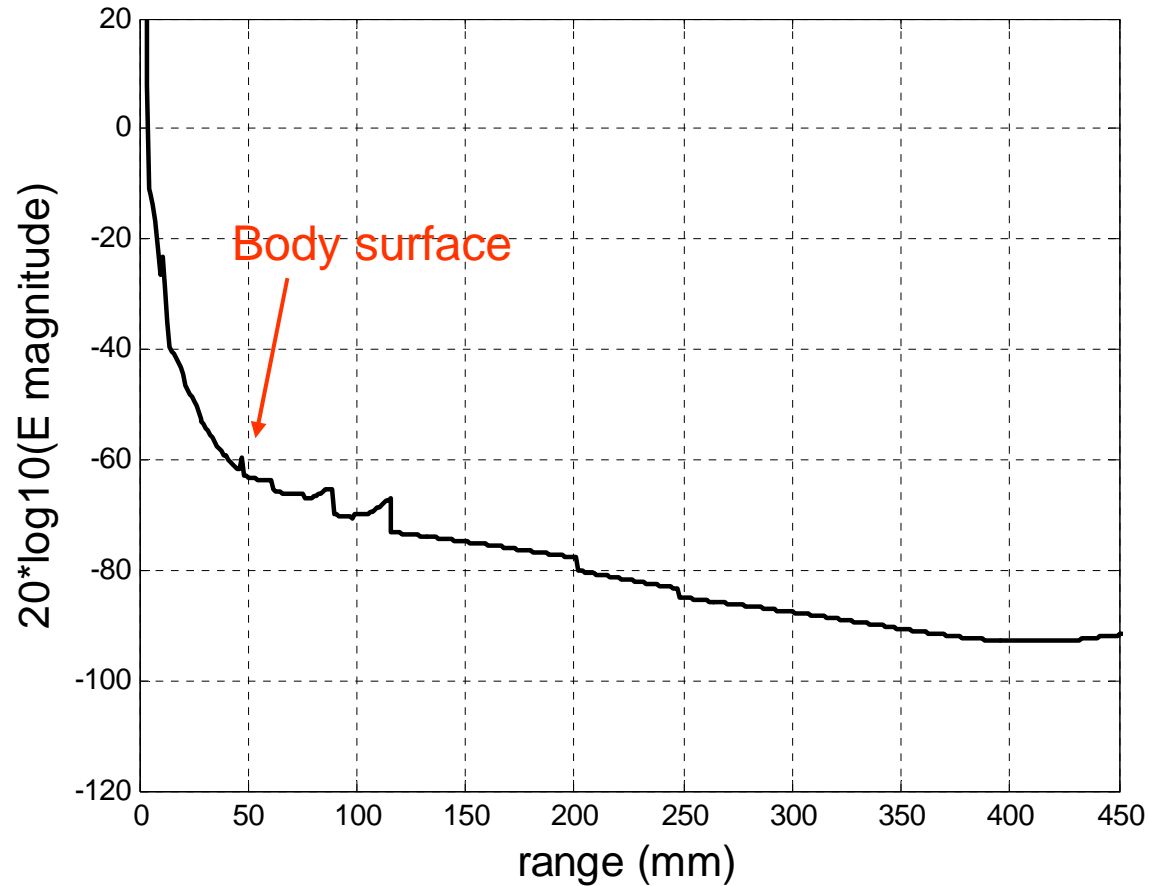
Electric Field Magnitude Along the Front-side



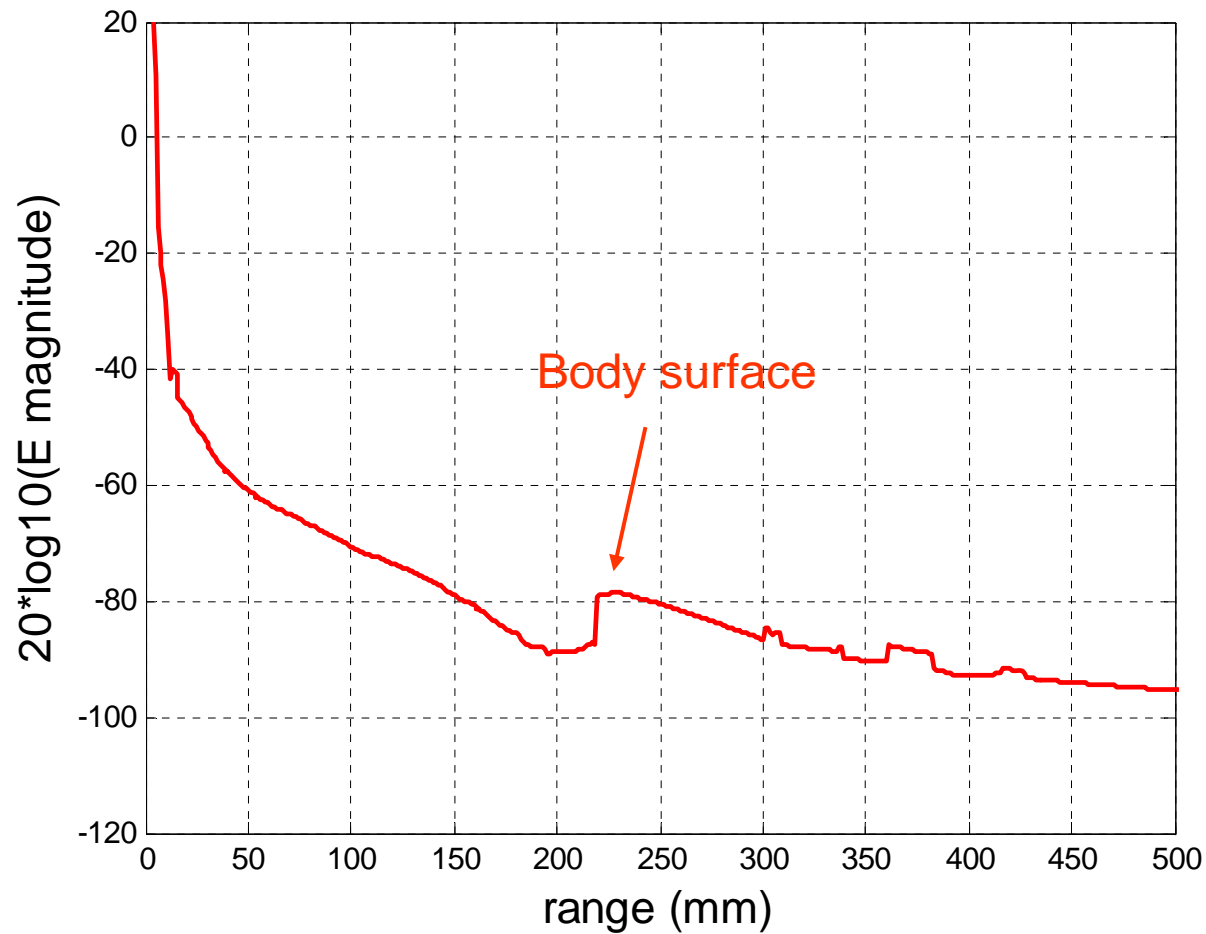
Electric Field Magnitude Along the Backside



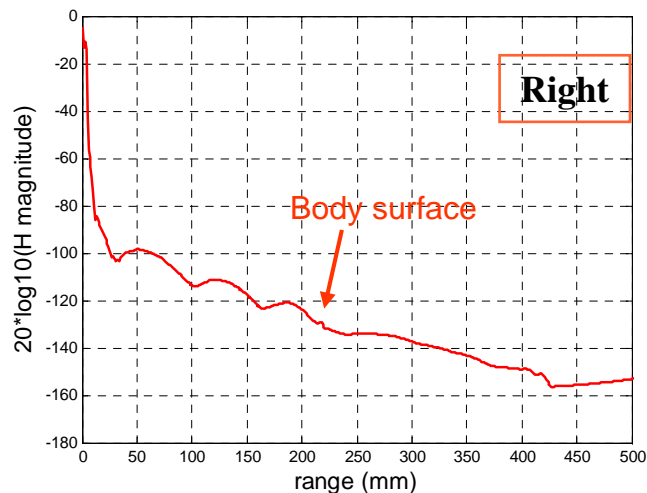
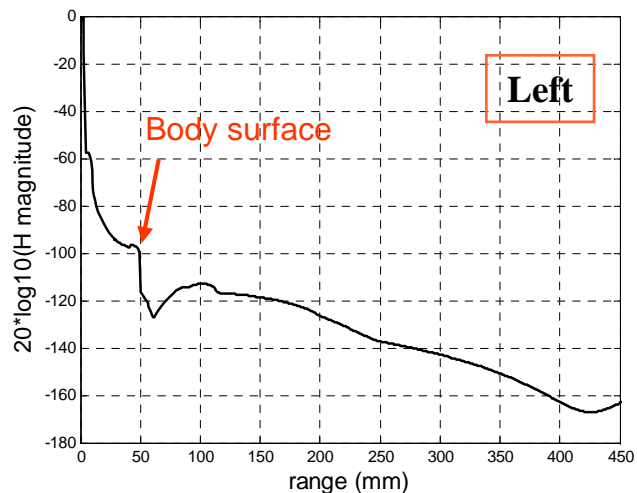
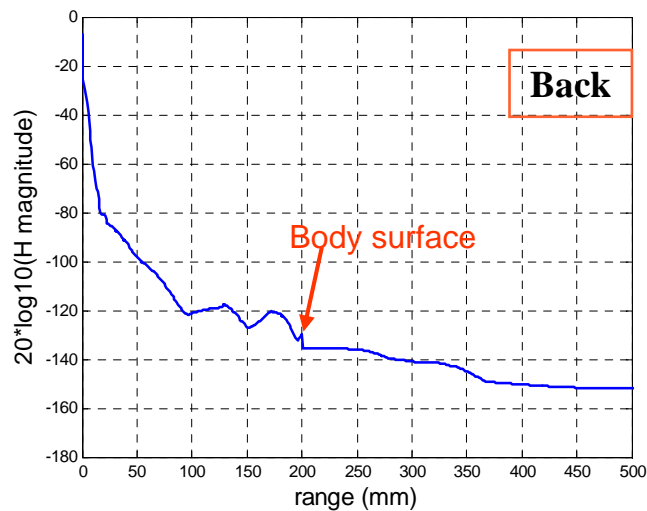
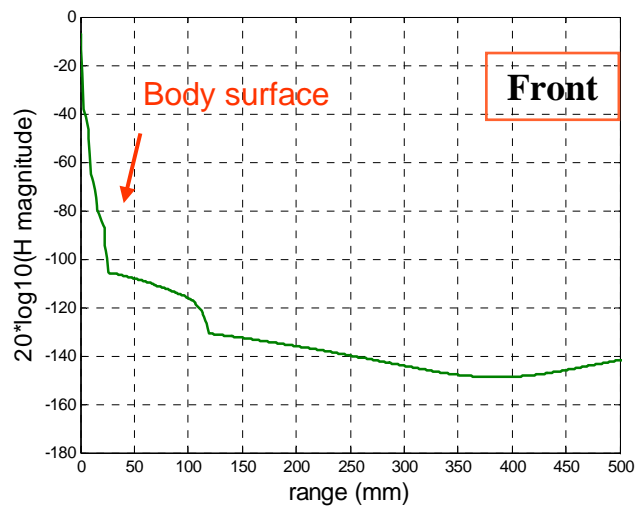
Electric Field Magnitude Along the Left-side



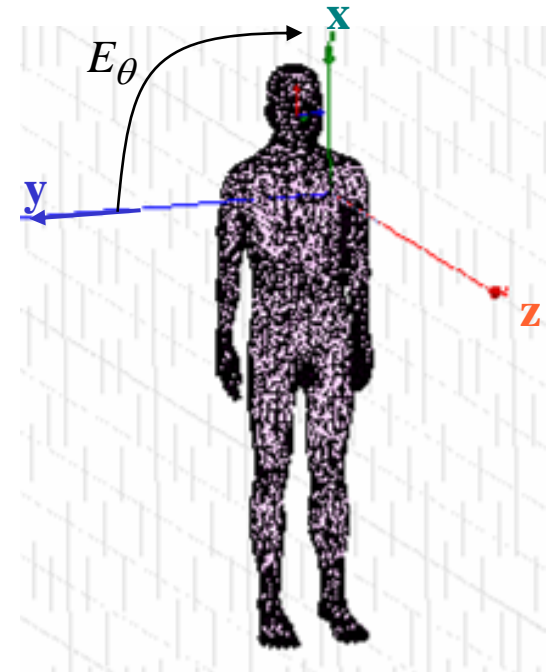
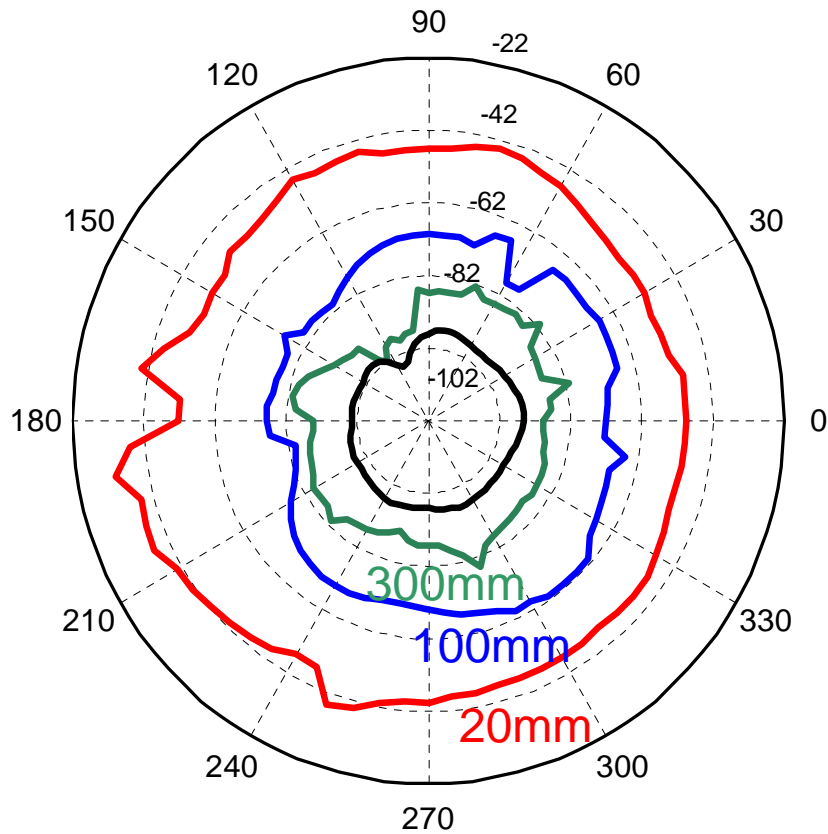
Electric Field Magnitude Along the Right-side



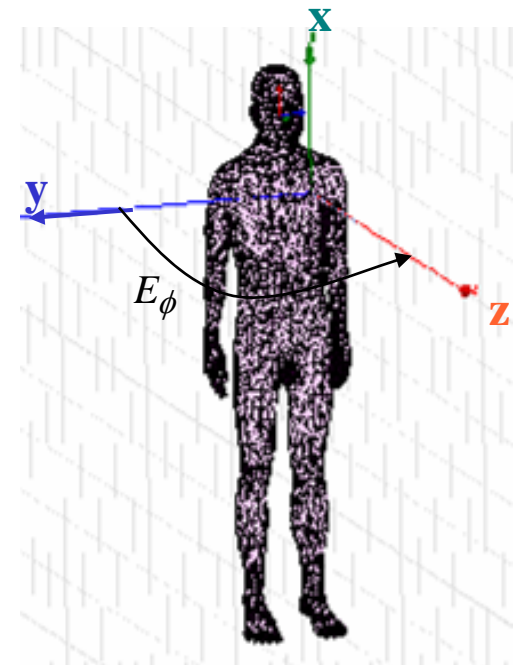
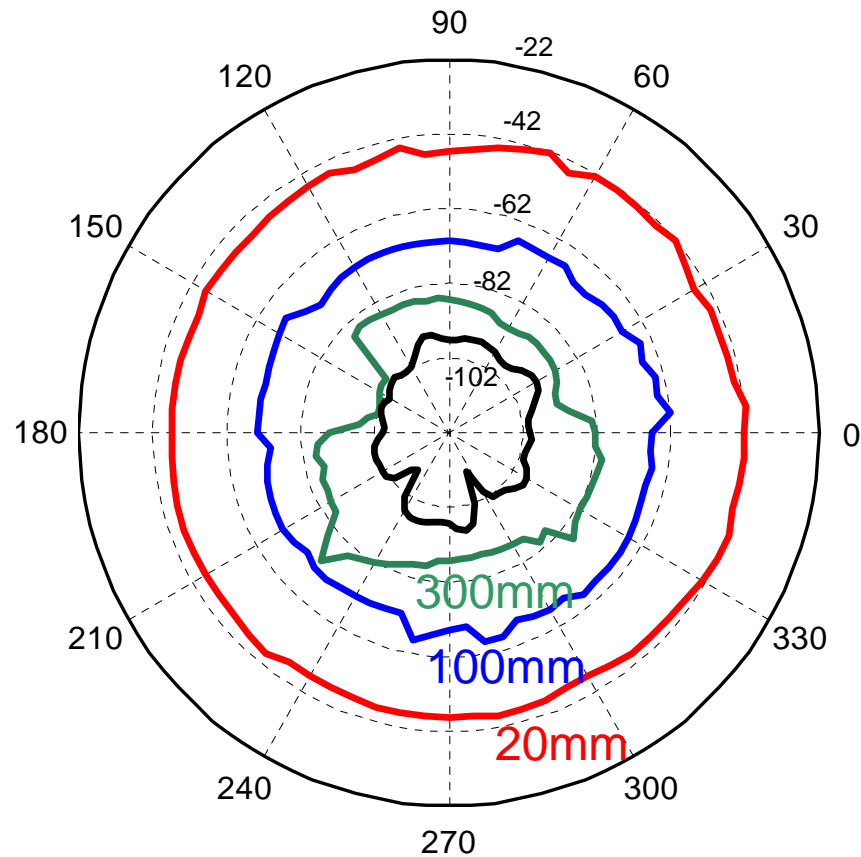
Magnetic Field Magnitude in the 4 Directions



Horizontal Radiation Pattern



Vertical Radiation Pattern



Issues to be considered

- What frequency should be considered for implant to implant channel model?
- Are there currently any application for implant to implant communication so that we can simulate the right scenarios?
- Will there be any measurement for S6 (S7) with MICS frequency band?

Acknowledgement

The authors would like to express their gratitude to Nicholas Hirth and Ken Ferreira from Ansoft Corporation for their assistance and support in applying the body model to the 3D immersive system.