EXPOSURE SYSTEM FOR SIMULATING GSM AND WCDMA MOBILE PHONE USAGE

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Overview

• Objective
• Exposure setup block diagram
• Exposure signals
• Antenna solution
• Dosimetry
• SAR results
• Conclusion
Objective of the Study

• DMF study „Investigation of volunteers exposed to electromagnetic fields of mobile phones“

• Analysis of possible effects on brain activity in sleep and waking

• Wake outcome variables
  • Spontaneous EEG
  • Evoked and event related potentials
  • Cognitive functions

• Sleep outcome variables
  • Classical sleep parameters
  • Quantitative parameters derived from the raw data

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Block Diagram of the Exposure Setup

- Computer controlled double blind protocol
- GSM, WCDMA and sham exposure (isolation >80 dB)
- Permanent monitoring of power levels
- Alarm generation and auto-switch-off in case of malfunctions
Exposure Signal Characteristics

GSM:
- 900 MHz
- Pulse modulated carrier

\[ T_{on} = 553 \, \mu s \]
\[ T_{off} = 4,062 \, ms \]

WCDMA:
- Signal generation according to [Mbonjo, 2004]
- 1966 MHz QPSK signal with fast power control
State of the Art Antenna Solutions

Exposure setups simulating mobile phone usage

- Commercially available mobile phone [Lee, 2003]
- Patch antennas in a wooden mount [Huber, 2000]
- Quasi-far-Field [Borbély, 1999]
- Body worn antenna [Schmid, 2004]
Antenna Specs and Intended Use Position

Specifications:

- Localized exposure
- GSM and WCDMA coverage
- Exposure times of 8 hours during day and night

Dual band antenna surrounding the pinna
Antenna Details

- PCB with a PIFA type radiator
- PCB covered by foam and a washable textile cover
- Weight: 14 g
- Total thickness: 4 mm
- Free space reflection coefficient:

![Graph showing s11 in dB vs frequency in MHz]
Measurement Method

- DASY4 system
- Tissue simulating liquids according to FCC requirements
- SAM head inappropriate because of collapsed pinna
- Measurements in the flat section of SAM phantom
Simulation Method

- Empire™ software
- Based on FDTD
- Heterogeneous Visible human head model (AFRL)
- Antenna is directly placed at the head model
- FDTD grid terminated with 6 layer PML
900 MHz Flat Phantom SAR Results

- No experimental artifacts due to antenna feeding cable
- Widespread SAR distribution
1966 MHz Flat Phantom SAR Results

- SAR maximum near the radiating element
Flat Phantom Localized SAR Values

- 1 W antenna input power
- 22 % max. difference measurement/simulation
Visible Human Localized SAR Values

- 1 W antenna input power
- 28 % max. positioning dependency
Conclusion

- Development and Characterization of a GSM and WCDMA exposure system simulating mobile phone usage
- Computer controlled double blind protocol
- Permanent monitoring and auto-switch-off in case of malfunctions
- Low weight and thin planar dual band antenna
  - Localized exposure
  - Enabling 8 hours exposure time during day and night
- Reasonable SAR sensitivities due to changes in antenna positioning