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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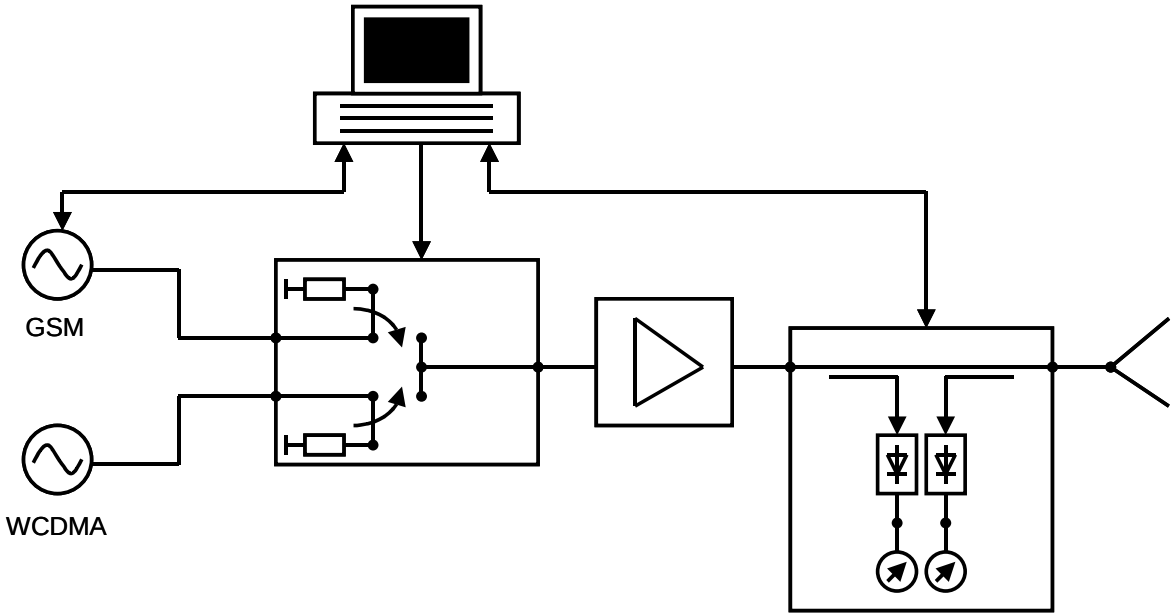
Block Diagram of the Exposure Setup

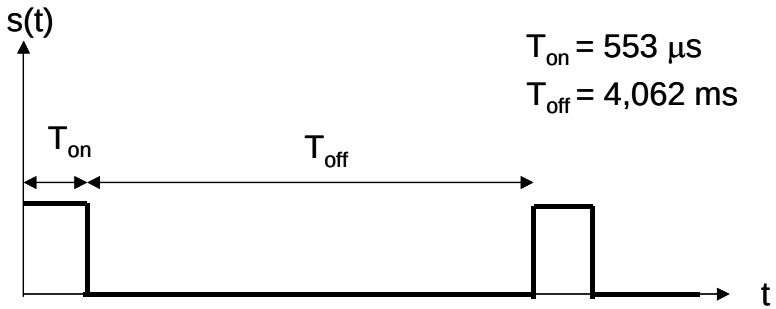


- **Computer controlled double blind protocol**
- **GSM, WCDMA and sham exposure (isolation >80 dB)**
- **Permanent monitoring of power levels**
- **Alarm generation and auto-switch-off in case of malfunctions**

Exposure Signal Characteristics

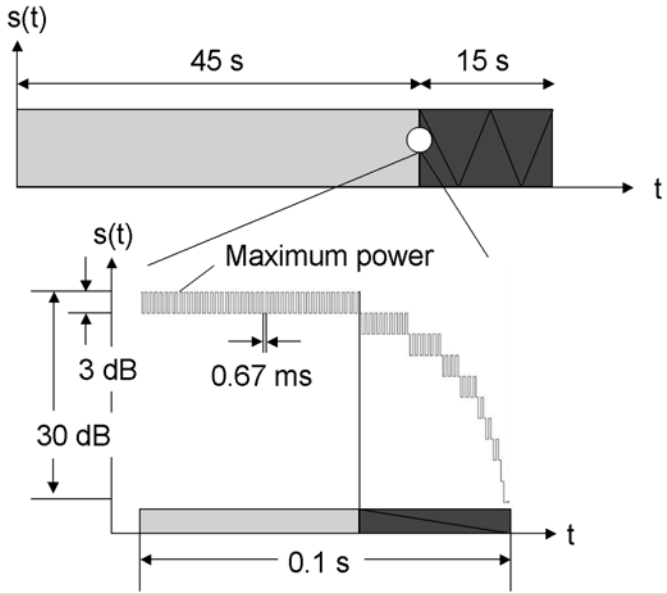
GSM:

- **900 MHz**
- **Pulse modulated carrier**



WCDMA:

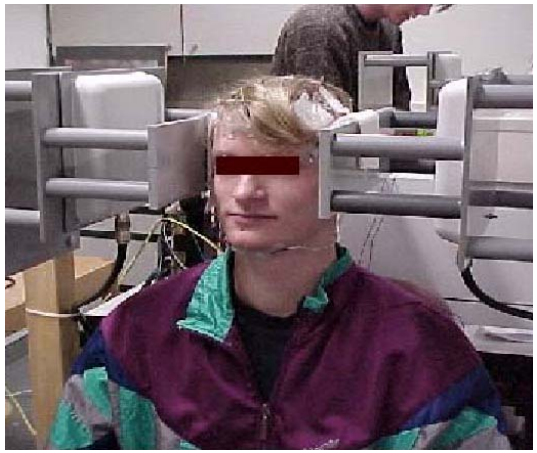
- **Signal generation according to [Mbonjo, 2004]**
- **1966 MHz QPSK signal with fast power control**

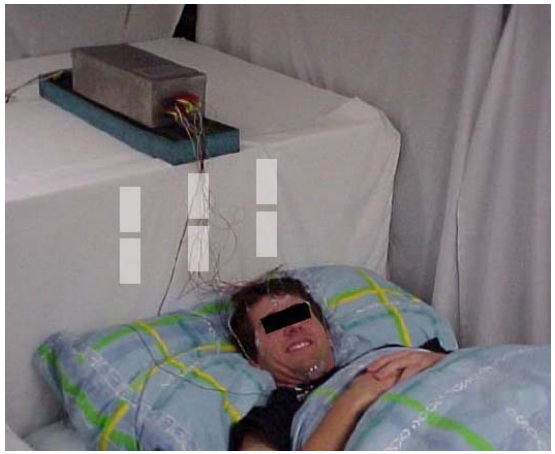


State of the Art Antenna Solutions

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

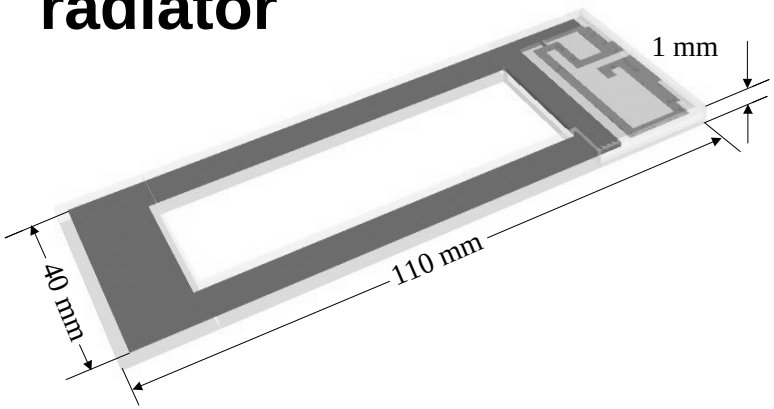
Specifications:

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

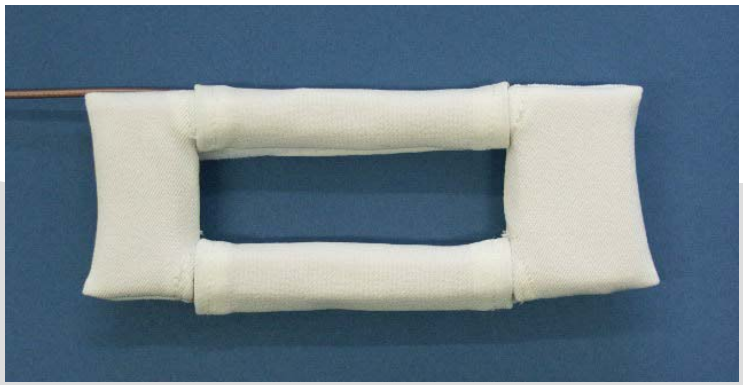
Dual band antenna surrounding the pinna

Antenna Details

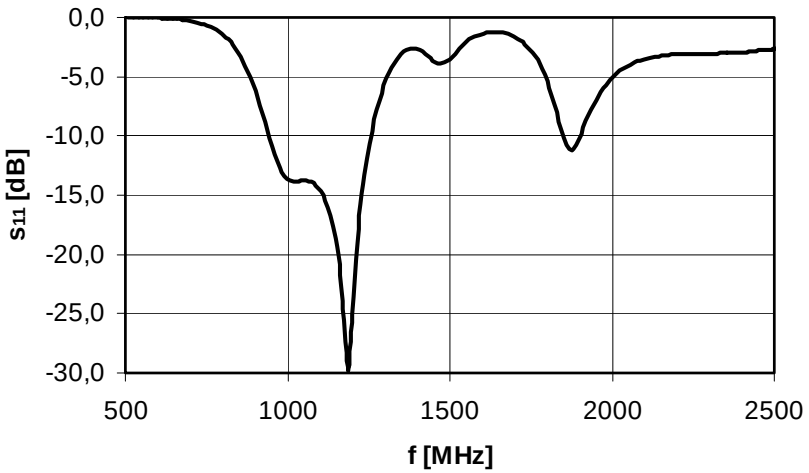
- **PCB with a PIFA type radiator**



- **PCB covered by foam and a washable textile cover**



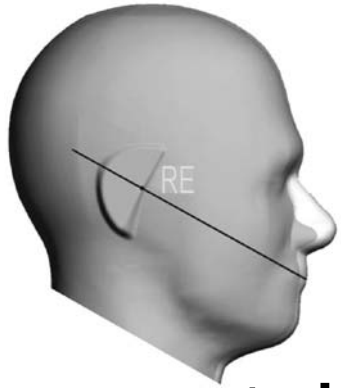
- **Weight: 14 g**
- **Total thickness: 4 mm**
- **Free space reflection coefficient:**



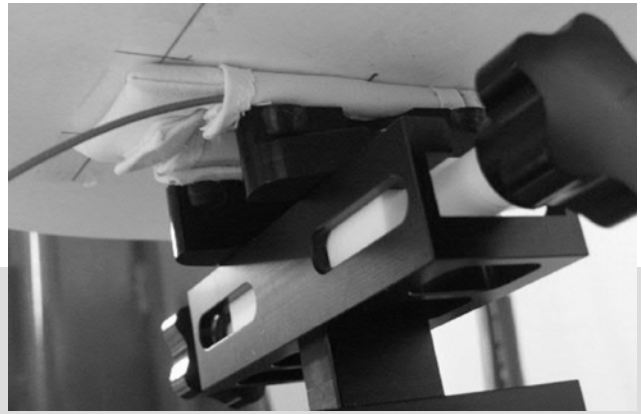
Measurement Method

- **DASY4 system**
- **Tissue simulating liquids according to FCC requirements**

- **SAM head inappropriate because of collapsed pinna**

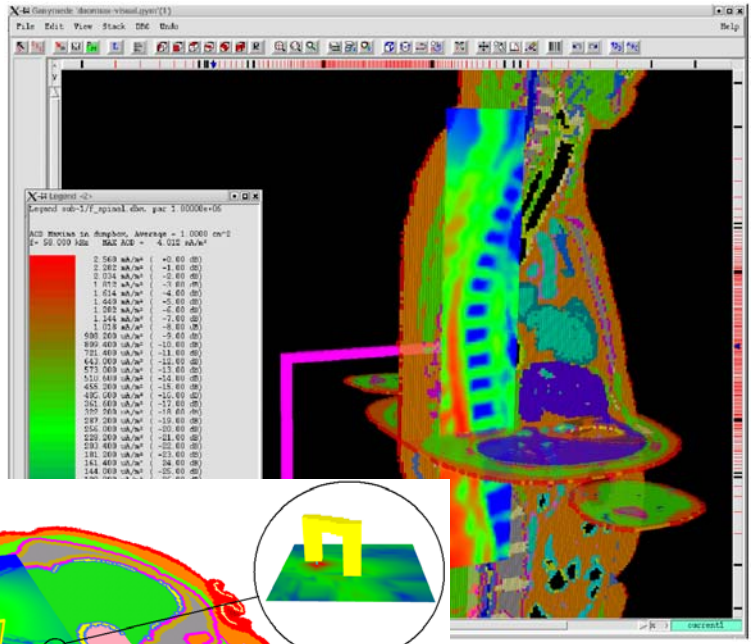


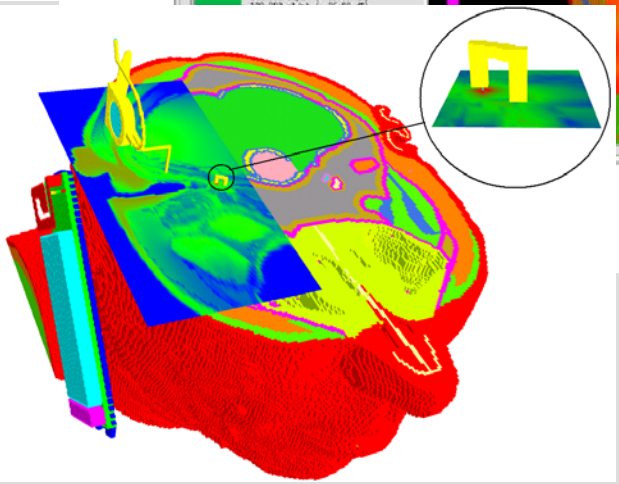
- **Measurements in the flat section of SAM phantom**



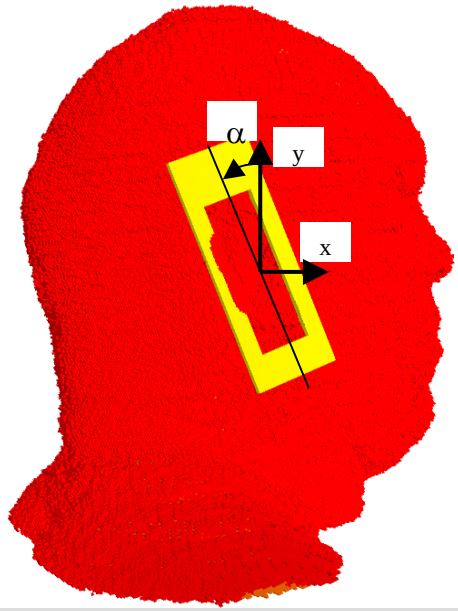
Simulation Method

- **Empire™ software**
- **Based on FDTD**



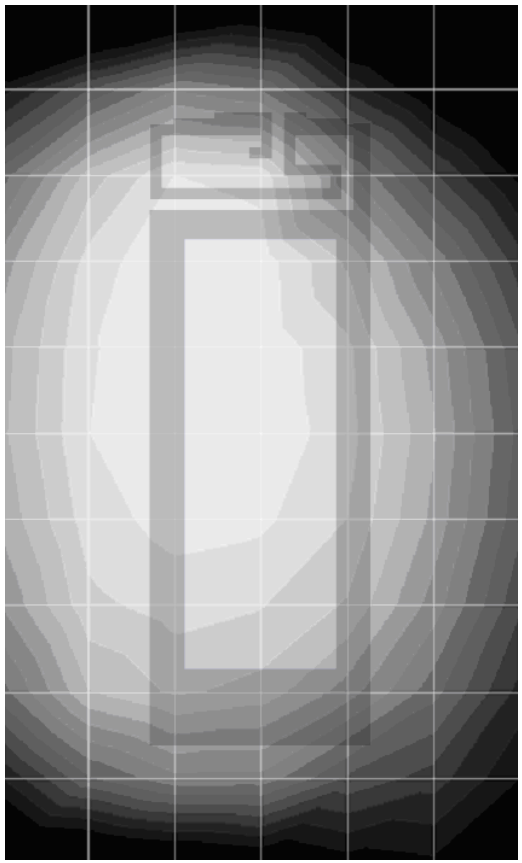


- **Heterogeneous Visible human head model (AFRL)**
- **Antenna is directly placed at the head model**
- **FDTD grid terminated with 6 layer PML**

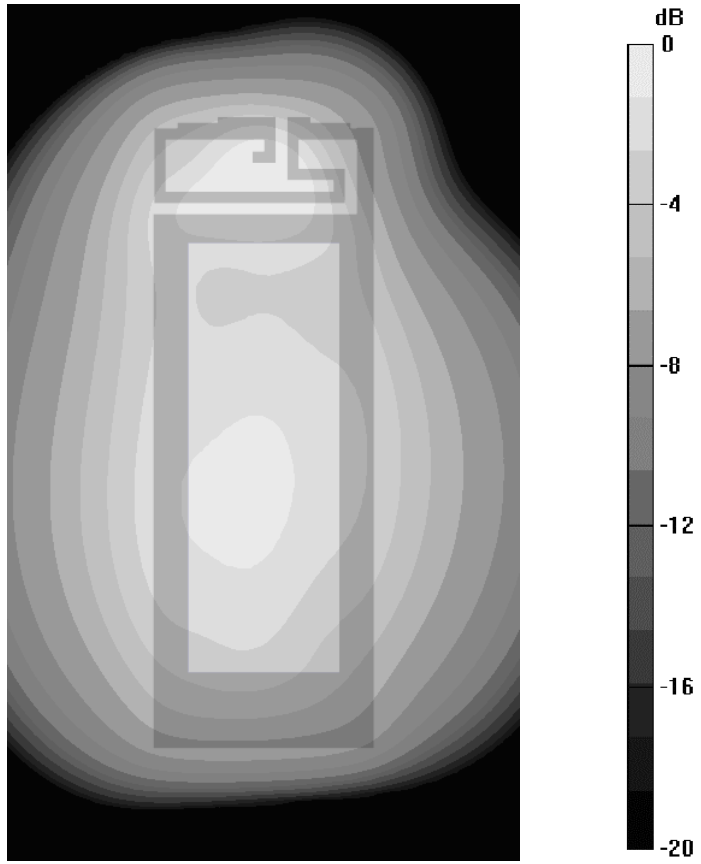


900 MHz Flat Phantom SAR Results

Measurement



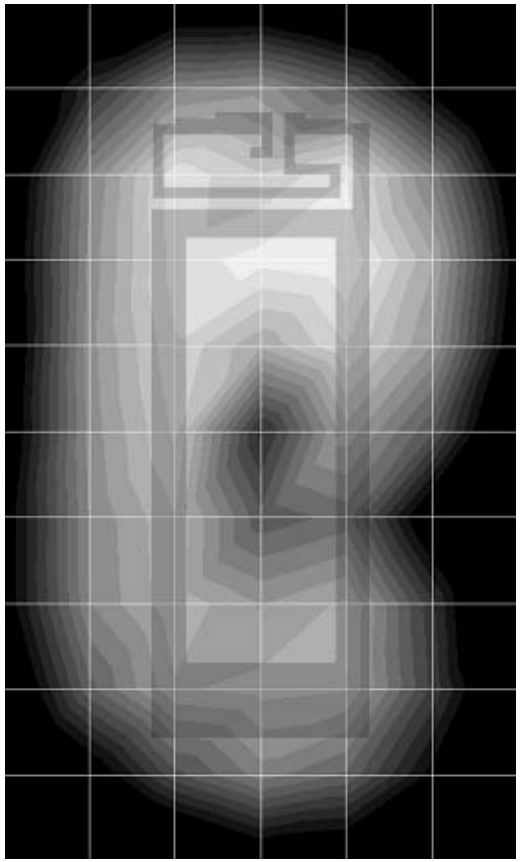
Simulation



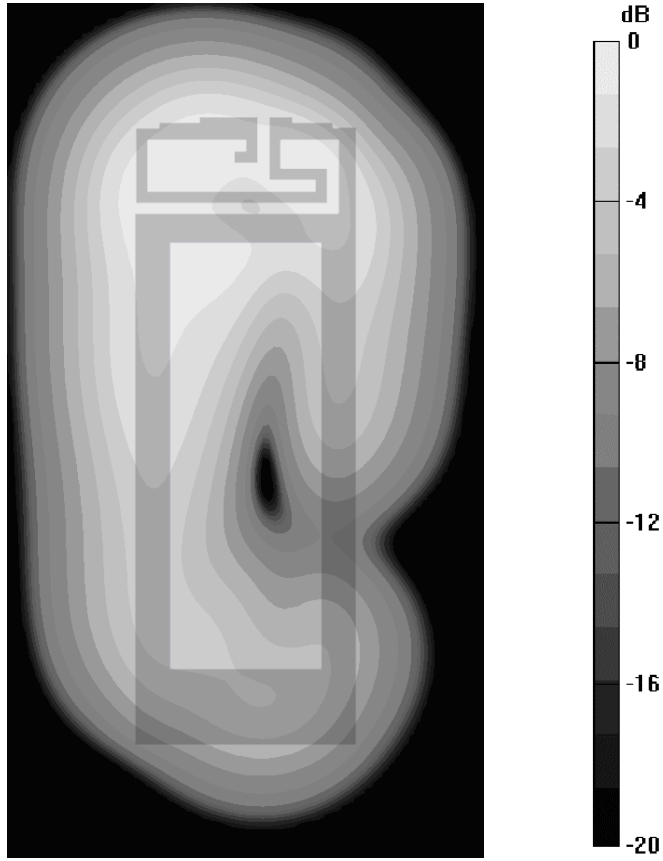
- **No experimental artifacts due to antenna feeding cable**
- **Widespread SAR distribution**

1966 MHz Flat Phantom SAR Results

Measurement

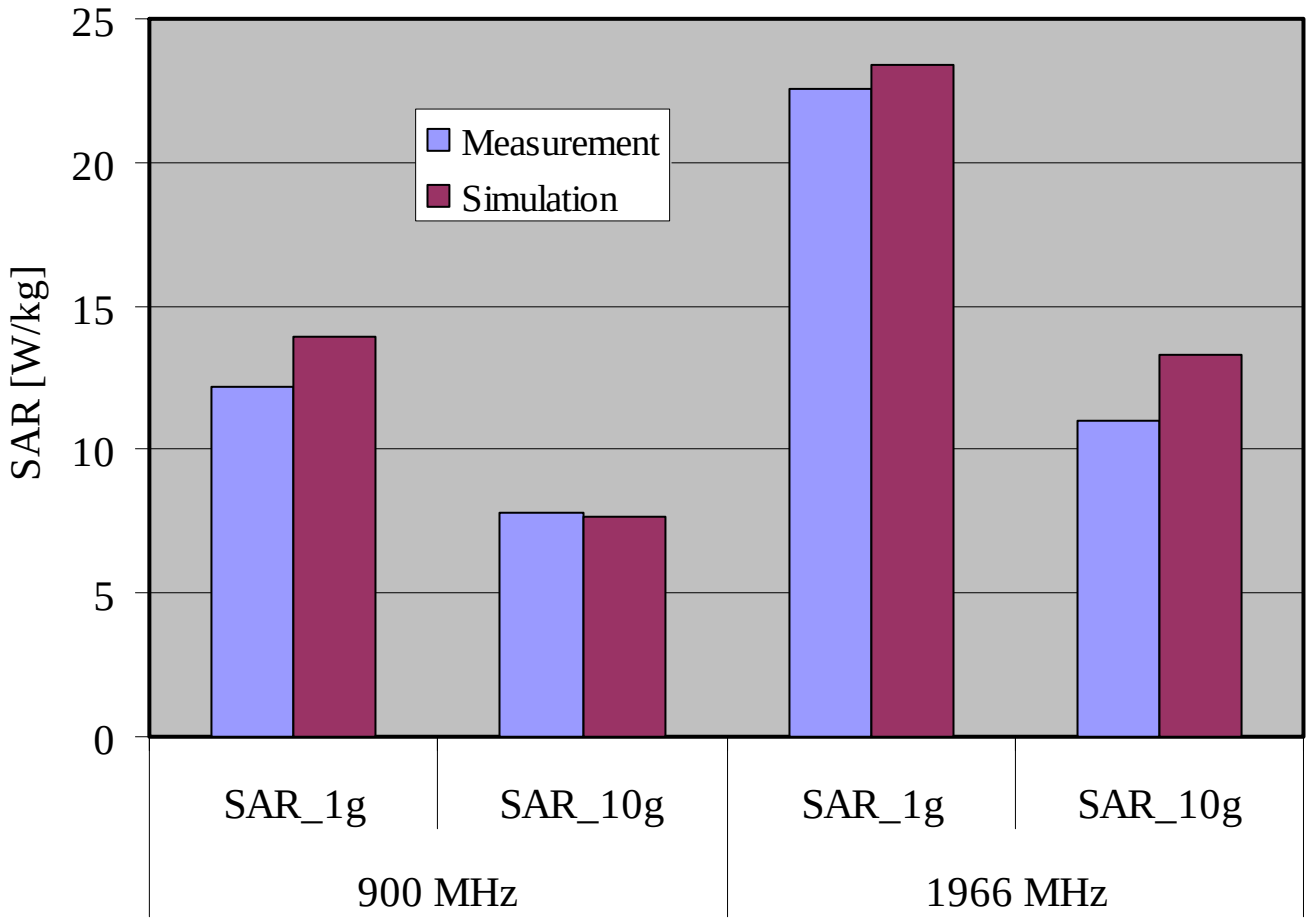


Simulation



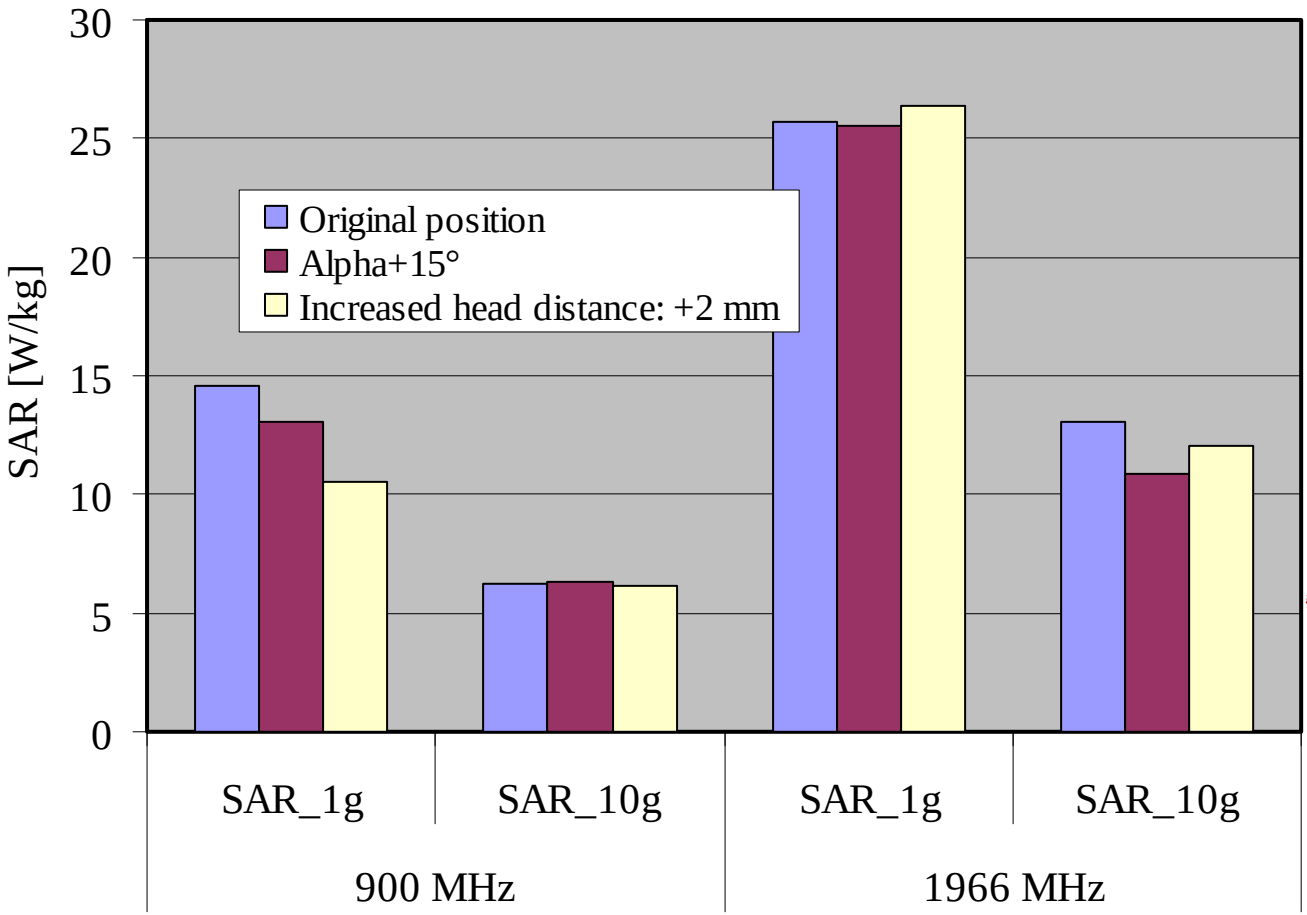
- **SAR maximum near the radiating element**

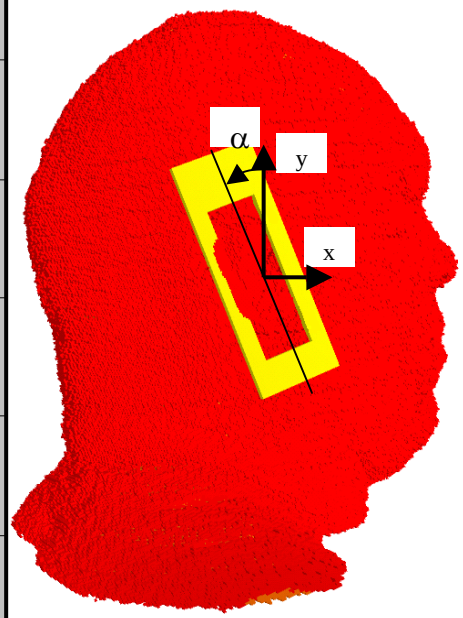
Flat Phantom Localized SAR Values



- **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**