ATTACHMENT 16

ICES TC34 / SC2 / WG3

IEEE P1528.3/D3.0

Draft Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz: **Specific Requirements for Finite Difference Time Domain (FDTD) Modeling of Mobile Phones/Personal Wireless Devices**

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Chairman WG3

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Scope and motivation

- Numerical SAR limit compliance testing of personal wireless devices, in particular mobile phones
- Test setup and human models according to measurement standards
- Using CAD based models

- Main advantage: give a possibility to evaluate compliance early and when there are changes in the design

WG3 participants

- Mobile phone manufacturers
- Electromagnetic simulation software manufacturers
- University groups
- Independent research organizations

Time line

- Started in 2006
- Expected Date of Submission for Initial Sponsor Ballot: June 2009
- Projected Completion Date for Submittal to RevCom: June 2010

Outline of IEEE 1528.3 draft

1. Overview
2. Definitions
3. Simulation procedure
   1. FDTD model space preparation
   2. Grid generation
   3. Simulation parameters
   4. FDTD simulation
   5. Result evaluation
   6. Procedure summary – flow chart
4. Benchmark validation models
5. Computational uncertainty
6. References

Current focus – uncertainty...

An International Inter-laboratory Comparison of Mobile Phone SAR Calculation with CAD-based Models

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INTRODUCTION

An international inter-laboratory study to compare numerically evaluated Specific Absorption Rate (SAR) using computer simulations based on Specific Anthropomorphic Mannequin (SAM) and mobile phones CAD models has been conducted in order to investigate the repeatability and reliability of such evaluation and to provide input in the development of standardized procedures. This work has been conducted within the standardization organization of the International Commission on Electromagnetic Safety (ICES) IEEE TC34 Sub-committee 2, Working Group 3 which is developing the IEEE 1528.3 standard for numerical SAR compliance testing of wireless terminals.

MATERIALS AND METHODS

For this inter-laboratory comparison, CAD files representing three different commercially available mobile phone models were provided each by Motorola, Nokia and Sony Ericsson (See Figure 1). Calculations of radiated electromagnetic fields from these phone models were conducted in free-space and when the models were positioned at the right ear of the standard SAM head phantom [1] in the cheek and +15° tilt phone positions. SAR, absorbed power in the head phantom and source impedance were calculated at one specific frequency in both the 900 MHz and 1800 MHz bands. Nine laboratories conducted the calculations, in a blind-study manner, with four different commercially available software packages; CST MICROWAVE STUDIO® and CST MICROSTRIPES™ by CST AG, SEMCAD X® by Schmid & Partner Engineering AG, and XFdtd® by Remcom Inc. The dielectric parameters of the materials of the SAM head phantom model were the international standard parameters. The parameters for the materials in the phone models were provided by the manufacturers.

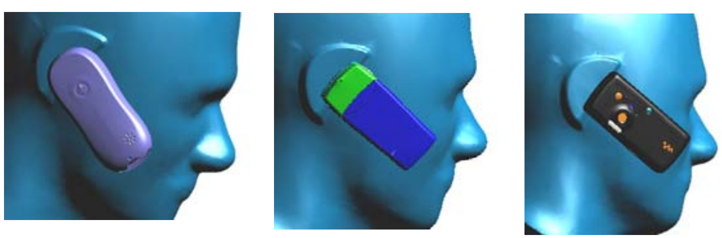

Figure 1: The Motorola c330 phone model (left), the Nokia 8310 phone model (center) and the Sony Ericsson W810 phone model (right) positioned next to the SAM head phantom

RESULTS

In Figures 2 and 3 the calculated 10g averaged SAR results for all three phone models are presented as percentage of the mean result. All SAR results are normalized to the source output power. The maximum relative standard deviation for all numerical SAR results for the three simulated phone models was 30%. The largest deviation from the mean SAR results was about 65%. A Cumulative Distribution Function (CDF) was computed for all the deviations from the mean SAR results and is shown in Figure 3 (right). The 95-percentile is about 40% for both the 1g and 10g averaged SAR results. The variation for the Motorola and Sony Ericsson models are higher than for the Nokia model possibly indicating a higher sensitivity to differences in the simulation parameters such as meshing, simulation time, etc. Other sources of deviations include positioning errors of the phone at the phantom, source model simplifications, location of simulation boundaries and numerical method approximations. Human errors can of course also be present considering the high complexity of the CAD models.

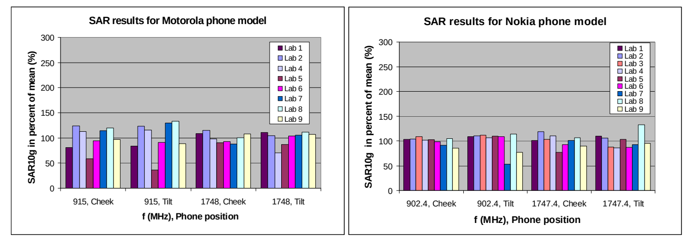

Figure 2: The peak 10g averaged SAR results for the Motorola phone model (left). The peak 10g averaged SAR results for the Nokia phone model (right).

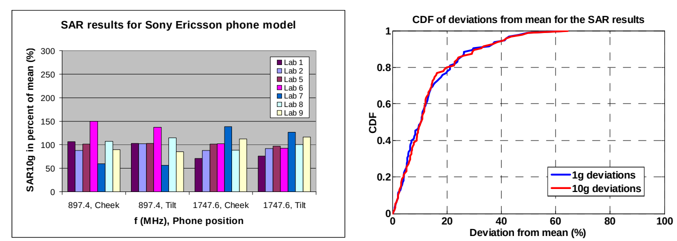

Figure 3: The peak 10g averaged SAR results for the Sony Ericsson phone model (left). The CDF of the deviations from the mean SAR results for the three computed phone models (right).

CONCLUSIONS

The agreement in calculated SAR between the participating laboratories is very similar to the agreement obtained in inter-laboratory comparisons involving SAR measurements. This shows that reproducible results are possible to obtain and it motivates the further development of standardized procedures for numerical SAR testing of mobile phones. Sources for the observed deviations are analyzed as part of an uncertainty evaluation to be included in the IEEE 1528.3 standard.

[1] IEC 62209-1:2005, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", 2005.

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