VOLUME-AVERAGED SAR IN ADULT AND CHILD HEAD MODELS EXPOSED TO REALISTIC MOBILE PHONES

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Background

- The introduction of wireless mobile technology has led to several early studies investigating the RF energy absorption, i.e. SAR, in child and adult head models in various exposure scenarios using scaled head models, same dielectric parameters for both child and adult head models as well as simple exposure sources.
- Use of realistic head models and the effect of dielectric variations were addressed in our previous studies.
- The exposure source models used in early studies were mainly generic simplified sources or half-wave dipole antennas ➔ the validity of previous conclusions for the case of commercial mobile phones are questioned by some researchers
- CAD models of commercial mobile phones have not been easily available to the research laboratories.

Objectives

- Repeating our previous works using a CAD based mobile phones instead of simplified generic sources.
- Compare the average SAR values in child and adult head models.
- Compare the SAR variation in child head models to that of adult head models.
- Compare the SAR distribution in different models.
- To look at the compliance of the considered devices comparing to the standardized phantom (SAM).
- The energy absorption issue is considered at macroscopic level and only from SAR point of view!

Simulation platform and computational method

- SEMCAD-X commercial EM simulation platform which is based on FDTD technique is applied for simulations.
- Grading mesh technique was used to reduce the number of voxels and computational time.
- The computational space was truncated by a perfectly matched layer (PML).
- In the phone model, in particular in antenna regions, the minimum voxel size was 0.1 and the maximum was limited to 0.25mm, whereas outside that region but inside the phone the grid size was increased up to 0.5 mm.
- In the head region, the mesh was graded and the size was varied between 1 and 5mm.
- Two adult and two child head models were used: an European adult female head (EF), a Visible human male adult head (VH), a 3-year-old child (CH3) and a 7-year-old child (CH7) head model. The models contained fifteen tissue parameter values.

Exposure Sources and power levels

- Nokia 8310: a mobile phone with dual band transceiver unit designed for the GSM 900 (including EGSM) and DCS 1800 networks.
- Nokia 6630: a mobile phone with three band transceiver: was the first 3G phone in the world designed to operate at UMTS / GSM 900 / GSM 1800 and GSM 1900 networks.

Operation Frequency	Middle traffic channel (MHz)	Forward Power	Transmitted power (SWR=2)
GSM900	902.4	32 dBm	31.49 dBm
DCS1800	1747.4	29 dBm	28.49 dBm

- Standard touch and tilt positions are simulated.
- Values are normalized to forwarded input power.
- The values of each group is compared to the highest value in the group.

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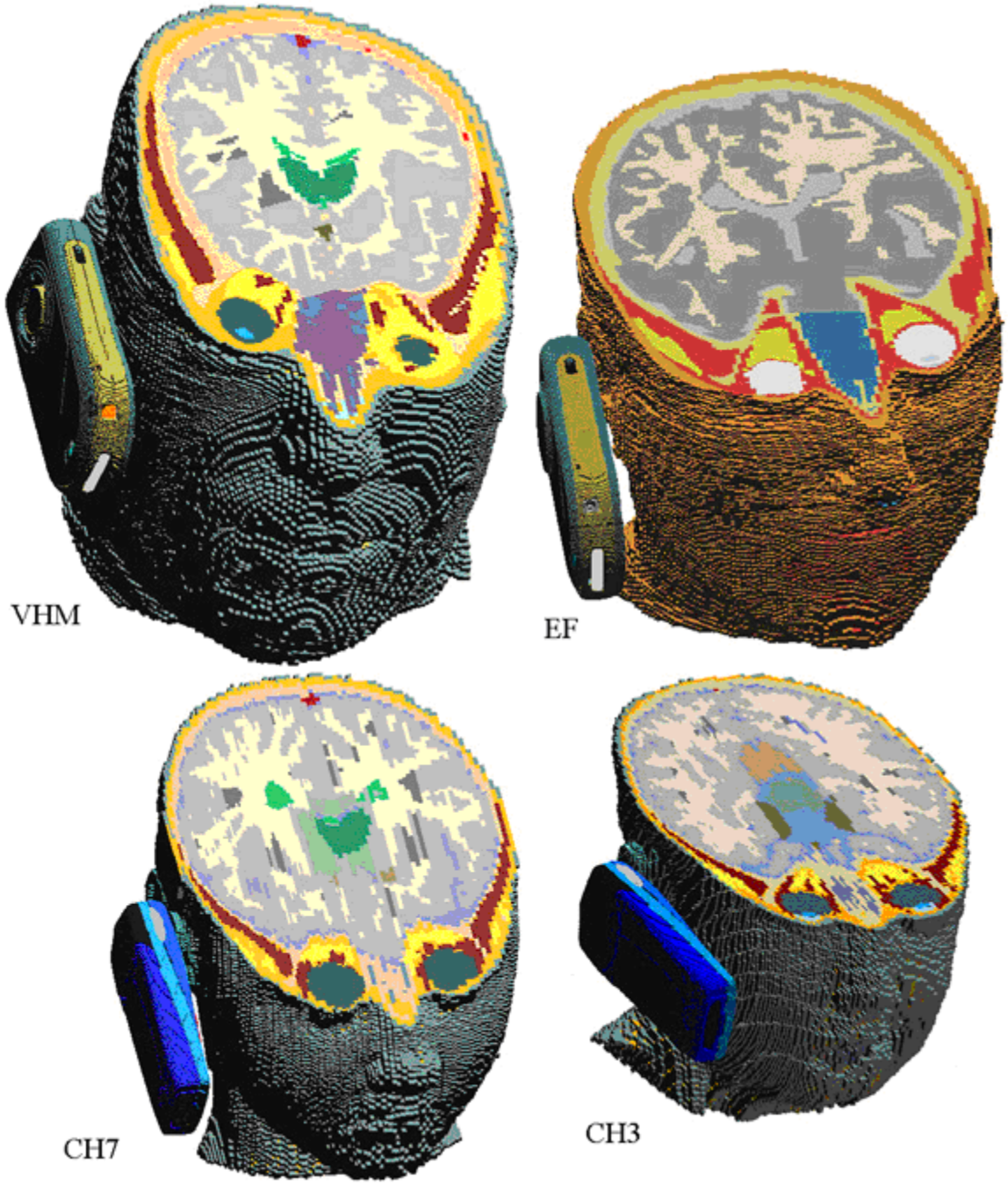

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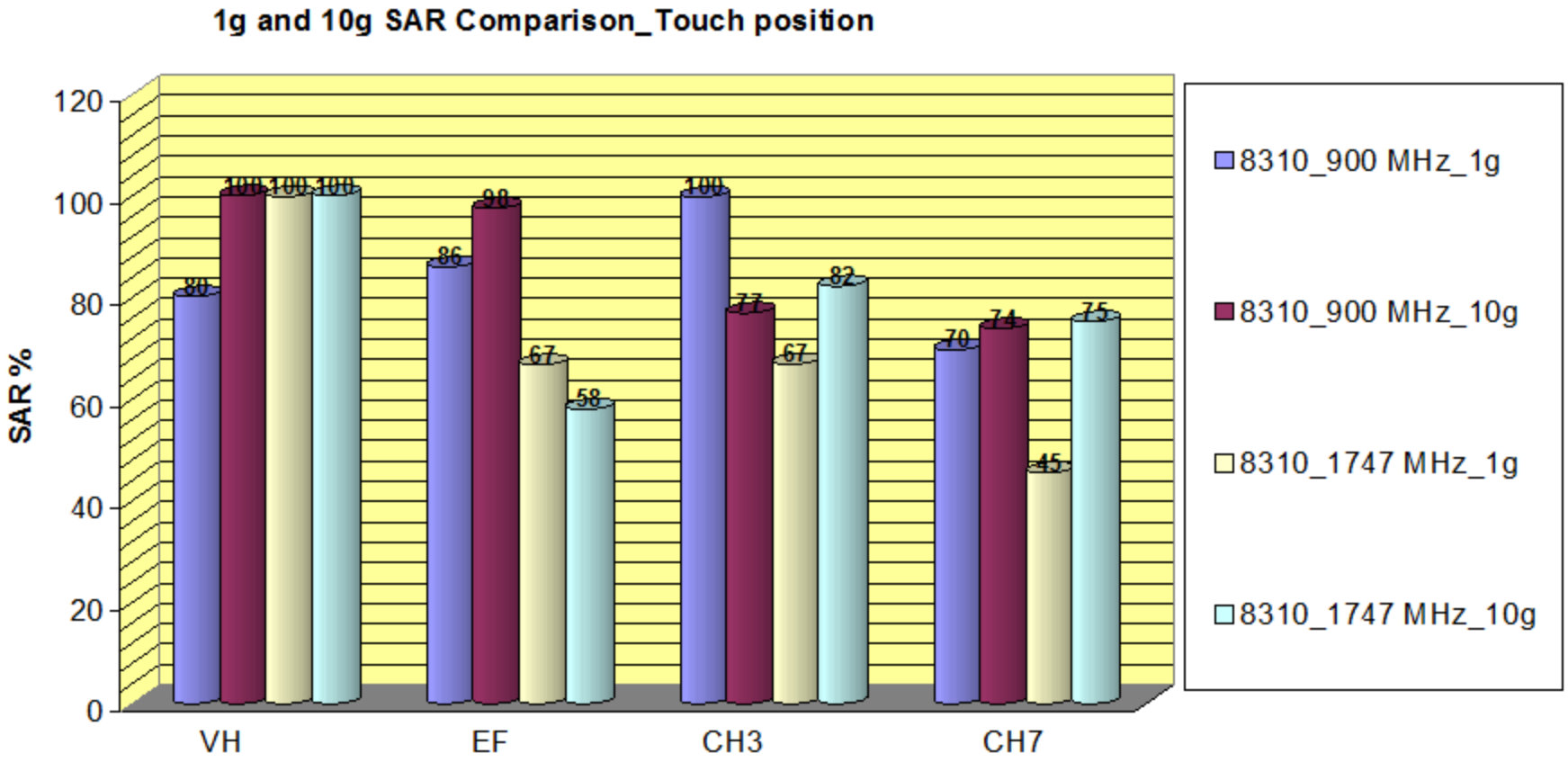
Results



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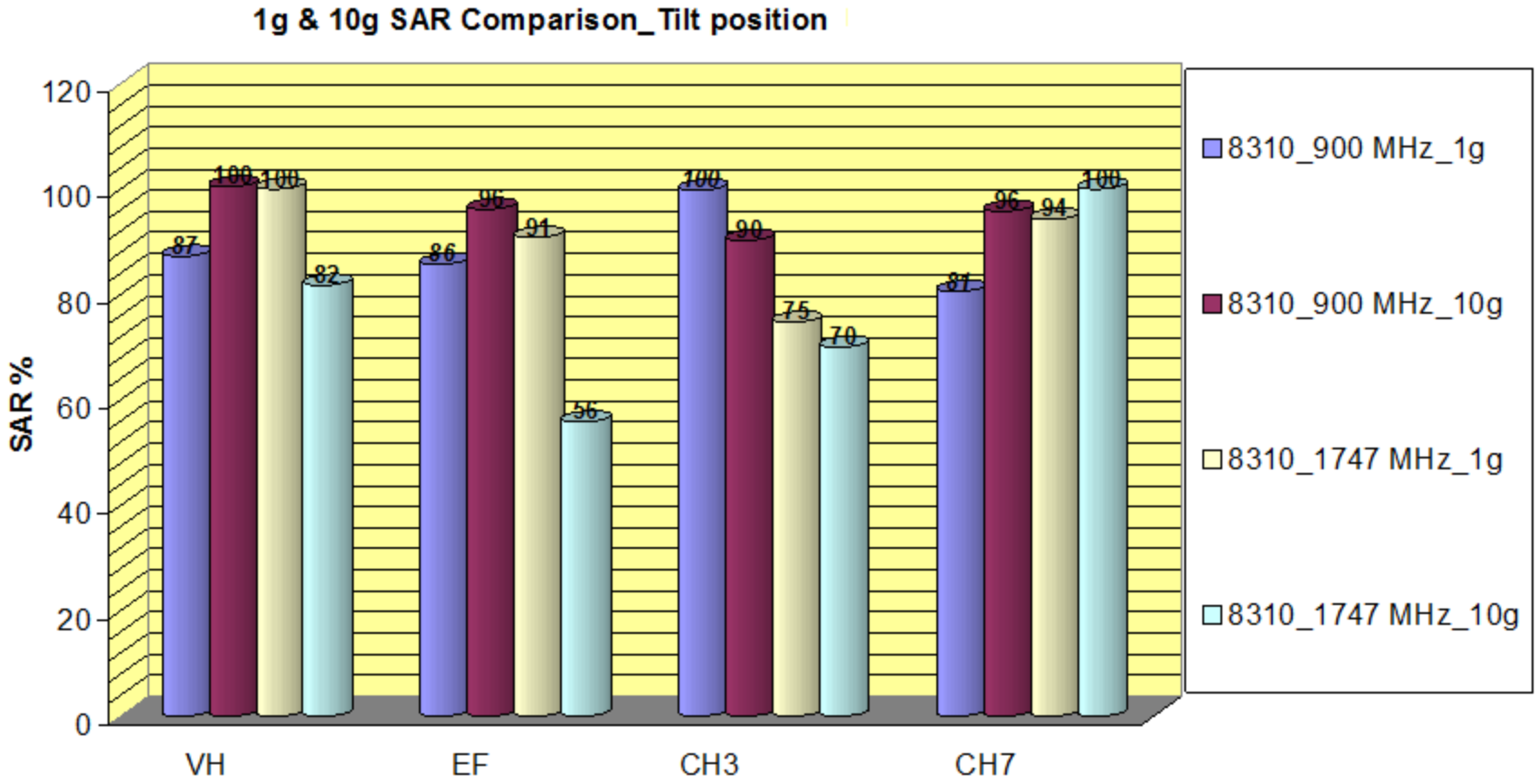

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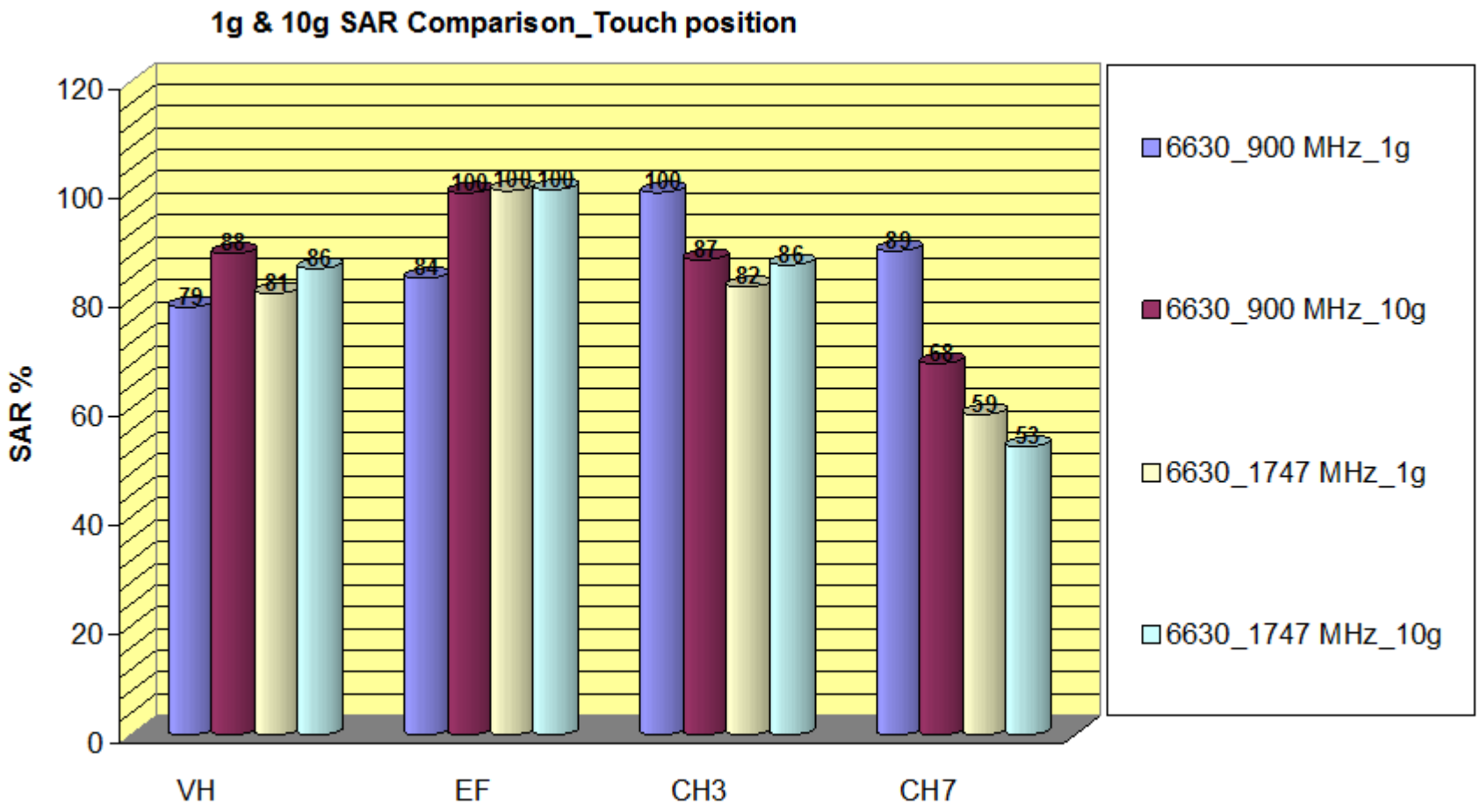

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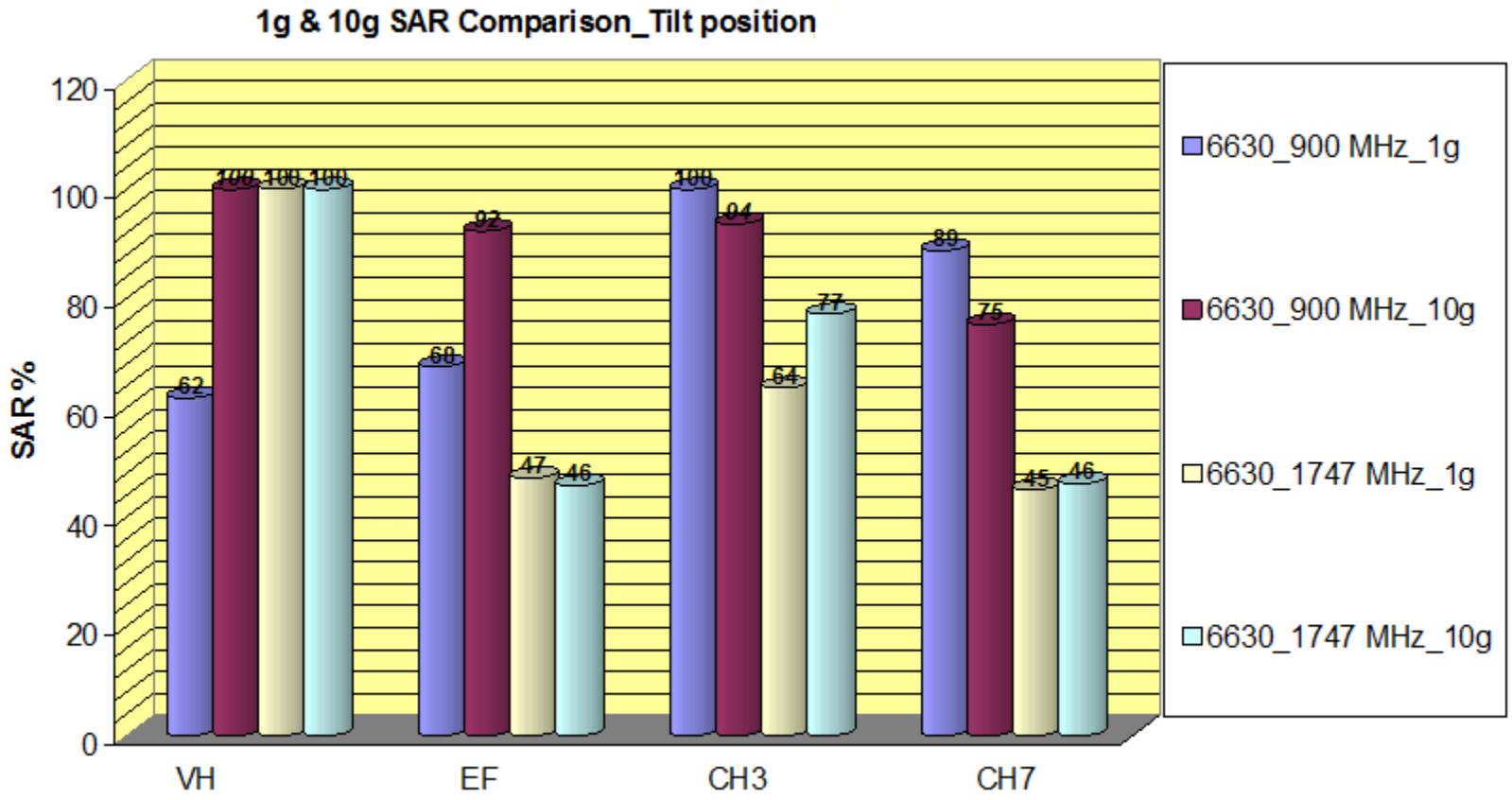

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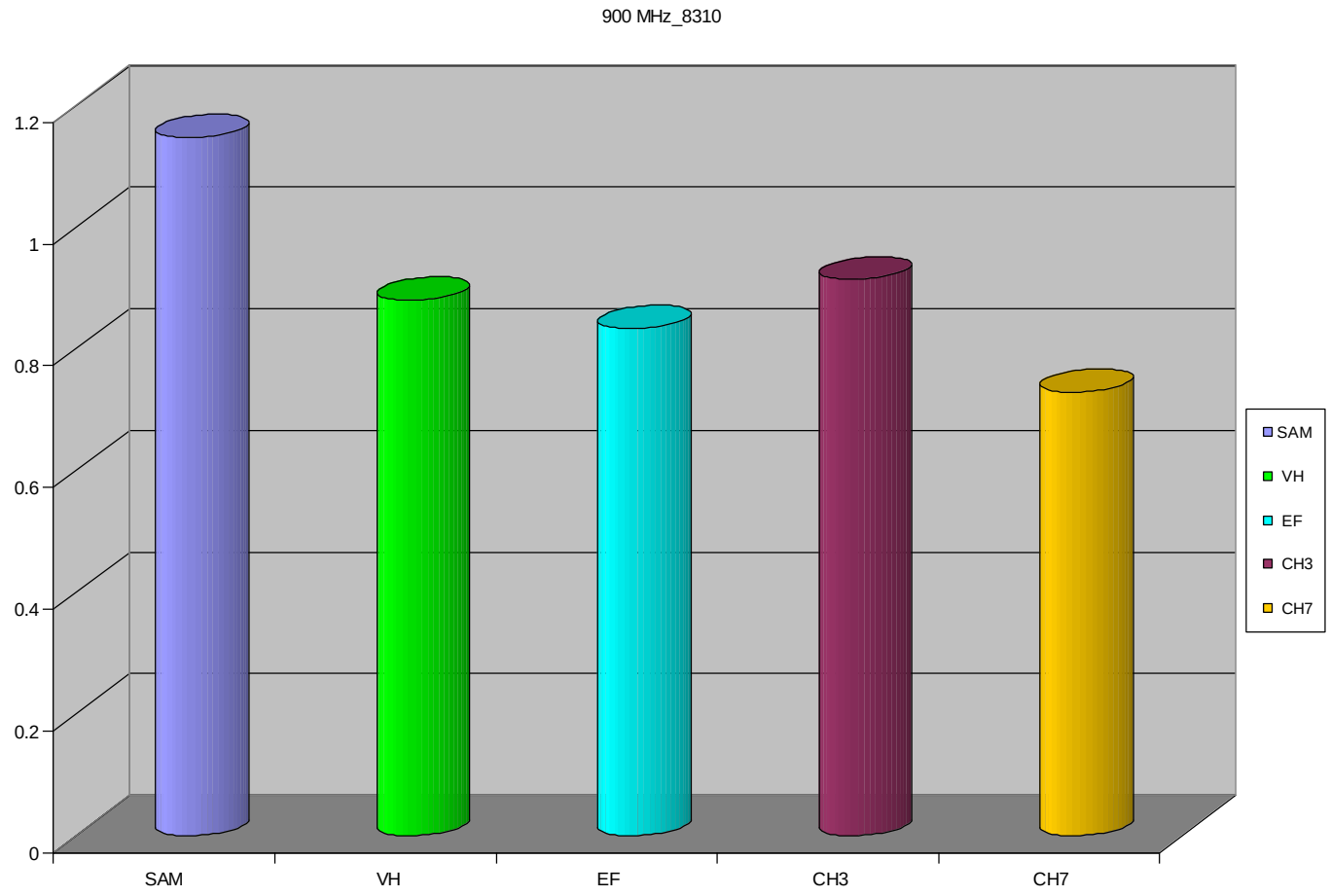
Results...



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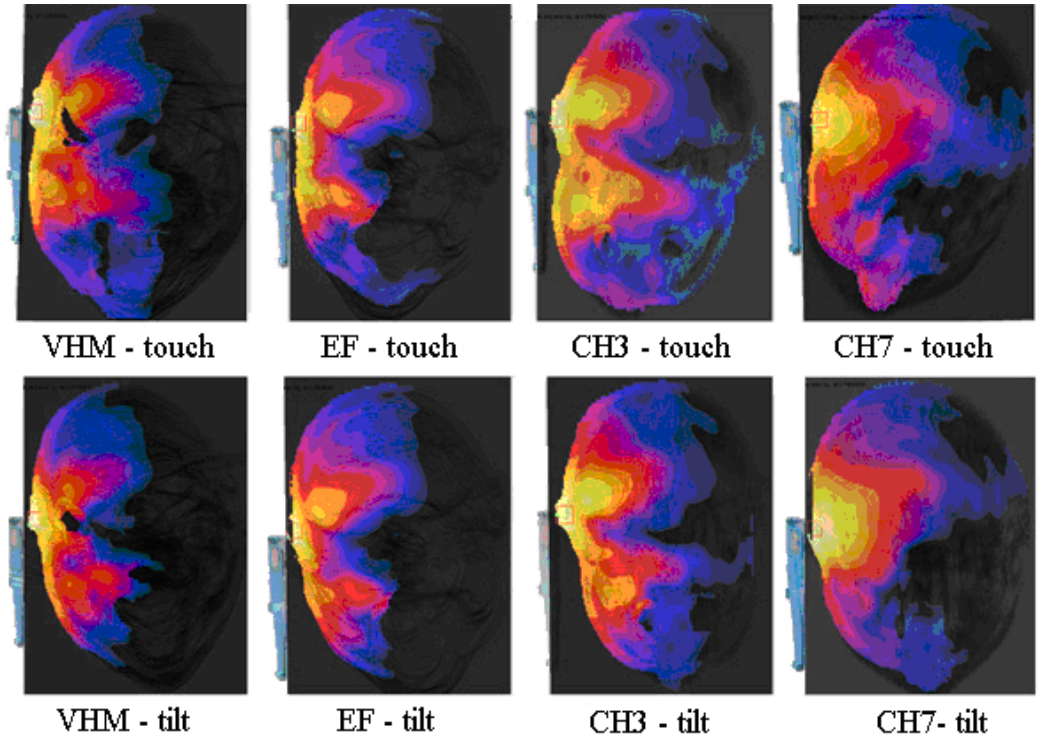
Results

Example for SAR distribution

8310 at 1747 MHz



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Conclusions

- The previous findings reported in the literature, such as the significant effect of the anatomy of the head, source position, frequency were also confirmed in this study.
- The effect of phone model, head anatomy and phone positioning on SAR seem to be more predominant than other parameters.
- The SAR distributions of generic source models are not representative of real mobile phones
- The SAR distribution highly dependent on the phone model.
- The absolute SAR values between child and adult head models are in the same range, but the relative SAR distribution seems to be slightly higher in the smaller head models.

Conclusions...

- The general conclusion is that there is no consistent difference in volume average SAR in child and adult head models.
- Type of the exposure source should be considered as one of the most significant parameters in these kinds of studies.
- The conclusions given in this study are based only on the limited mobile phone models used in this study !