

한국인 인체두부모델을 이용한 SAR 계산

1999년 7월 8일

전파연구소 전파환경연구과 안전기준담당
홍수원 김기회 오학태



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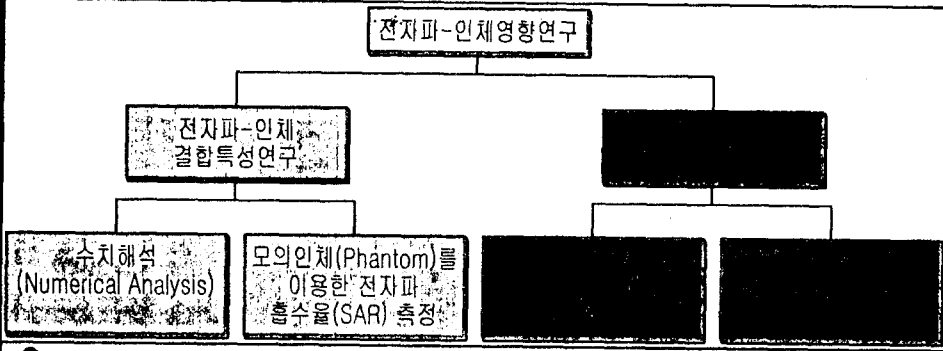
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1. 개요



1. 개요

전자파 비흡수율

SAR(Specific Absorption Rate)

✓ 단위시간·질량에 흡수된 에너지(W/Kg)

✓ 온도변화를 이용한 측정

- c: 비열

- dT/dt: 단위시간당 온도변화

$$SAR = c_i \frac{dT}{dt}$$

✓ 전기장 측정법

σ: 전기전도도 (인체)

- ρ: 밀도 (인체)

- E: 전기장 세기

$$SAR = \frac{\sigma E_i^2}{\rho}$$

1. 개 요

✓ Dosimetric Measurement

- 50년대 초 *physical medicine* 에서 생체조직 분석

✓ 전자파 인체영향의 정량화된 수치

✓ Phantom

인체와 유사한 전기정수(유전율, 전도도)

✓ 단위시간·질량에 흡수된 에너지(W/Kg)

✓ 800MHz~3GHz 대역의 이동 통신용 무선 단말기에 적용

1. 개 요

Condition to be Tested(CENELEC)

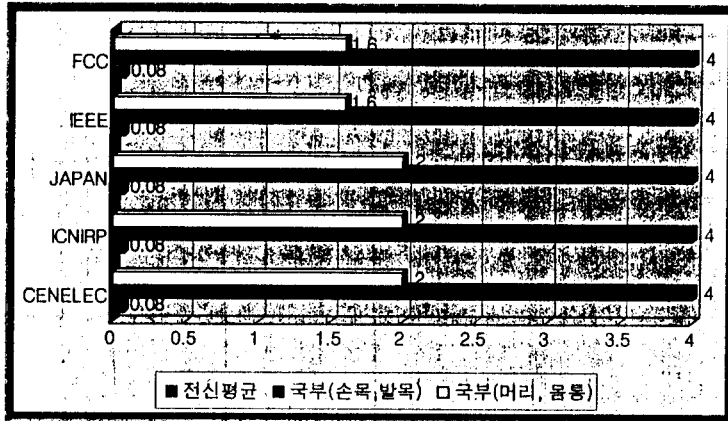


up : intended use, left : touch, middle : 100°, right : tilted

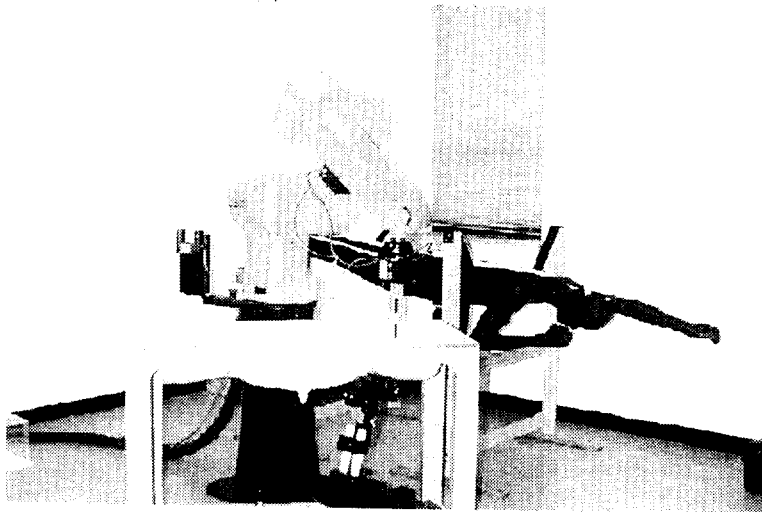


1. 개요

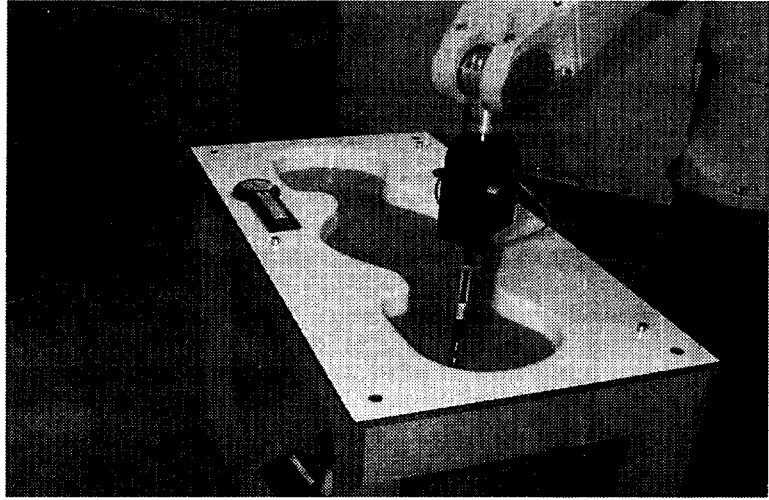
SAR for General Public



2. SAR 측정 시스템



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2. SAR 측정 시스템



측정 상황

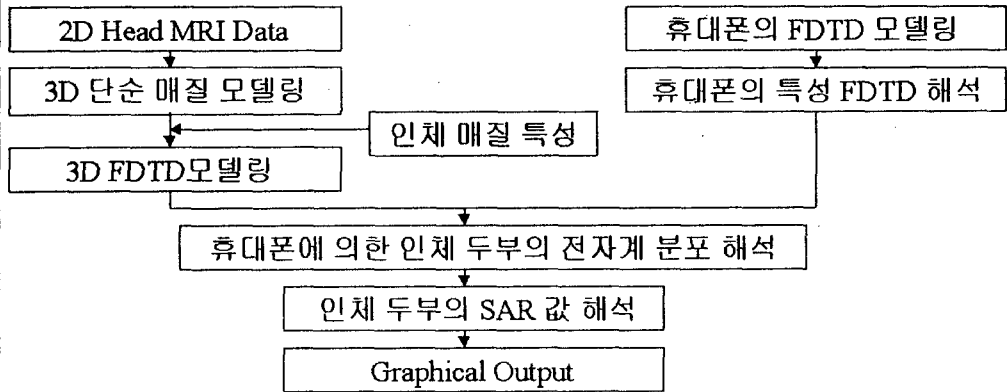


Phantom modeling



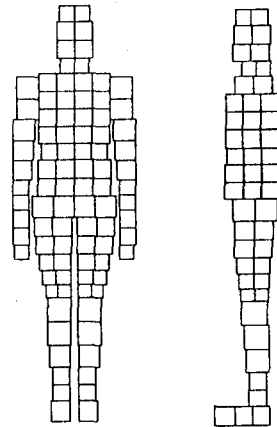
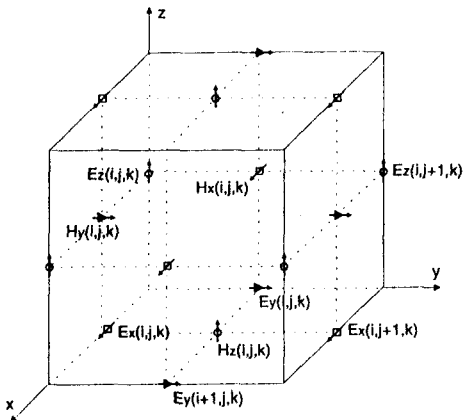
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3. 한국인 인체두부 모델링

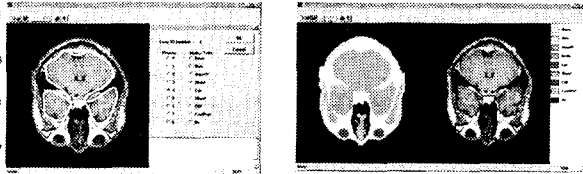
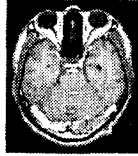


3. 한국인 인체두부 모델링

Yee Cell 의 구조



3. 한국인 인체두부 모델링



한국인 성인 표준
MRI 영상 이미지

매질구분
(자체개발 S/W)

인체와 전자파
결합해석을 위한
한국인 표준 데이터



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3. 한국인 인체두부 모델링



한국인 성인 표준
MRI 영상 이미지

매질구분
(자체개발 S/W)

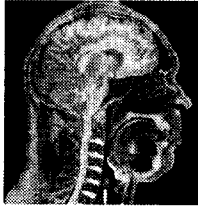
인체와 전자파
결합해석을 위한
한국인 표준 데이터



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4. 한국인 vs. 미국 흑인

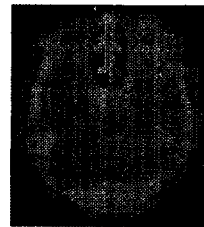
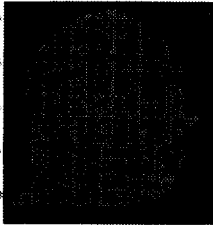
Visible Human Project



한국인 표준 모델



MRI 영상 이미지



인체와 전자파 결합해석을 위한 모델링 데이터



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4. 한국인 vs. 미국 흑인

	KOREA	Black
해상도	1mm, 2mm, 3mm (다양한 상황 계산 가능)	3mm
계산가능 주파수대역	최고 3GHz (미래 이동통신 서비스에 대한 연구 가능)	최고 1GHz (PCS폰에 대한 연구 불가능)
인체조직의 수	8	5
ear	pressed	normal
기초데이터	MRI	해부, CT, MRI



4. 한국인 vs. 미국 흑인

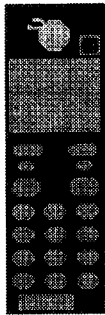
tissue type	ϵ	σ	Kg/m ³	KOREA	BLACK
Blood	61.6	1.5	1000	Yes	No
Cartilage	42.9	0.8	1130	Yes	No
C.S.F	68.8	2.4	1020	Yes	No
Eye	55.5	1.1	1000	Yes	Yes
Skin	41.8	0.8	1020	Yes	Yes
Brain	46.1	0.8	1030	Yes	Yes
Skull	16.7	0.2	1850	Yes	Yes
Muscle	56.1	0.9	1040	Yes	Yes



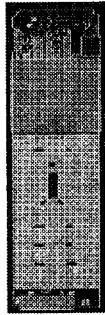
5. 휴대폰 모델링



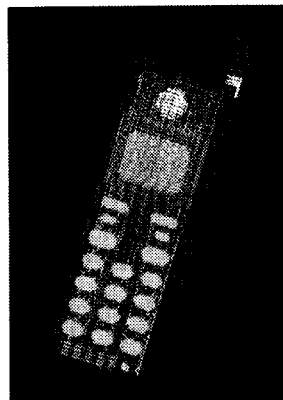
Front panel



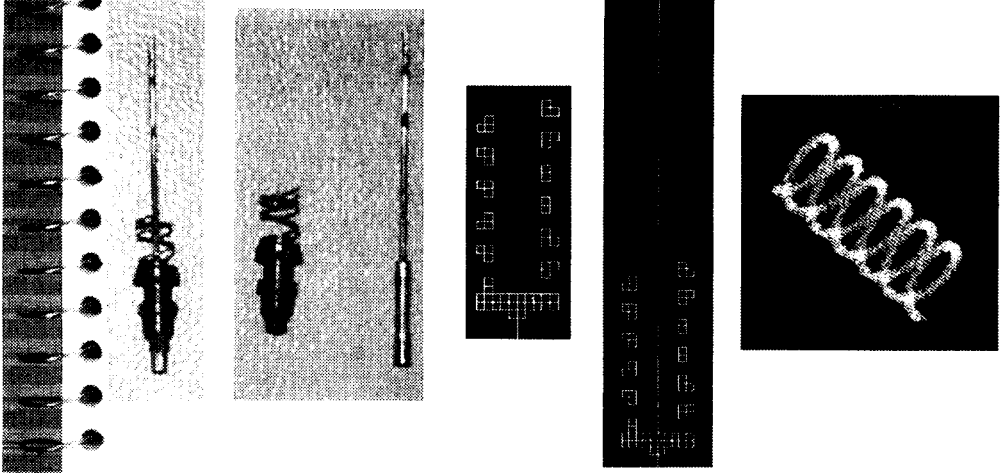
LCD



PCB

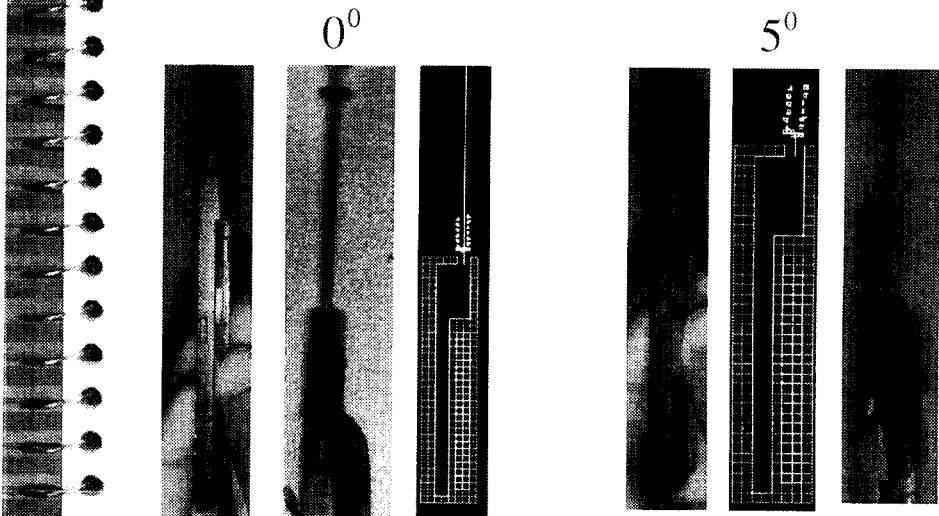


5. 휴대폰 모델링



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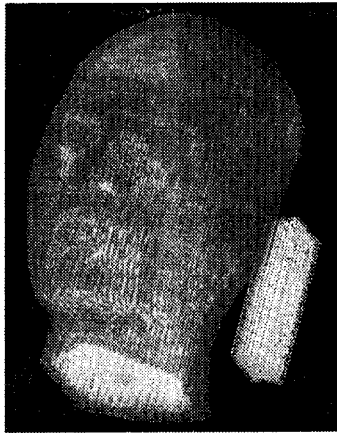
5. 휴대폰 모델링



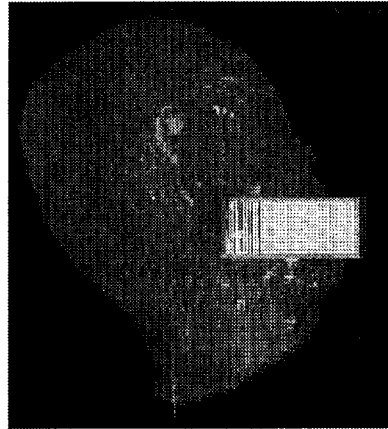
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6. Calculation & Measurement

0°



60°



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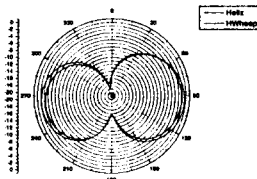
6. Calculation & Measurement

Far Field Pattern

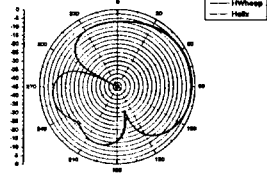
xz-plane



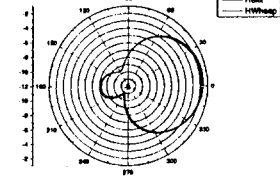
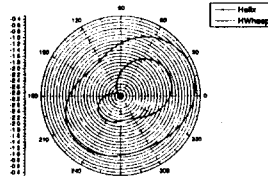
without head



with head



xy-plane

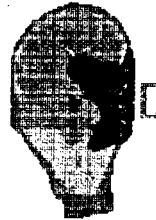


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6. Calculation & Measurement



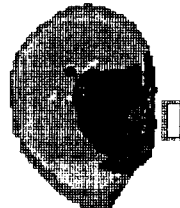
xy-74 (left)



xy-74 (right)



xy-74 (left)



xy-83 (right)



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6. Calculation & Measurement

Figure 10-10-1
3D reconstruction of the skull
from the left side

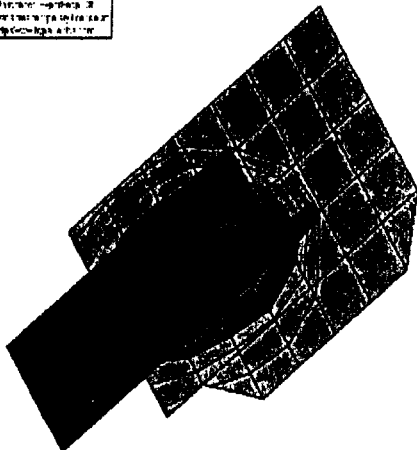
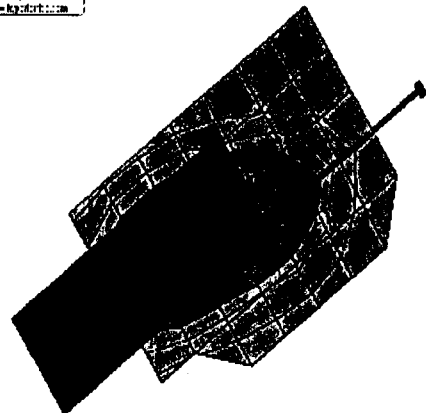


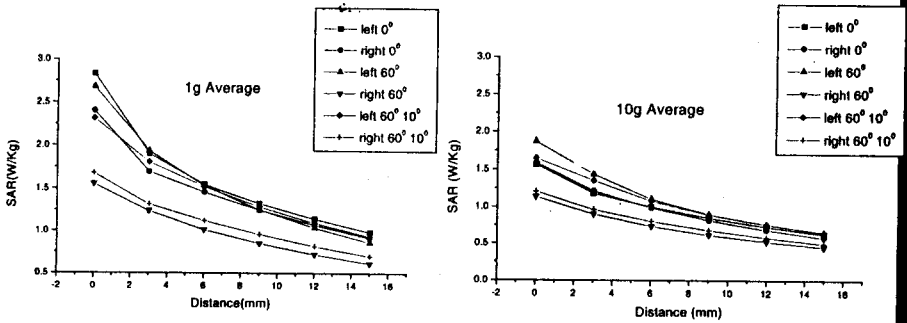
Figure 10-10-2
3D reconstruction of the skull
from the right side



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6. Calculation & Measurement

SAR vs. Distance



7. Discussion

- ✓ 국가 정책 운영의 측면
 - 국민의 전자파에 대한 막연한 불안감 해소
 - 관련 산업이 위축되지 않도록 대안 제시
- ✓ 휴대폰 사용자 요구사항
 - 양질의 통신서비스
 - 휴대폰의 소형화
 - LCD의 대형화
- ✓ 휴대폰 제조업체의 애로사항
 - 사용자 요구와 SAR 기준을 동시에 만족시켜야 함.
- ✓ 해결방안
 - 단기과제
 - 휴대폰 안테나와 사용자 두부의 거리를 확보하는 단말기 구조
 - Matching Network의 성능 향상
 - 장기과제
 - 기존의 helix와 wheep 안테나가 아닌 새로운 개념 안테나 개발