

FEKO를 이용한 WIFI DUAL BAND 안테나 설계 및 네트워크 커버리지 소개

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Q&A

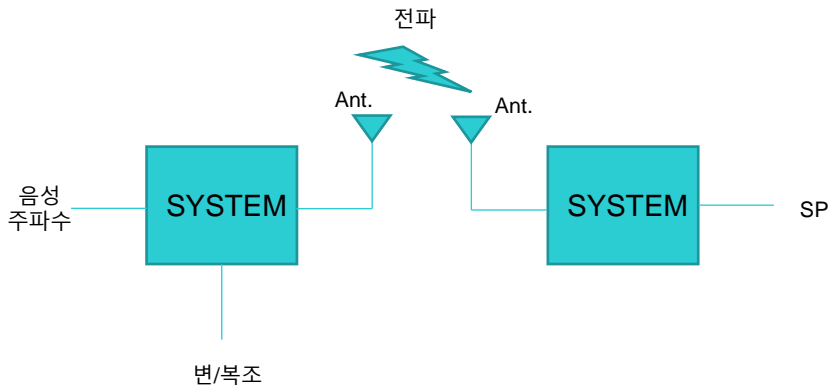
WAVE & ANTENNA

전파(wave) 정의

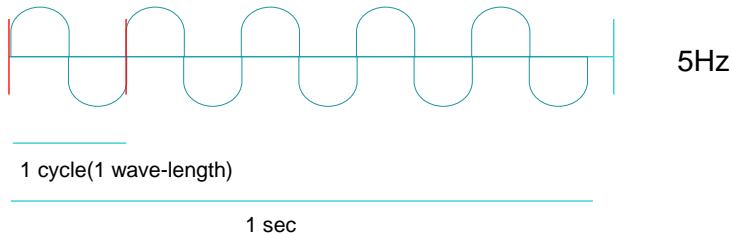
전파	Freq.[Hz]	Wave		
VLF	3K ~ 30K		저주파	해상
LF	30K ~ 300K			
MF	300K ~ 3M	AM Radio		
HF	3M ~ 30M			
VHF	30M ~ 300M	Microwave	고주파	육상
UHF	300M ~ 3G			
SHF	3G ~ 30G	위성주파수		
EHF	30G ~ 300G			

변조 후의 개념

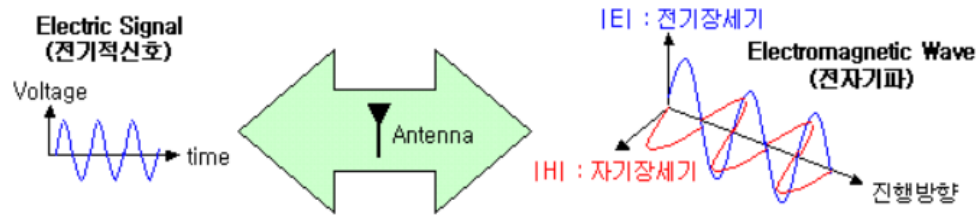
변조 전의 개념



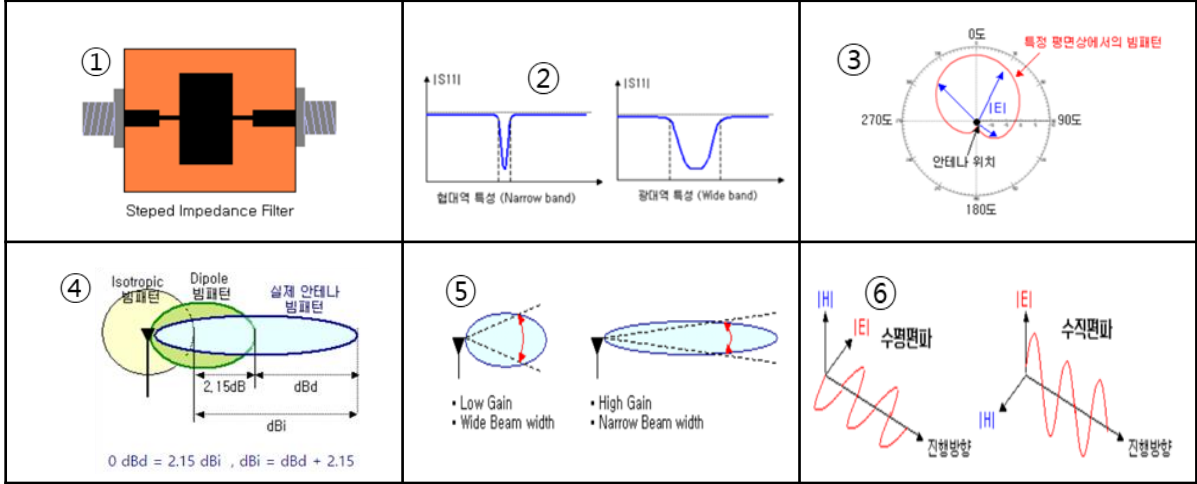
Hz : cycle 수 / sec



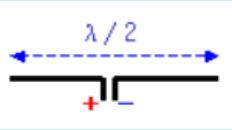
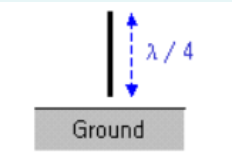
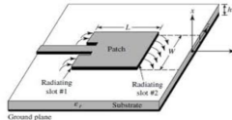
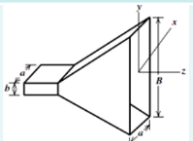
Antenna 정의



Terminology used for antenna	
①	S-parameter
②	Resonance
③	Beam pattern
④	Gain
⑤	BW
⑥	Polarization



Antenna 종류

Antenna name	photo	specifications
Dipole		안테나 이득이나 지향성의 표준 안테나 전파 파장 $\text{Lambda}[\lambda]$ 의 $\frac{1}{2}$ 길이의 half-wave dipole antenna, 단파, 초단파로 사용 단일보다 배열 구성으로 사용
Monopole		접지와 연결되는 직선 형태의 안테나 전파 파장 $\text{Lambda}[\lambda]$ 의 $\frac{1}{4}$ 길이 무지향성 안테나로 이동통신용 단말기, FM radio receiver로 사용
Patch		Microstrip 안테나의 일종 제작이 용이 하지만, 주파수 대역이 좁음
Aperture		UHF(Ultra High Frequency) 이상 광대역 주파수에서 사용 매우 높은 안테나 이득 가능 위성통신에 많이 사용
Others	내장형	PIFA (Planar Inverted F antenna), Small Loop Antenna, SMD(Surface Mounted Device), DRA(Dielectric Resonator Antenna), Chip Antenna
	외장형	Helical antenna, Monopole(whip) antenna , Retractable(Helical + whip) antenna

FEKO INTRODUCE

CEM 이란

※ CEM = Computational Electro-Magnetics

일반적인 해석

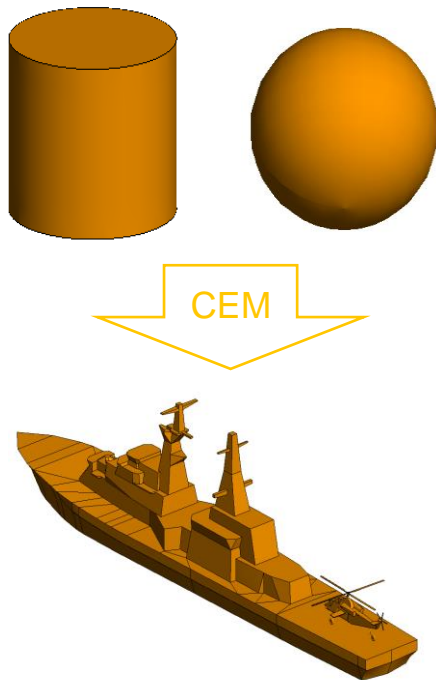
- 간단한 구조 : 정확한 솔루션
- 복잡한 구조 : 수치/계산적 기술 필요

CEM 특징

- Maxwell 방정식의 수치 해석적 분석
- 정확도 상승 및 분석적 결과 근접
- CPU 시간 & 메모리 최소화

CEM 분류

- Full-wave
 - Geometric dimensions $\leq \lambda_l$
 - Exact solutions
 - MoM(Feko), FEM, FDTD
- Asymptotic
 - Geometric dimensions $> \lambda_l$
 - High Efficiency & low Memory
 - Application of the geometric and physical theory of diffraction
 - Lack of confidence in the results

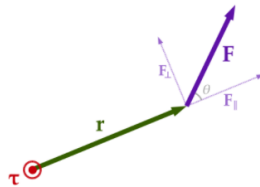
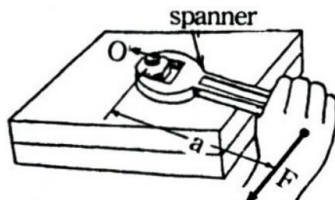


MoM 이란

※ MoM = Moment of Method

What is Moment?

- 거리 X 물리량
- Torque, axis / function / pivot 의 회전시키는 힘 $\vec{\tau} = \vec{r} \times \vec{F}$



- MoM

- 미지의 매개변수 결정 후 방정식 유도

$$E_z^{inc} = \frac{j}{\omega \epsilon} \int_{-L/2}^{L/2} I_z(z') \left(k^2 + \frac{\partial^2}{\partial z'^2} \right) \frac{e^{-jk r}}{4\pi r} dz'$$

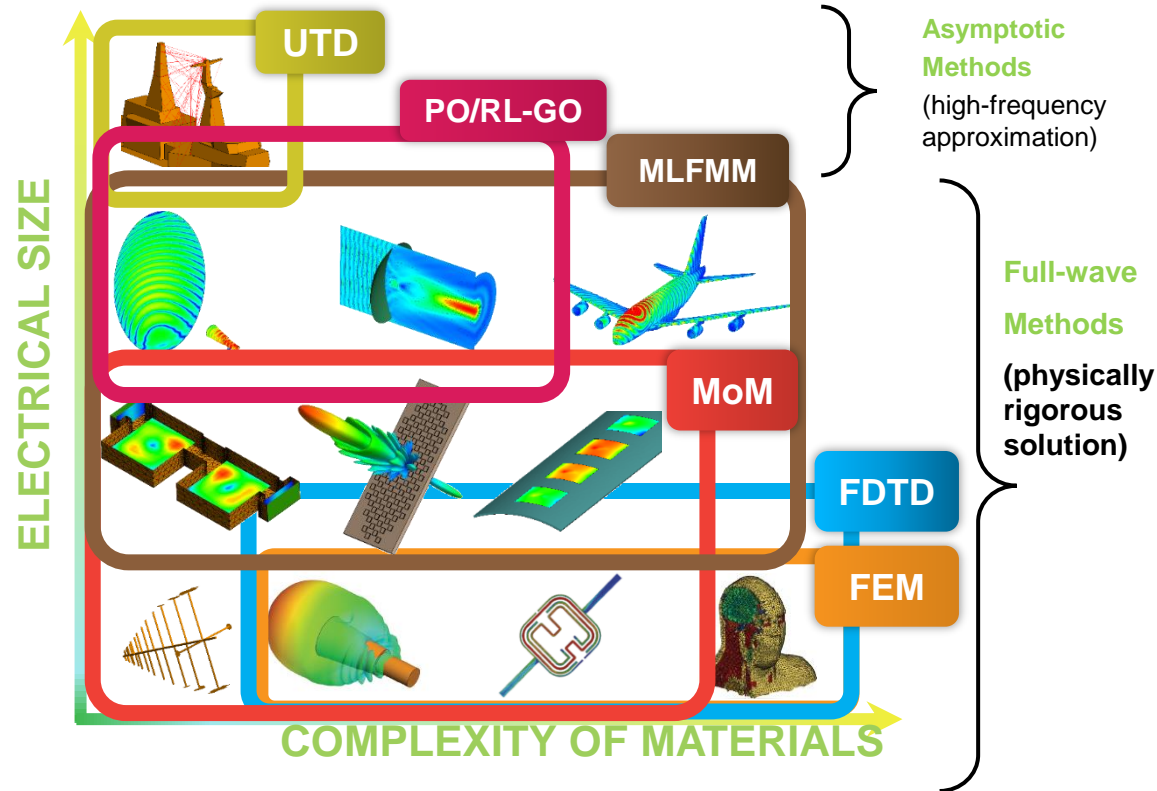
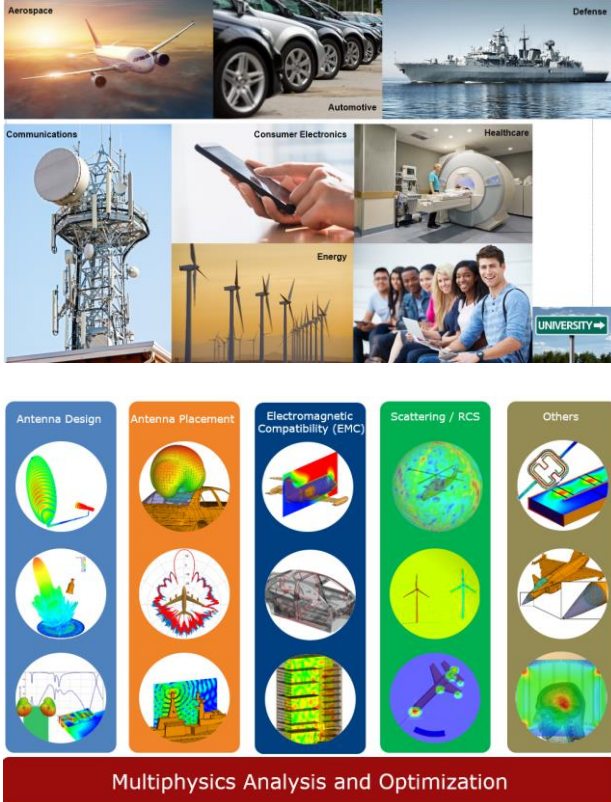
- 장점

- 금속장비의 최고 효율적인 분석 가능
- 매우 빠름
- MLFMM으로 우수한 확장성
- FEM, PO, GO와 함께 사용 가능

- 단점

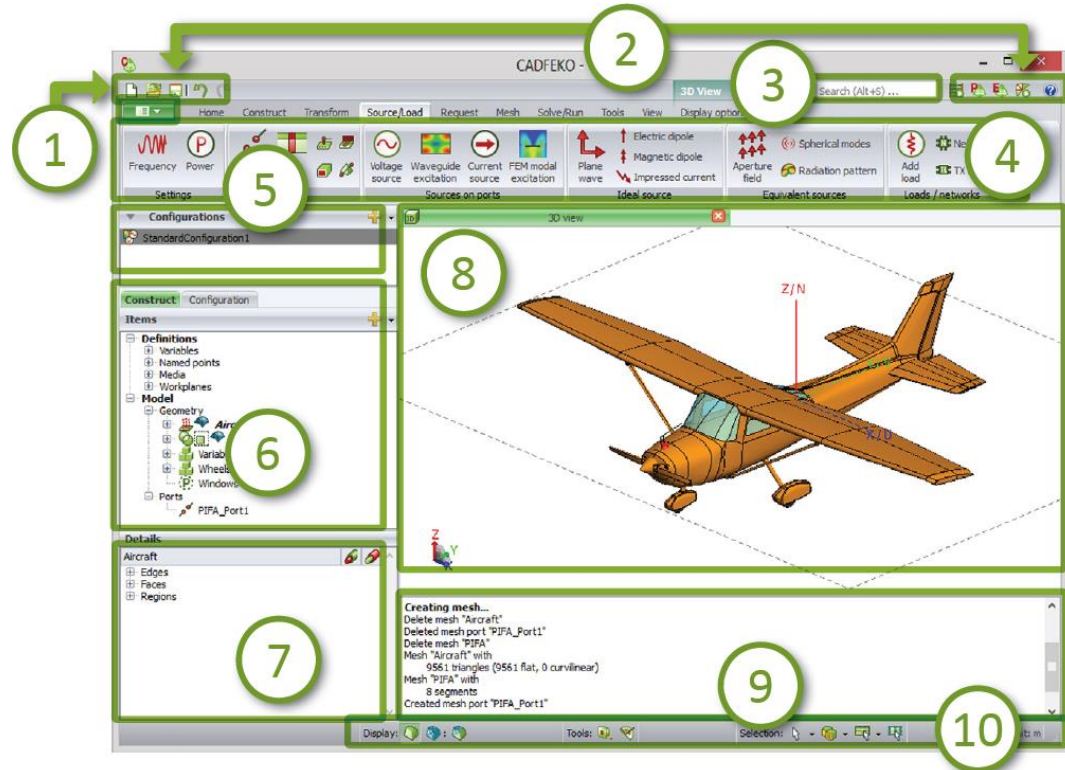
- 수식화 필요
- 복잡한 구조(인체 등)에서 비효율적

Feko



CADFEKO

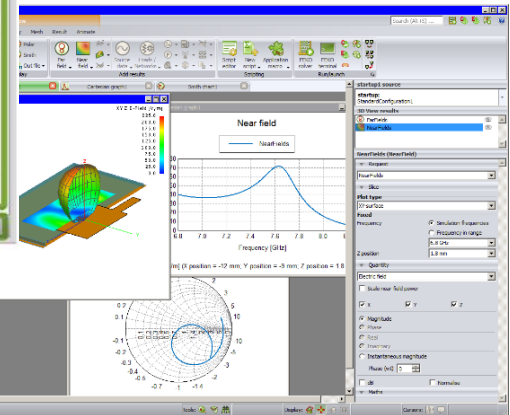
No.	Layout
1	Application menu
2	Quick access toolbar
3	Search bar
4	Ribbon
5	Configuration list
6	Model tree
7	Detail's tree
8	3D view
9	Message window
10	Status bar



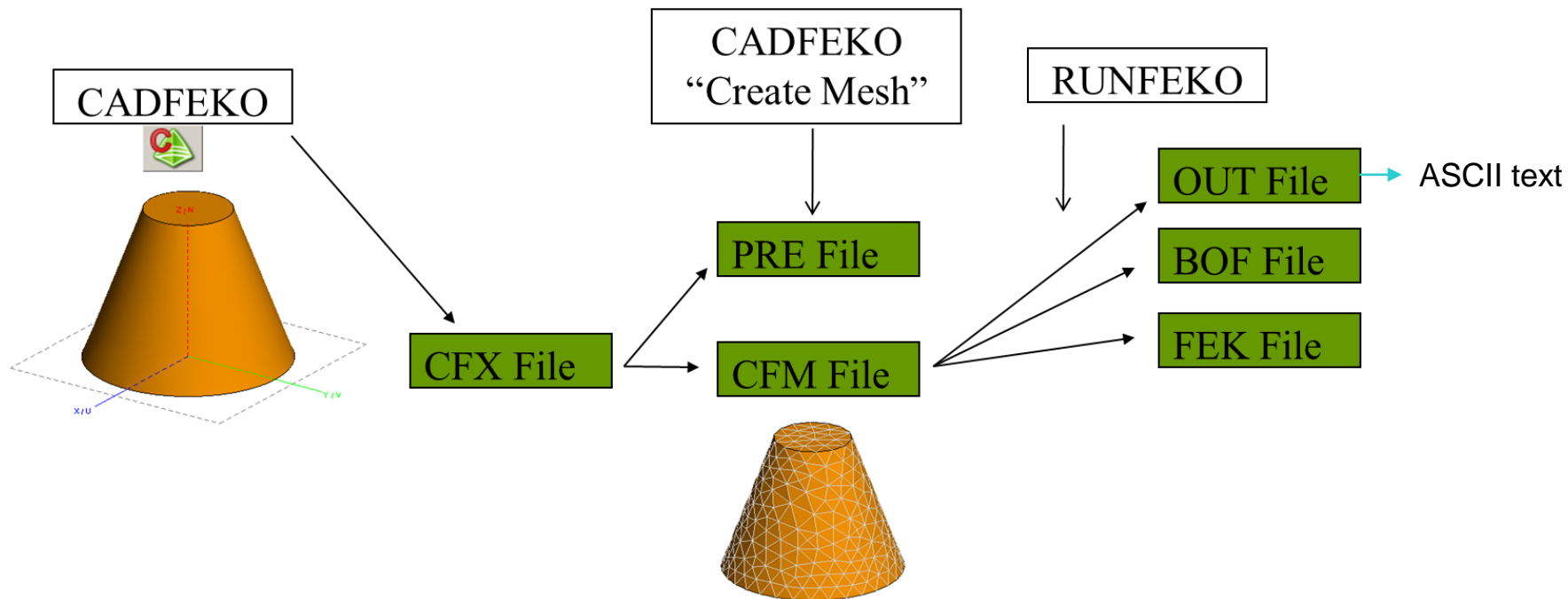
POSTFEKO



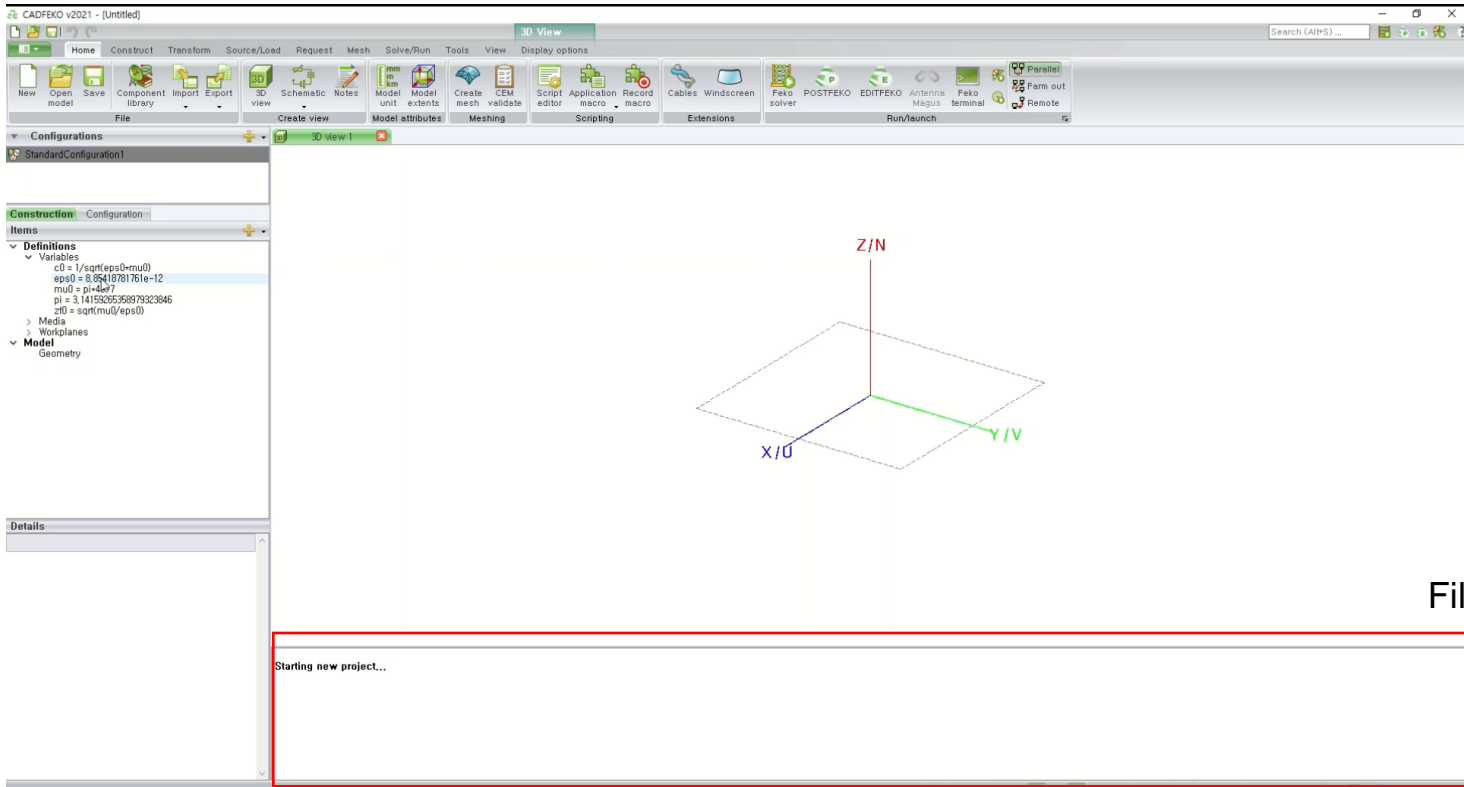
No.	Layout
1	Application menu
2	Quick access toolbar
3	Search bar
4	Ribbon
5	Project, model, details, browser
6	3D and 2D views
7	Result palette
8	Status bar



Feko 의 권장 사용 모델



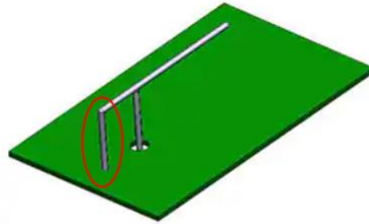
Feko 의 권장 사용 모델 [DEMO]



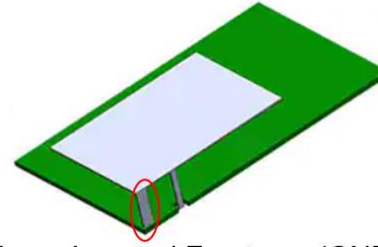
File 생성 확인 가능

PIFA ANTENNA

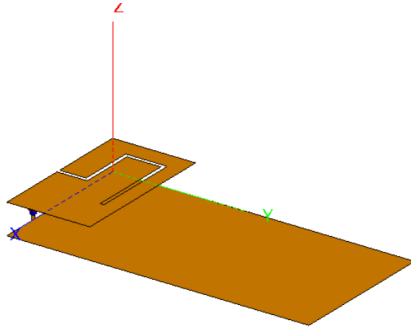
PIFA type의 Antenna



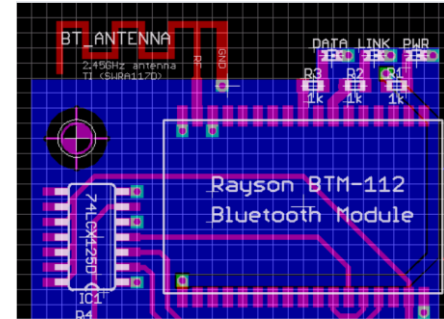
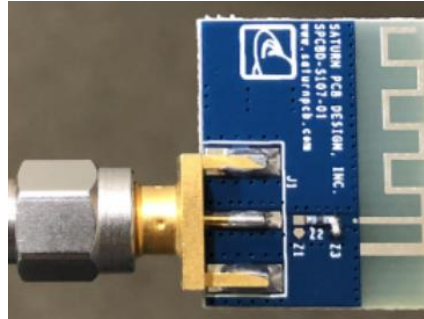
Inverted F antenna(GND pin이 사용)



Planar Inverted F antenna(GND pin이 사용)



발췌: www.google.co.kr



발췌: 2.4Ghz PCB Antenna for Bluetooth - Page 1 (eevblog.com)

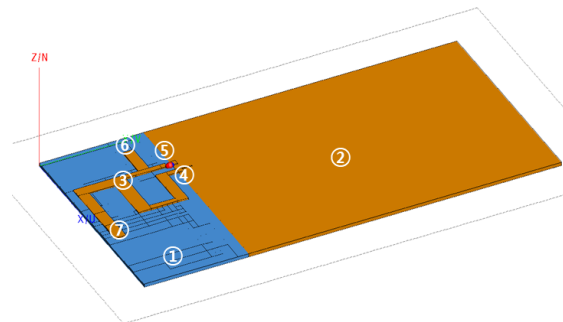
Antenna Design Variables & Specifications

< Variables >

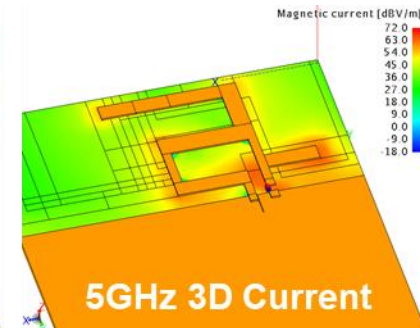
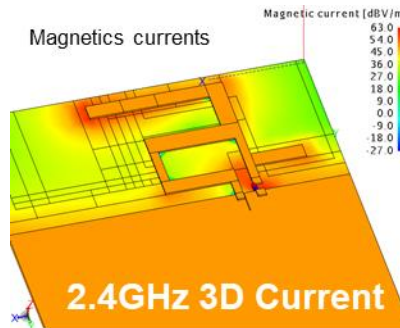
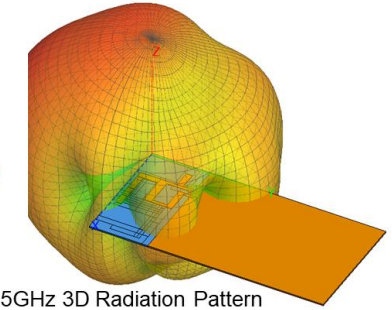
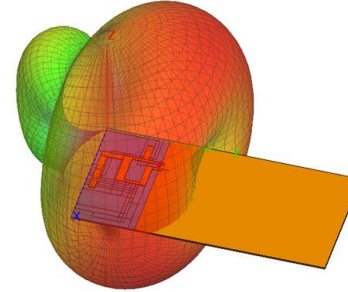
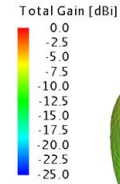
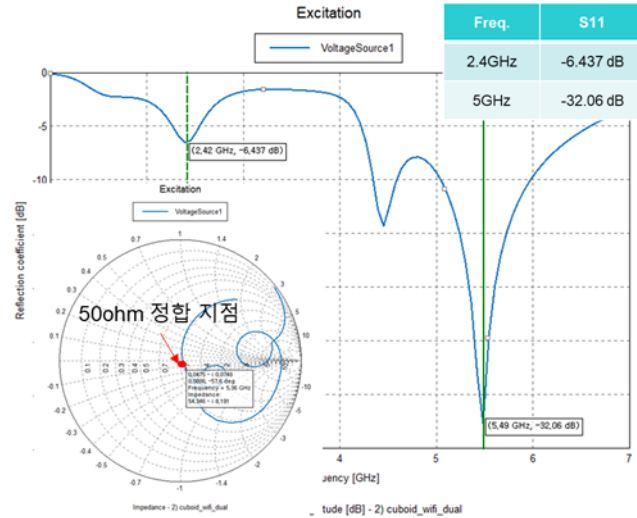
Variables	Values	Comments
F1(f1)	2.45e9(2.45GHz)	IEEE 802.11b/g/n 의 중심주파수
F2(f2)	5.5e9(5.5GHz)	IEEE 802.11.n/a 의 중심주파수
Lambda1 [λ1]	C0/F1	$C0 = 3 \times 10^8 \text{ m/s}$
Lambda2 [λ2]	C0/F2	$C0 = 3 \times 10^8 \text{ m/s}$
PIFA _ substrate _ conductivity	0.001422	도전율[σ]
PIFA _ substrate _ permittivity	3.55	유전율[ε] (부도체의 전기적 특성)
PIFA _ wire _ radius	Lambda1 x0.000400276	Port 에 대한 반지름

< Antenna Specifications >

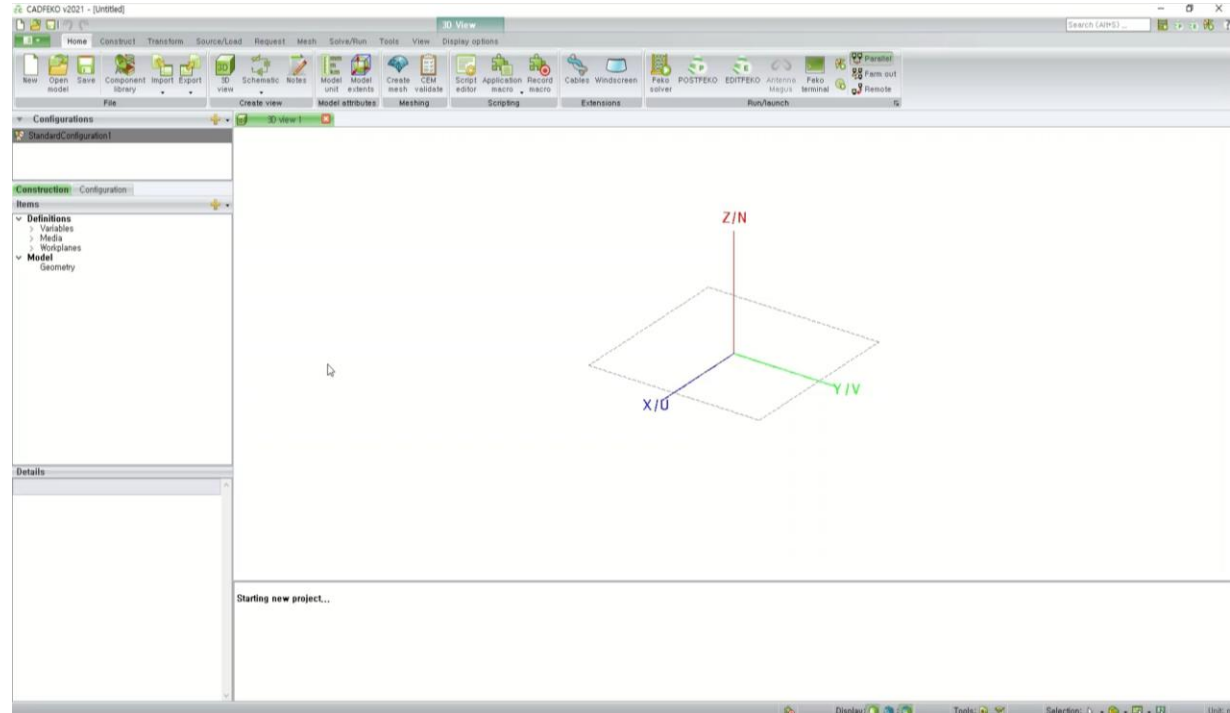
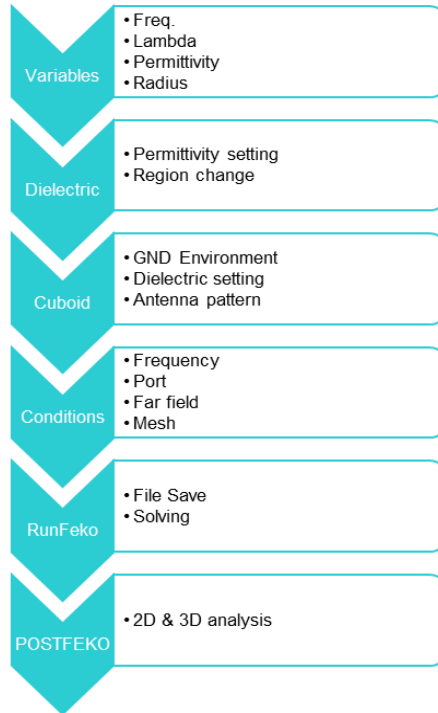
Geometry	Size[cm] Width x Depth x Height	Comment
① Substrate	4 x 2 x 0.1	유전율을 갖는 구조체
② GND	4 x 6 x 0.1	Radiation을 위한 GND
③ Antenna	? X ? X 0.02	Ant. 체적은 유동적
④ GND pin	0.1 x 0.1 x 0.02	Ant.와 연결하기 위함
⑤ Feeding	0.1 x 0.1 x 0.02	Line을 이용한 port 지정
⑥ 5GHz	Ant. Length [lambda/4]	Radiation pattern
⑦ 2.4GHz	Ant. Length [lambda/4]	Radiation pattern



Antenna TEST Result

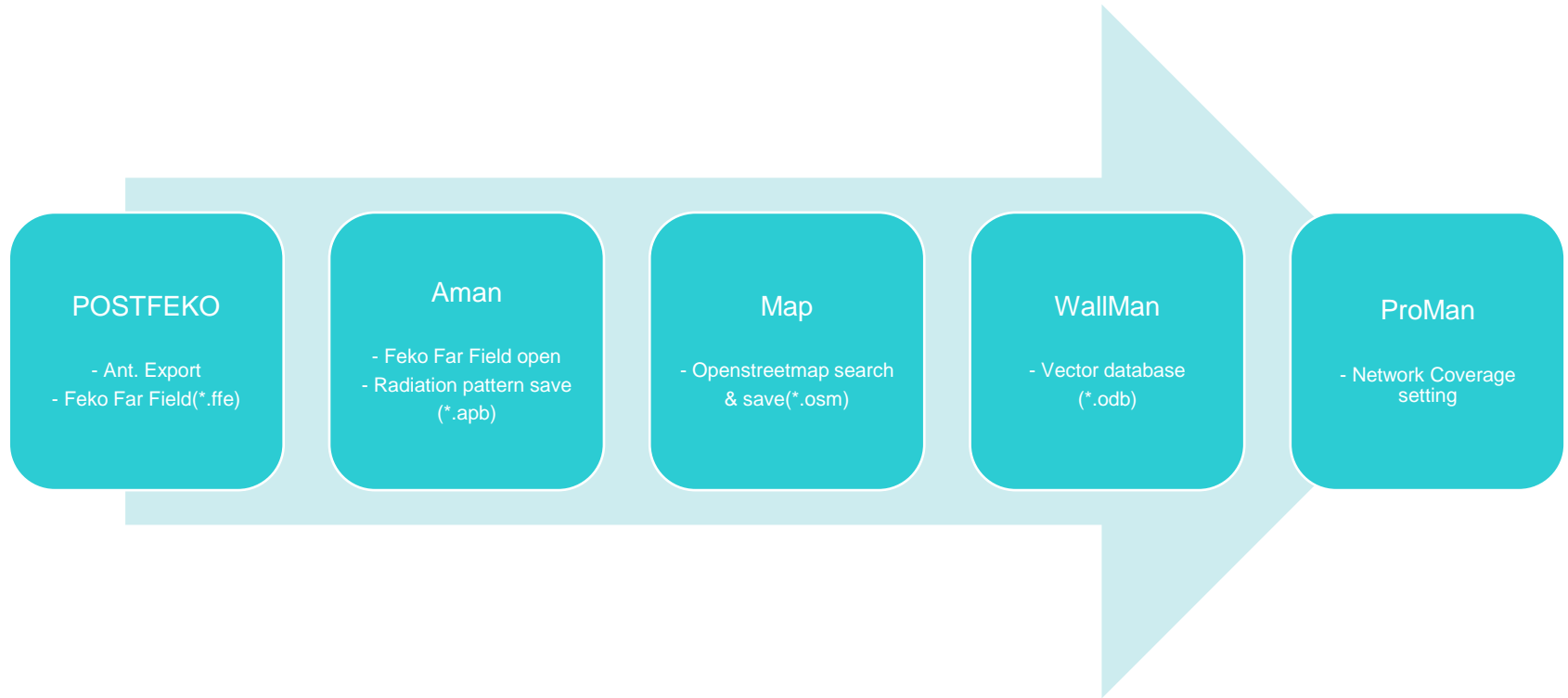


Antenna Design & Analysis [Demo]



NETWORK COVERAGE 소개

Network Coverage Processing Workflow



Network Coverage [Demo]

