94GHz Millimeter Wave Radar

AMPLET Communication Laboratory

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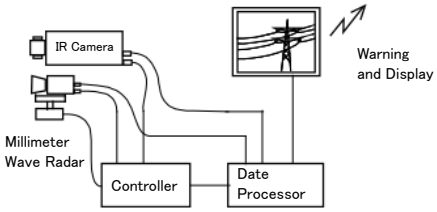
AMPLET Communication Lab.

Radar Technology

AMPLET Communication Laboratory

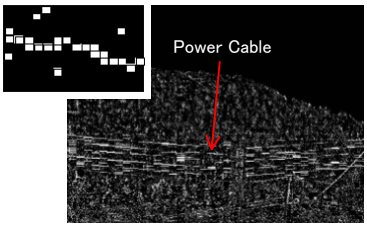
1. Millimeter Wave Mono-pulse Radar
2. Millimeter Wave FMCW Radar
3. Vivaldi Antenna
4. Constant Fraction System
5. Appendix

Obstacle Detection for Helicopter Flights



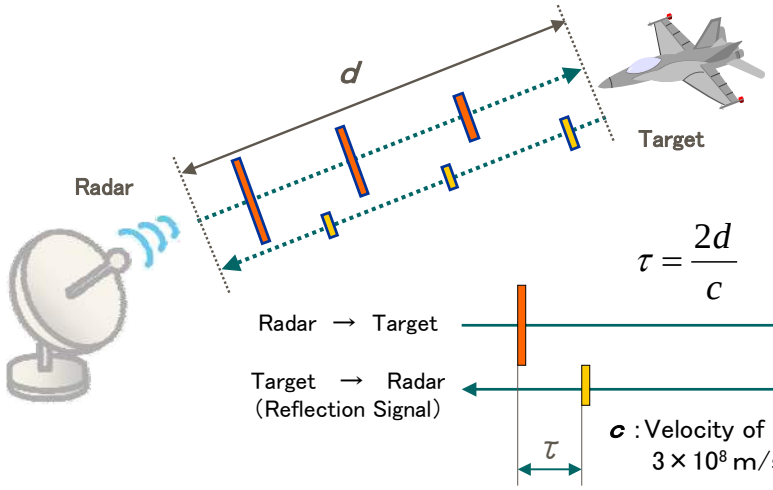
An obstacle detection and warning system for Civil Helicopters is now being developed. An Infrared Camera and a 94GHz Millimeter Wave (MMW) Radar have been used as its sensor. Experimental MMW radars have been built to examine their propagation properties and obstacle detection performance. 94GHz Vivaldi antenna has been fabricated for a compact radar antenna. Measured results demonstrated that the experimental FM CW radar has a satisfactory range and accuracy.

(Research period ：1998～2003)

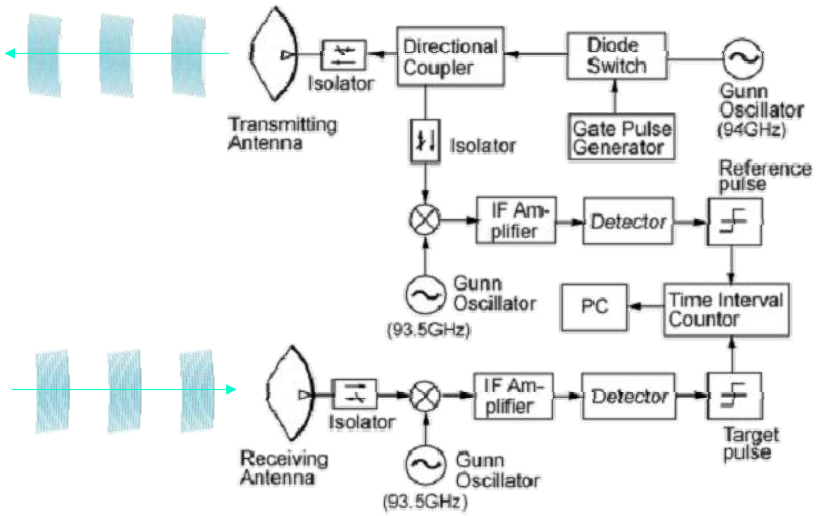


1. Millimeter Wave Mono-pulse Radar

Millimeter Wave Mono-pulse Radar



Blockdiagram of Experimental Mono-pulse Radar



Blockdiagram of Transmitter of Mono-pulse Radar

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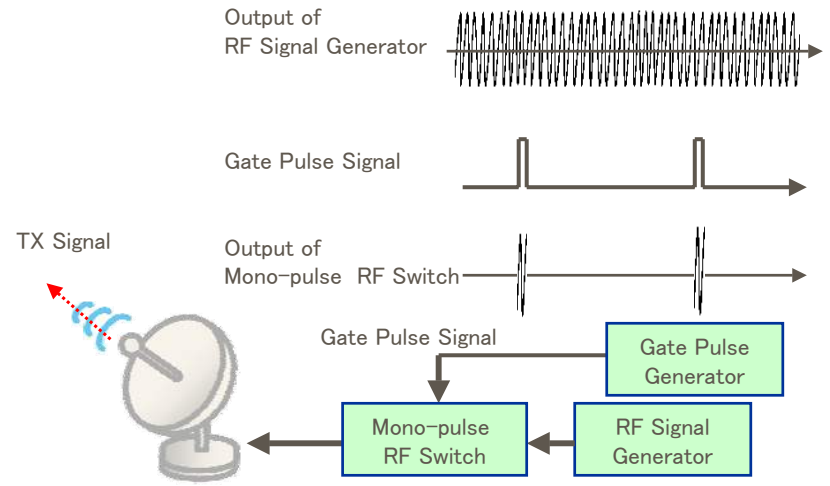

Blockdiagram of Receiver of Mono-pulse Radar

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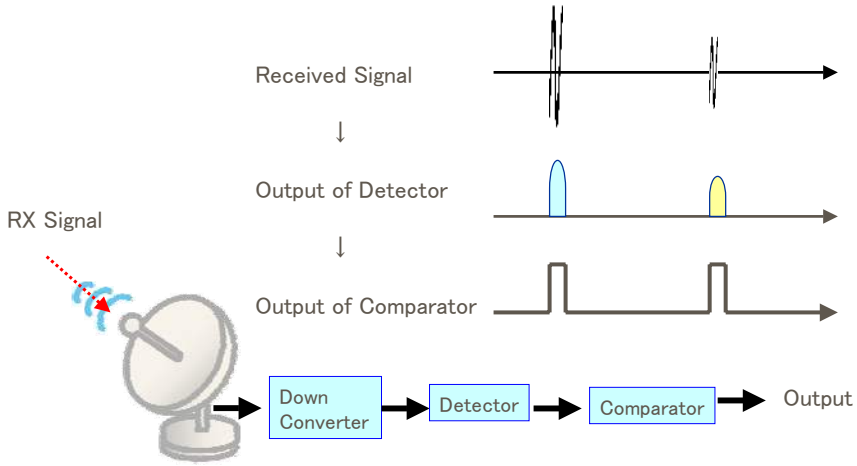
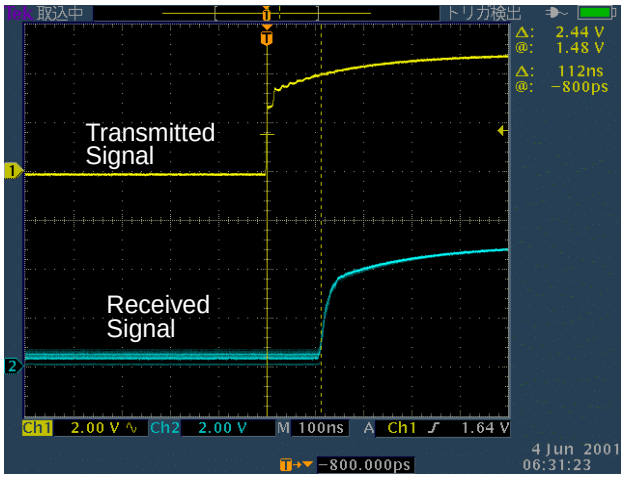


Transmitted and Received Signals of Mono-pulse Radar



2. Millimeter Wave FMCW Radar

Blockdiagram of Experimental FMCW Radar

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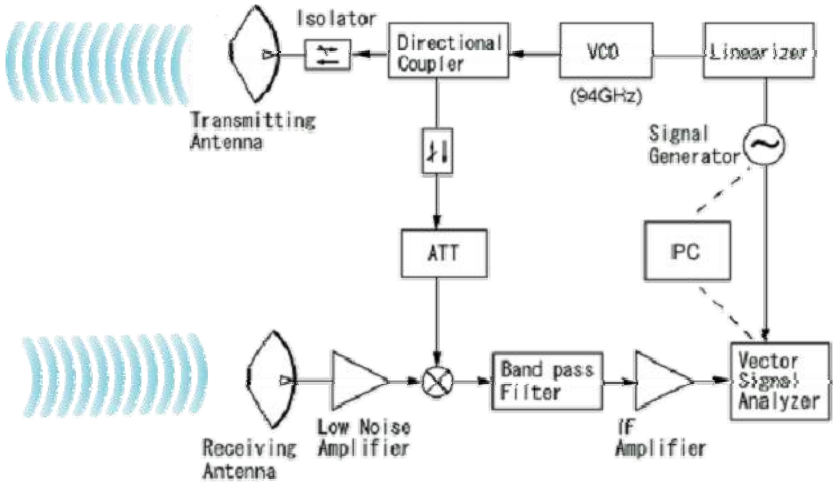
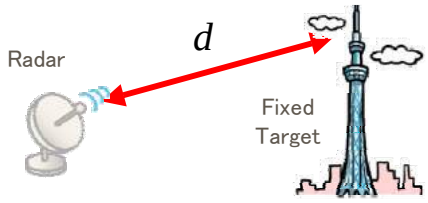


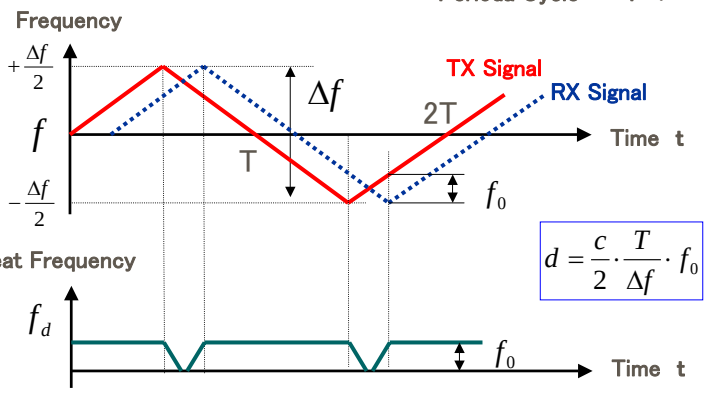


Beat Frequency : f_0

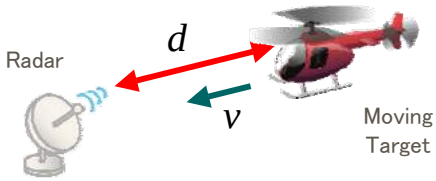
Max Freq. Shift : Δf

Velocity of Light : c

Perioda Cycle : T

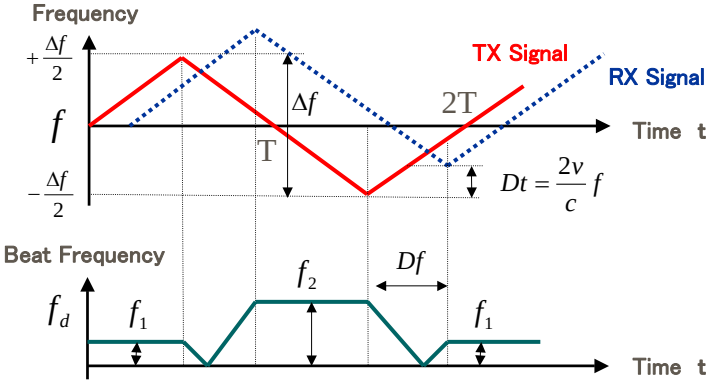


$$d = \frac{c}{2} \cdot \frac{T}{\Delta f} \cdot f_0$$



$$d = \frac{cT}{4\Delta f}(f_1 + f_2)$$

$$v = \frac{c}{4f}(f_2 - f_1)$$



Range Error of FMCW Radar

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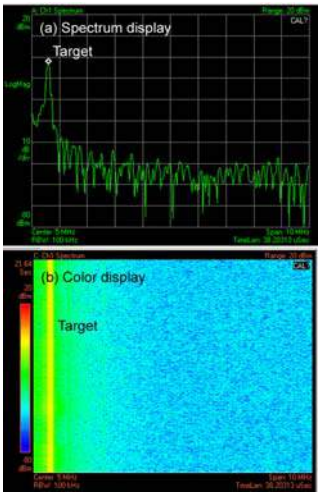
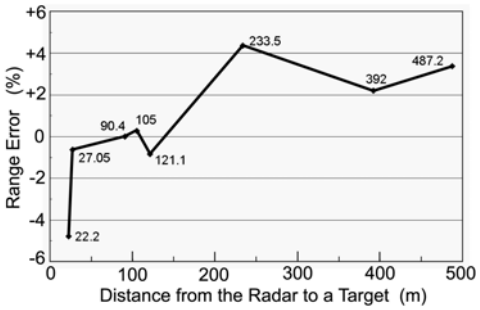
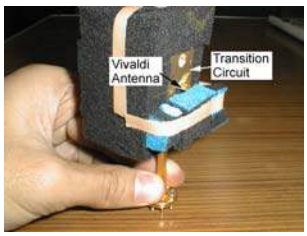
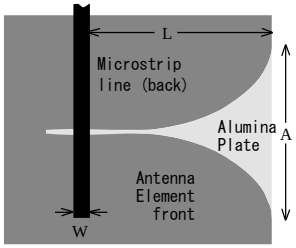


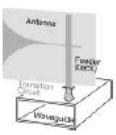


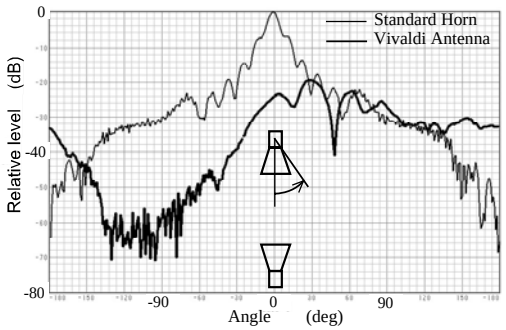
3. Vivaldi Antenna

Prototype of Vivaldi Antenna





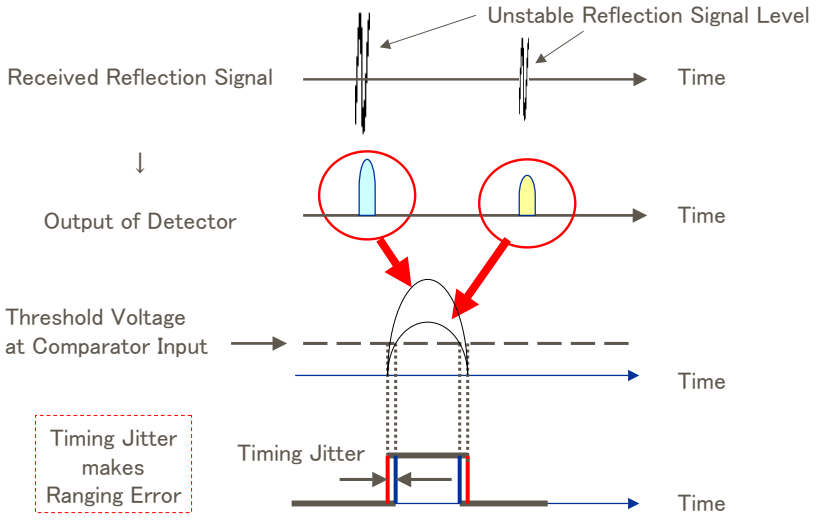




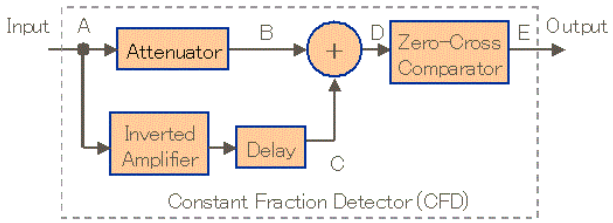
Radiation patterns of Standard Horn Antenna and Vivaldi Antenna

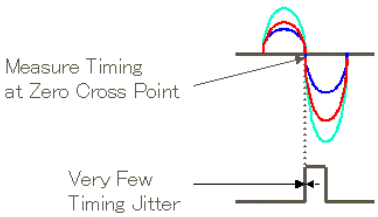
4. Constant Fraction System

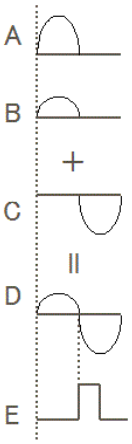
Ranging Error by Timing Jitter



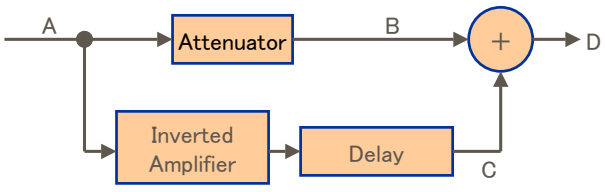
Ranging Error by Timing Jitter



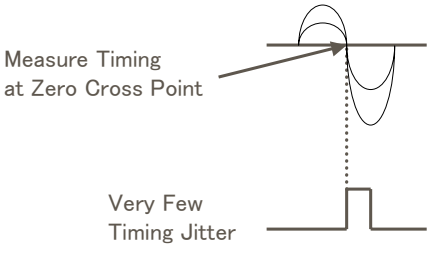


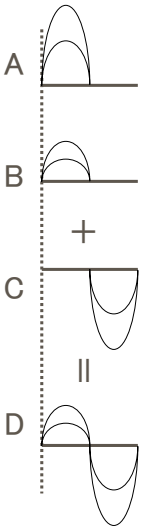


Constant Fraction System



Constant Fraction System





Constant Fraction Detector

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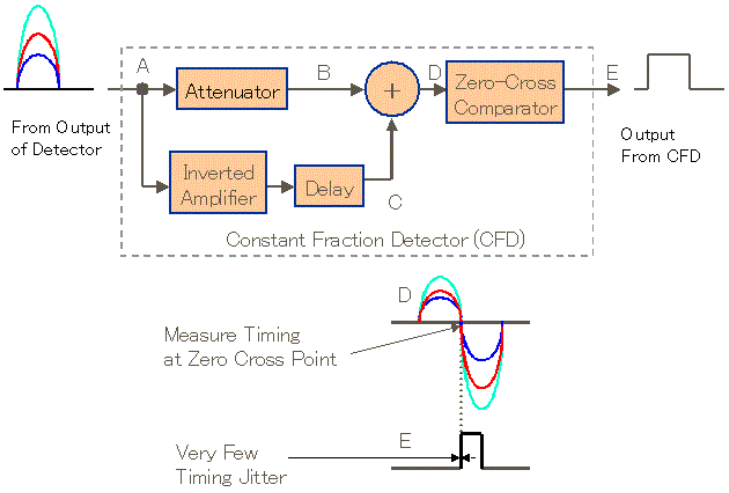

Advantage of CFD over Normal Comparator

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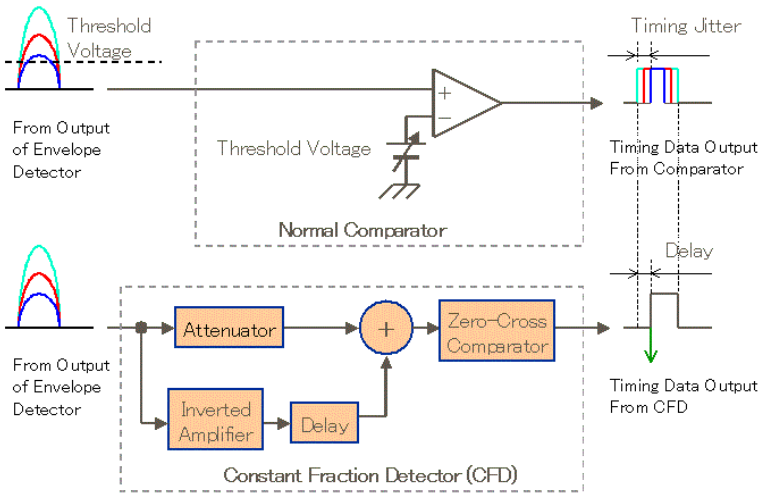


5. Appendix

Chungnam National University

Antenna Lab.,
Dept. of Radio Science and Engineering,
Chungnam National University, Daejeon, Korea

Dep. of Radio and Information Communications Engineering

College of Engineering

Building No. 1

Building No. 2

Building No. 3

Building No. 4

Building No. 5

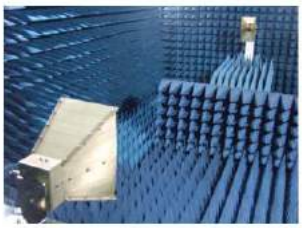
Department

- Dept. of Architecture
- Dept. of Architectural Engineering
- Dept. of Civil Engineering
- Dept. of Environmental Engineering
- School of Mechanical Engineering
- Dept. of Mechatronics Engineering
- Dept. of Naval Architecture and Ocean Engineering
- Dept. of Aerospace Engineering
- Dept. of Electrical Engineering
- Dept. of Electronics Engineering
- Dept. of Radio and Information Communications Engineering
- Dept. of Computer Science & Engineering
- Dept. of Materials Science & Engineering
- Dept. of Chemical Engineering and Applied Chemistry
- Dept. of Organic Materials Engineering

Professor

Professor	Associate professor	Assistant professor
143	22	20

Dep. of Radio and Information Communications Engineering



1993 The Department of Radio Science and Engineering was founded

2016 Radio Science combined with Communications Engineering

Professor

Professor	Associate professor	Assistatn professor
16	1	0

Student

Male student	Female student
223	55

Alumni status(During the last three years)

Graduate school	etc	Employed			Employment rate
		Major company	Venture	Laboratory and agency	
79	85	157	57	26	73.9%

IV. Antenna Laboratory

Full Name	First	Jong-Myung	
	Last	Woo	
	■ Mr.	□ Ms.	
Nationality	Republic of Korea		
Company	Chungnam national university		
department	Dept. of Radio Science and Engineering		
Position	Professor		
Educational Experience	- 1993~1996: Nihon Univ., Ph. D. in Electronics Engineering. - 1991~1993: Nihon Univ., Master's degree in Electronics Engineering. - 1985~1990: Konkuk Univ., Master's degree in Electronics Engineering. - 1981~1985: Konkuk Univ., Graduate in Electronics Engineering.		
Work Experience	- 2002~present: Electromagnetic Environment Research Center at Chungnam national Univ., Head of a department -2011~2014: Radio wave & Electrical Engineering Research Center at Chungnam national Univ., Director - 2007~2008: Univ. Of Texas at Austin, Visiting professor - 2002~2002: Nihon Univ., Visiting professor - 1987~1988: Goldstar Tele-electric Co., Ltd., Staff engineer - 1985~1987: The 9th special forces brigade in ROK(Republic of Korea) Army, Signal officer		
Phone Num.	Office	+82-01-4246-9537	
	Mobile	+82-01-4246-9537	
Address	Dept. of Radio Science and Engineering, College of Engineering, Chungnam National University, 99 Daehak-ro, Yuseong-gu, Daejeon 305-764, Korea		
E-mail	jmwoo@cnu.ac.kr		

- International paper(SCI & SCIE) : 23
- Domestic paper: 32
- International conference papers: 57
- Domestic conference paper : 197
- International patents : 7
- Korea patents : 72
- Patent transfer activities : 12
  SKRF Inc. : 2 , RF4U Inc. : 2 , MTG : 3
  Soft In Hard : 2 , Roswin : 1 , ADD : 2

Objective

Ranets-E
(Russia, X-band)

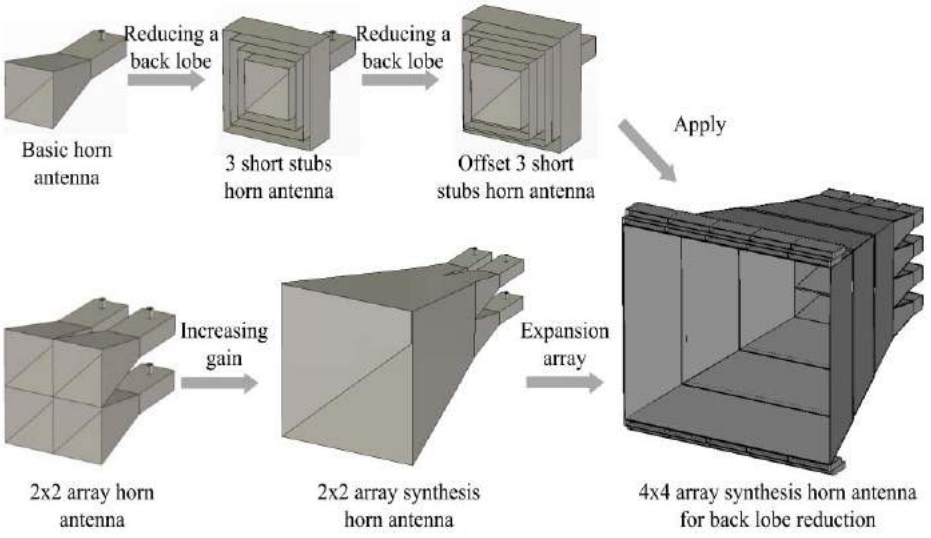
Active Denial System
(USA, 94GHz)

Proposed antenna, 2.45 GHz
(Scale : tank 1/35)

- **Current high-power microwave systems**
  - **Parabolic, Flat reflector antenna**
    - Using a single source
    - Having a problem when the antenna frequency down-size
    - Strong back lobe by spill over

- **Proposed antenna**
  - Narrow beamwidth and high gain
  - Structure that can withstand high power
  - reducing a back lobe
  - Strong output with a small source

Design process



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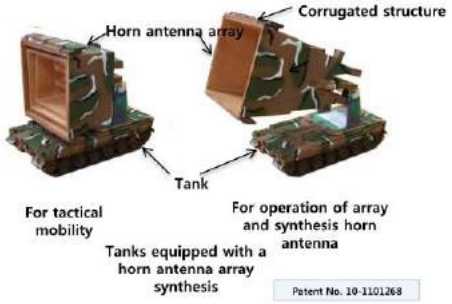
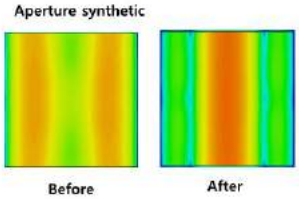
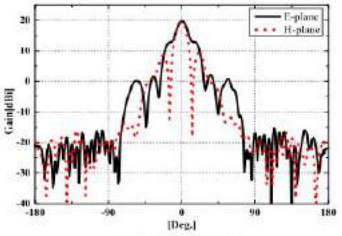
Chungnam National University, Daejeon, Korea

Antenna characteristic



2 short stubs 2x2 array synthesis horn antenna





Radiation pattern

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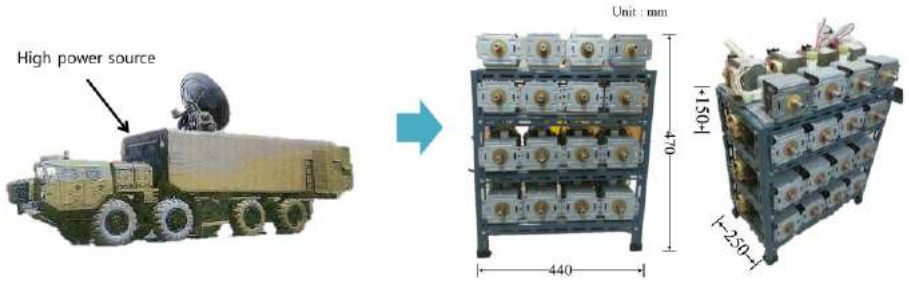
Chungnam National University, Daejeon, Korea

High power horn antenna source production



Existing high power source

Produced high power surce

- It is difficult to implementing an existing high power source

→ **Arranging the individual magnetron sources into 4x4**

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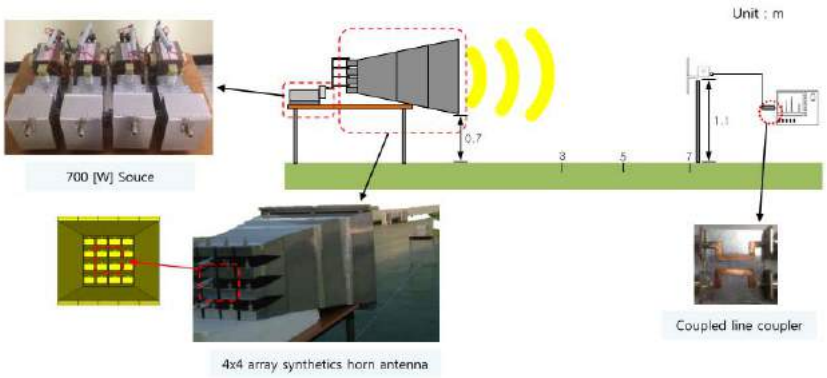
Chungnam National University, Daejeon, Korea

Measuring a radiation power



700 [W] Souce

4x4 array synthetics horn antenna

Coupled line coupler

- Middle 4 Port were used for measuring a radiation power of 4x4 synthetic horn antenna
- receive antenna: center frequency 2.45 [GHz] Dipole antenna used
- for preventing an overload of instrument, coupled line was used.
- Radiation power measuring distance : 3, 5, 7 [m]

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Chungnam National University, Daejeon, Korea

Thank you for your attention.

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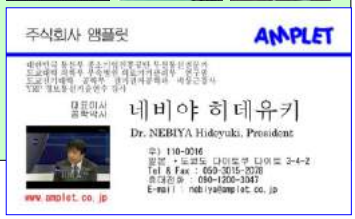

Feb. 23, 2017

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