Radar Technology

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

\[ \tau = \frac{2d}{c} \]

de: Velocity of Light
\[ 3 \times 10^8 \text{ m/s} \]

Blockdiagram of Experimental Mono-pulse Radar
Blockdiagram of Transmitter of Mono-pulse Radar

Blockdiagram of Receiver of Mono-pulse Radar
2. Millimeter Wave FMCW Radar
Blockdiagram of Experimental FMCW Radar

Bea$\text{t Frequency} : f_0$

Max Freq. Shift : $\Delta f$

Velocity of Light : $c$

Perioda Cycle : $T$

$$d = \frac{c \cdot T}{2 \cdot \Delta f \cdot f_0}$$
Range Error of FMCW Radar
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

- Received Reflection Signal
- Output of Detector
- Threshold Voltage at Comparator Input
- Timing Jitter makes Ranging Error
Ranging Error by Timing Jitter

Constant Fraction System
Constant Fraction Detector

Advantage of CFD over Normal Comparator
5. Appendix

Chungnam National University
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

Professor

<table>
<thead>
<tr>
<th>Professor</th>
<th>Associate professor</th>
<th>Assistant professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>143</td>
<td>22</td>
<td>20</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Professor</th>
<th>Associate professor</th>
<th>Assistant professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Student

<table>
<thead>
<tr>
<th>Male student</th>
<th>Female student</th>
</tr>
</thead>
<tbody>
<tr>
<td>223</td>
<td>55</td>
</tr>
</tbody>
</table>

Alumni status (During the last three years)

<table>
<thead>
<tr>
<th>Graduate school</th>
<th>etc.</th>
<th>Major company</th>
<th>Venture</th>
<th>Laboratory and agency</th>
<th>Employment rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>81</td>
<td>157</td>
<td>67</td>
<td>26</td>
<td>73.0%</td>
</tr>
</tbody>
</table>
IV. Antenna Laboratory

Objective

- 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
  -cluding a back lobe
  - Strong output with a small source

- Proposed antenna (2.45 GHz)
- Scale: tank 1/33

- Ranets-6 (Russia, X-band)
- Active Denial System (USA, 94GHz)
- Proposed antenna

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

1. Basic horn antenna
2. Reducing a back lobe
3. 3 short stubs horn antenna
4. Increasing gain
5. Offset 3 short stubs horn antenna
6. Expansion array
7. 2x2 array horn antenna
8. 2x2 array synthesis horn antenna
9. 4x4 array synthesis horn antenna for back lobe reduction

**Antenna characteristic**

- Tanks equipped with a horn antenna array synthesis
- Corrugated structure
- Horn antenna array
- For tactical mobility
- For operation of array and synthesis horn antenna
- 2 short stubs 2x2 array synthesis horn antenna
- Aperture synthetic
- Before and After radiation pattern
High power horn antenna source production

- It is difficult to implementing an existing high power source
  - Arranging the individual magnetron sources into 4x4

Measuring a radiation power

- Middle 4 ports were used for measuring a radiation power of 4x4 synthetic horn antenna
- Receive antenna: center frequency 3.45 GHz Dipole antenna was used
- For preventing an overload of instrument, coupled line was used.
- Radiation power measuring distance = 3.5, 7 m
Thank you for your attention.