Design and Fabrication of Small-Sized Radar-Radiometer Sensors with a Single Antenna Configuration in W-Band for Sensor-Fuzed Systems

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Wan-Joo Kim, Myung-Suk Jung,
Won-Young Uhm, Jae-Hyun Choi

Fuze Group, Agency for Defense Development Republic of Korea
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Why Millimeter Wave for Fuzes?

- Advantages of MMW Fuzes
  - Located between microwave and IR, MMW (millimeter wave) can overcome drawbacks of the bands.
  - MMW fuzes can be structurally small in size.
  - If the carrier frequency is high, we can generally get the high space resolution.
Why Millimeter Wave for Fuzes?

- **Passive Radiometer**
  - Receive the energy emitted from the targets and backgrounds.
  - Receive the reflected energy of sky radiation by the targets and backgrounds.
  - Contrasts exist between the targets and backgrounds.
Why Millimeter Wave for Fuzes?

- **Active Radar**
  - Detect the portion of the transmitted signal scattered from a target in the direction of the receiver.
  - Since the reflectivity of a target is larger than that of the clutter, there exists signal level difference between the target and clutter.
W-Band Radar / Radiometer
Fuzing Sensors

- Common Tx / Rx with a single antenna configuration
- FMCW radar / TP radiometer
- Simultaneous operation
- Compact size
W-Band Radar / Radiometer Fuzing Sensors
W-Band Radar / Radiometer
Fuzing Sensors

- Front-end & Antenna
  - Pout : 11 dBm
  - Rx Loss : 6.5 dB
  - NF : 10.2 dB
  - Ant. Gain : 23 dB
  - Ant. BW : 12.5°
W-Band Radar / Radiometer Fuzing Sensors

- Duplexer
  - OMT & Polarizer
  - Insertion Loss : < 0.5 dB
  - Isolation : > 30 dB
W-Band Radar / Radiometer Fuzing Sensors

- MMIC Receiver
  - LNA + Mixer
  - LNA NF : 3 dB
  - Total CL : 6.5 dB
W-Band Radar / Radiometer Fuzing Sensors

- VCO & Magic Tee
  - VCO Pout : 15.5 dBm
  - Sweep BW : 300 MHz
W-Band Radar / Radiometer Fuzing Sensors

- VCO & MMIC Module
W-Band Radar / Radiometer Fuzing Sensors

- Radar & Radiometer Signal Processing
  - Radar BW : 2 MHz
  - Radiometer BW : 500 MHz
W-Band Radar / Radiometer Fuzing Sensors

- Radar & Radiometer Signal Processing

Diagram showing the signal processing blocks for both Radar and Radiometer. The blocks include:
- Mixer Out
- LNA
- Divider
- BPF
- AGC
- Log
- Offset
- HPF
- LNA
- Detector
- Audio Amp.
- Audio Amp. & Offset
- Beat
- Envelope
- Magnitude
Experimental Results

- Target Detection (1)

- Top: radar
- Bottom: radiometer
- Range: 25 m
Experimental Results

- Target Detection(2)
  - Top: radar
  - Bottom: radiometer
  - Range (FFT): 60 m
Summary

- W-band radar / radiometer fuzing sensors
- Compact size with MMIC receiver
- High output power because of the low insertion loss of duplexer (OMT & polarizer)
- MMW fuzing sensors will be widely used because of high resolution and small size.
Thank You

Fuze Group, Agency for Defense Development Republic of Korea