Effect of Dummy Elements on Monopole-Array assisted Doppler Spread Compensator for Digital Terrestrial Television Broadcasting Receiver

Communications Lab.
Young-Cheol, Yu

Research Background

- Digital Terrestrial Television Broadcasting

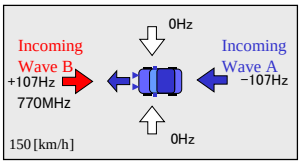
DTTB has been started on December, 2003

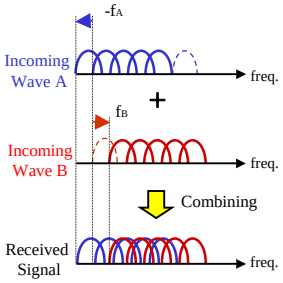
Stationary Reception->13segment spec(64QAM)
Cellular Phone Reception->1segment spec(QPSK)

OFDM(Orthogonal Frequency Division Multiplexing)
➡ robust multi-path delay
(Narrow bandwidth among sub-carriers)
➡ weak in Doppler spread
(It can cause problem when high speed mobile reception)

Problem of Mobile Reception

- **Multi-path Environment**
  - →Several incoming waves affect the different Doppler shift
  - →ISDB-T has narrow bandwidth among sub-carriers
  (eg. Mode3: 1kHz)





Outline of Conventional Research

- High Speed Mobile Reception of DTTB

➡

Doppler Spread Problem
➡ Array Antenna assisted Doppler Spread Compensator

➡

The conventional system uses monopole-array
− Install on the roof of a vehicle

Research Goal

- The Conventional Monopole-Array
  - •Narrow Antenna Spacing

→ Mutual Coupling Problem

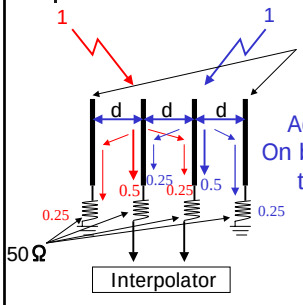
↓ Solution

Mutual Coupling Canceller: Narrow Operating Bandwidth

↓ Propose

Dummy Elements add on both sides of Monopole-Array

The Proposed Monopole-Array



Adding the dummy elements On both sides of monopole-array, the mutual coupling effect has been reduced

Antenna Simulation

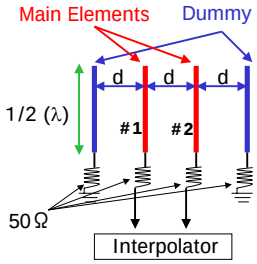
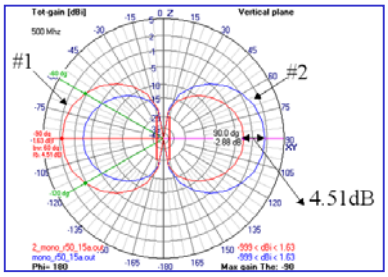


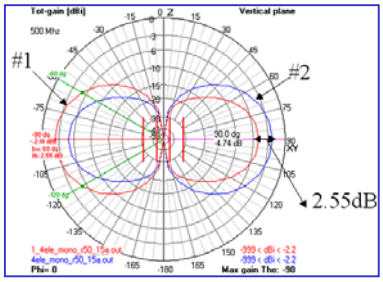
Table.1

Frequency	500MHz
Load Impedance	50Ω
Antenna Length	1/2（λ）
Antenna Spacing	d=0.1 λ ~ 0.5 λ

Radiation Pattern(2-elements)



Radiation Pattern(4-elements)

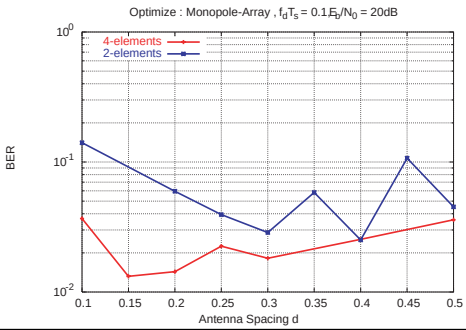


Computer Simulation Parameters

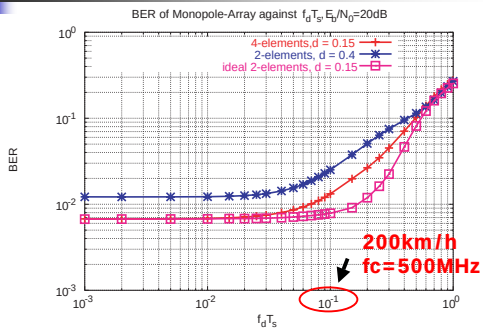
Table.2

Band Width	5.572MHz
Carrier Spacing	0.992kHz
Number of Carriers	5617
Carrier Modulation	64QAM
Effective Symbol Duration	1.008ms
Guard Interval	126 μs(1/8)
Propagation Model	Two-ray Rayleigh Fading
D/U(dB)	0dB
Antenna Spacing	d=0.1 λ ~0.5 λ

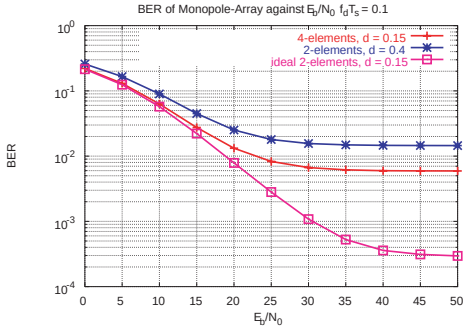
Optimization against Antenna Spacing d(λ)(f_dT_s=0.1 E_b/N_0=20dB)



BER Performance against f_dT_s (E_b/N_0 =20dB, d=0.15 λ)

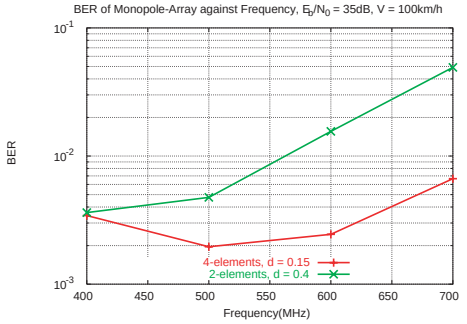


BER Performance against E_b/N_0 (f_dT_s=0.1, d=0.15 λ)



13

BER Performance against Carrier Frequency (Eb/N0 = 35dB, V=100km/h, d=0.15λ)



14

Conclusion

- Adding the Dummy Elements on both sides of Monopole-Array
  - —Reduction of Mutual Coupling effect among Array Elements
  - —A wide Operating Bandwidth
  - —The BER performance of Doppler spread compensator is improved due to reduction of Mutual Coupling effect

15

Future work

- The inequality antenna spacing apply to computer simulation

16

Thank you!

17