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A Compact Tri-Polarization Antenna for MIMO Communication Systems

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- 2. Tri-Polarization Antenna
- 3. Hand-Made Radio Echoic Chamber

(Creation of Multipath-rich Environment)

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Applications are from W-LAN to next-generation mobile wireless systems.





MIMO Propagation Channel Model









Average Channel Capacity in iid Rayleigh Fading Environment

$$C_{1} \rangle = m \int_{0}^{\infty} \log_{2} \left(1 + \frac{\gamma_{0}}{N_{t}} \lambda \right) p^{unord} (\lambda) d\lambda$$
$$\approx m \log_{2} \left(1 + \frac{\gamma_{0}}{N_{t}} \langle \lambda \rangle \right)$$
$$= m \log_{2} \left(1 + \frac{\gamma_{0} N_{r}}{m} \right) \quad (\text{since } \langle \lambda \rangle = N_{t} N_{r} / m)$$

$$\{C_0 \equiv \log_2(1 + \gamma_0); \gamma_0 >> 1; N_t = N_r\}$$



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Increase of Channel Capacity

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Use of Dual-Polarization Branches Use of Triple-Polarization Branches

Compact MIMO Antenna





Dual-Polarization antenna

Triple-Polarization antenna



The tripolarization antenna acts as a threeelement MIMO antenna in the case of multipath-rich environment

N.K. Das et al., IEEE VTC2004 Fall, LA, Sep. 27-29, 2004.







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Antenna Element





(5 GHz)





Creation of a Multipath-Rich Environment

Radio Echoic Chamber (Reverberation Chamber) as a Reference Environment





Handmade Radio Echoic Chamber (Reverberation Chamber)

The chamber is enclosed with 20 aluminum plates (1mx2m plate)







Radio-Echoic Chamber

Creation of an ideal multipath-rich environment













Measurement of Propagation Characteristics







Measured Propagation Characteristics in frequency and spatial domains







Measured Characteristics of Radio-Echoic Chamber







CDF of Received Power for H-H, V-H, and Z-H







The largest eigenvalue for multiple polarizations













- B: dual-pol. (2x2)
- C: tri-pol. (3x3)
- D: 3-antenna array (3x3)













Conclusions

Tri-polarization antenna, which is one of very compact antennas, showed a nearly the same performance of 3x3 single-pol MIMO array in multipath-rich environment.

We will evaluate the performance of the antenna in actual environments (both indoors and outdoors).





Thank you very much for your kind attention!