B-1-254

Effect of Path Visibility on Urban MIMO System

Sirichai Hemrungrote* Toshikazu Hori* Mitoshi Fujimoto* Kentaro Nishimori**
*Graduate School of Engineering, University of Fukui **NTT Network Innovation Laboratories, NTT Corporation

1. Introduction

MIMO wireless communication architecture promises significant to achieve high bandwidth efficiencies and allow robustness against channel fading and interference [1]. In this paper, the effect of path visibility on urban MIMO system is studied. Herein, the word "path visibility" is defined as the probability that the direct wave can be received at mobile terminal (MT) or Line-of-Sight (LOS) exists.

2. Analysis Model

The urban propagation model is represented in Fig.1. This model is a 4x4 MIMO system with half-wavelength spacing. The distribution of the height of the buildings is assumed following chi-squared distribution with DOF of 5 [2].

$$h = f(\chi^2) + 4 \quad (1)$$

The width of building is determined from its height [2].

$$w_m = w_0\left\{1 - \alpha \times \exp(-\beta h)\right\} \quad (2)$$

Here, w_m is the width of the building, w_0 is 55m, α is 1.1, β is -0.025 m^{-1}, and h is the height of building.

To encounter a perfect reflection and diffraction environment, the MT is assumed to move on the road in the area of 280x280m around the center of the model along the broken lines in Fig.1. The propagation characteristics are calculated by using EEM-RTM based on ray-tracing method. The channel capacity is then calculated when the weight coefficients are controlled by MMSE [3].

3. Effect of Path Visibility on Channel Capacity

Figure 2 indicates that, at any heights of BS antenna, the path visibility decreases when the average height of surrounding buildings is higher. Fig. 3 indicates that, at any average heights of surrounding buildings, the path visibility reasonably increases when the BS antenna is mounted higher.

Figure 4 indicates that the channel capacity at 50% of CDF can be estimated from the path visibility without necessary to figure out from the propagation model configuration, neither the building height distribution nor the BS antenna height. Considering the curves on the right-hand side of the vertical dot line in Fig. 4, it is noticed that the channel capacity at 50% of CDF no more depend on the path visibility. That is to say, to obtain a satisfied urban MIMO communication with considering at the cost as well as the performance point-of-view, it is adequate to mount the BS antenna at the height so as the path visibility becomes 29 percents.

4. Conclusions

Considering the results mentioned above, it was clarified that the path visibility reasonably increased when either the average height of surrounding buildings was lower or the BS antenna was mounted higher. It was also indicated that the channel capacity characteristic of urban MIMO system could be estimated directly from the path visibility.

References

[1] H. Kuwahara, T. Hori, M. Fujimoto and K. Nishimori, "Change in characteristics in urban area environment," Proc. ISAP2004, Sendai, Japan, pp. 741-744, Aug. 2004.
[2] S. Ishida, T. Hori and M. Fujimoto, "Effects of path visibility on space division performances of SDMA in urban area," Proc. APMC2007, Thailand, Dec. 2007.
[3] S. Hemrungrote, T. Hori and M. Fujimoto, "Effect of BS configuration on urban MIMO system," The 2008 IEICE Society Conference, B-01-182, Kawasaki, Japan, Sep. 2008.

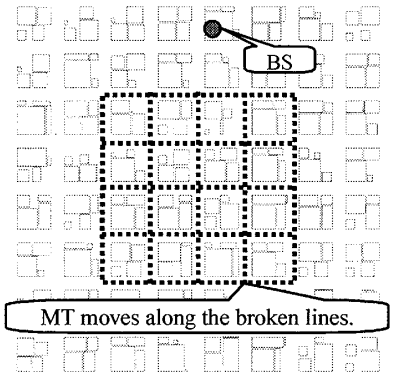

Fig.1 Urban Propagation Model

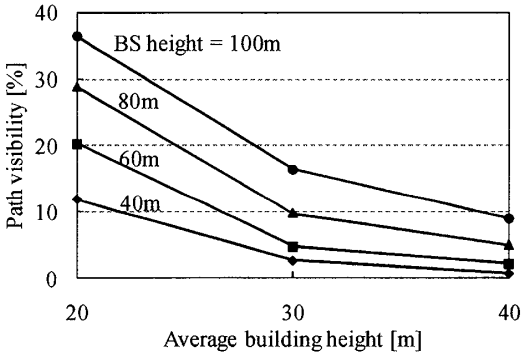

Fig.2 Relationship between Path Visibility and Average Building Height

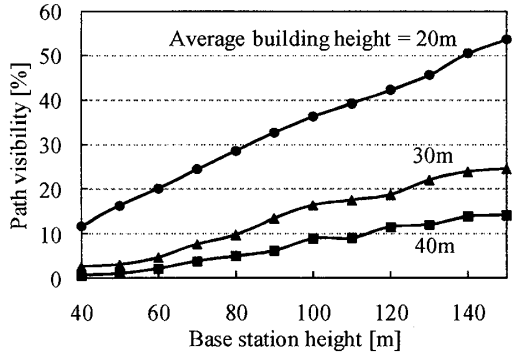

Fig.3 Relationship between Path Visibility and BS Antenna Height

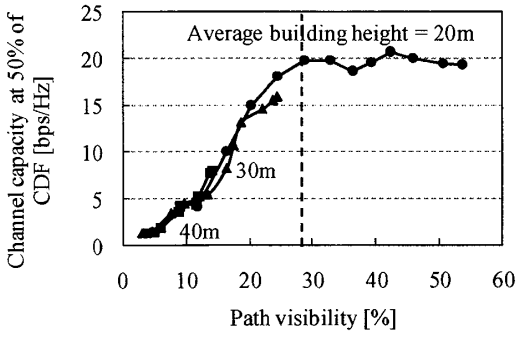

Fig.4 Effect of Path Visibility on Channel Capacity