Evaluation of Antenna Beam Search Algorithm Using Terminal Position Prediction in Frequency Sharing

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1. Introduction

Antenna beamforming is expected to enable spatial sharing in frequency sharing because it suppresses the radiation range of radio waves[1]. However radio waves do not always propagate in the same direction, and the number of possible combinations of beams that can be radiated at a given time is large, so efficient beam selection is required. This paper evaluates the coverage of terminals by pre-searching for beams using a beam search algorithm and the amount of reduction in the interference-affected area due to beam suppression.

2. Evaluation Environment

The algorithm used for beam selection is based on the algorithm proposed by the authors in a previous paper, which searches for beams based on received power and terminal position data within a range[2].

In this paper, an array antenna with 4×8 elements is used.The beam half-widths are 25 deg in the vertical direction and 12 deg in the horizontal direction, and they are arranged in a 4×8 configuration so that they do not overlap.

The simulation parameters are shown in Table 1.

3. Algorithm Evaluation

The algorithm performs an advance search of the beam and evaluates the percentage of terminals that can communicate with all beams emitted and the interference affected area. The pre-search is performed at the same time, one week before, and on the Saturday and Sunday immediately before the beam emission. The conventional selection method, in which four beams with shallow vertical angles and straight horizontal directions are continuously selected, is used as the conventional method for comparison.

Figure 1 shows the results of the evaluation of the percentage of available terminals at each time of day. The search conducted one week earlier resulted in 89%, which is close to 90%, but the search conducted on Saturday and Sunday immediately before the search resulted in a drop in the percentage of available terminals during the daytime hours.

Fig 2 shows the results of the evaluation of the interference affected area at different times of the day. Compared to the conventional method, the algorithmic search reduces the interference affected area less, and the difference between search dates is smaller.

From the viewpoint of how much the interference-affected area was reduced for the terminals that were not covered, the one-week-ahead search missed 11% of the terminals but reduced the area by 14%, which is a greater reduction than the conventional method. From this result, it can be said that the proposed method is an algorithm that can select beams that cover the terminals efficiently.

Acknowledgement

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References

[1] A. Mukherjee, "Energy-Efficient Beam Management in Millimeter-Wave Shared Spectrum,"IEEE WC, pp. 38-43, Oct. 2020.
[2] Kizuku KAWAMURA, Kohei AKIMOTO, Osamu TAKYU "Beam Selection Algorithm by Directional Antenna Beamforming for Spectrum Sharing" Technical Committee on Smart Radio , 65, July 2022

Table 1 simulation parameters

transmitting power	40[dBm]
center frequency	4500[MHz]
bandwidth	20[MHz]
reflection/transmission/diffraction frequency	3,0,1[times]

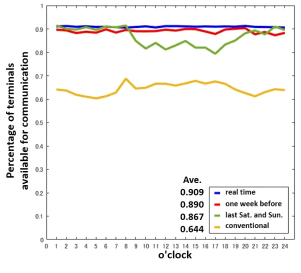

Fig. 1 Percentages of available terminals by time

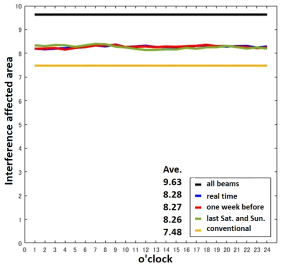

Fig. 2 Interference affected area by time

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