ANTENNA DIVERSITY METHODS FOR WIRELESS INDOOR COMMUNICATIONS

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Diversity reception is a technique in radio communications to provide better specrum efficiency with a cost of an extra set of antennas. The well known improvement from antenna diversity is the reduction of signal fading in multipath environments such as downtown areas in large cities. This study concentrates on the design problem and the performance considerations of an antenna array, which can be used in a base station of a wireless local area network (WLAN) to provide diversity.

An antenna pattern synthesis method is introduced, which results in exactly the same power pattern but dissimilar phase patterns for the array. The developed theory is rather general and can be applied for linear, planar and 3-dimensional array pattern design. The antenna patterns provided by the synthesis method can be applied in diversity reception while the dissimilar phase patterns give several possibilities to reduce destructive interference. The antenna diversity would therefore be implemented in selection combining between the different antenna pattern excitations and thus fulfilling the original coverage planning requirements. The well-known space diversity technique with selection combining between the antennas is shown to be a simple specific solution of the introduced method. In fact the space diversity scheme can be interpreted as phase diversity, since the receiving antenna's location actually chances the relative phases of the incoming plane wave components at the reception point.

In an indoor radio propagation channel reflections from the floor and the ceiling are important sources of signal interference, thus making the propagation environment more complex and prone to severe signal fading. A small 2-dimensional array in a base station, which is shown in Figure 1, could be a simple but effective method to neutralize the effects of fading. The fading reduction performance is assessed from a signal response of a 3-dimensional ray-tracing radio channel simulator program. The simulated indoor environment and an example of the signal response are shown in Figure 2. The simulator program takes into account the polarization effects of the propagating signal, which leads to a good estimate of the signal correlation between different array responses and antenna diversity methods.

The use of an antenna array in a base station provides means to design the radiation pattern according to coverage needs and on the other hand to utilize

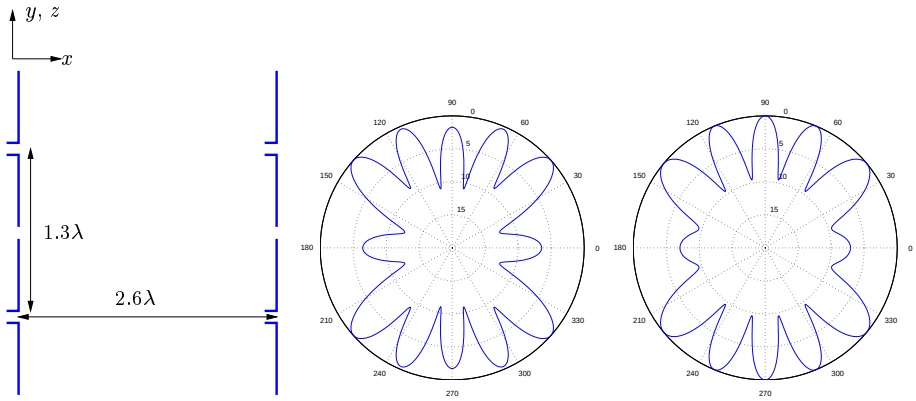

Figure 1: 2-dimensional diversity array and horizontal plane antenna patterns for both horizontal and vertical alignments of the array

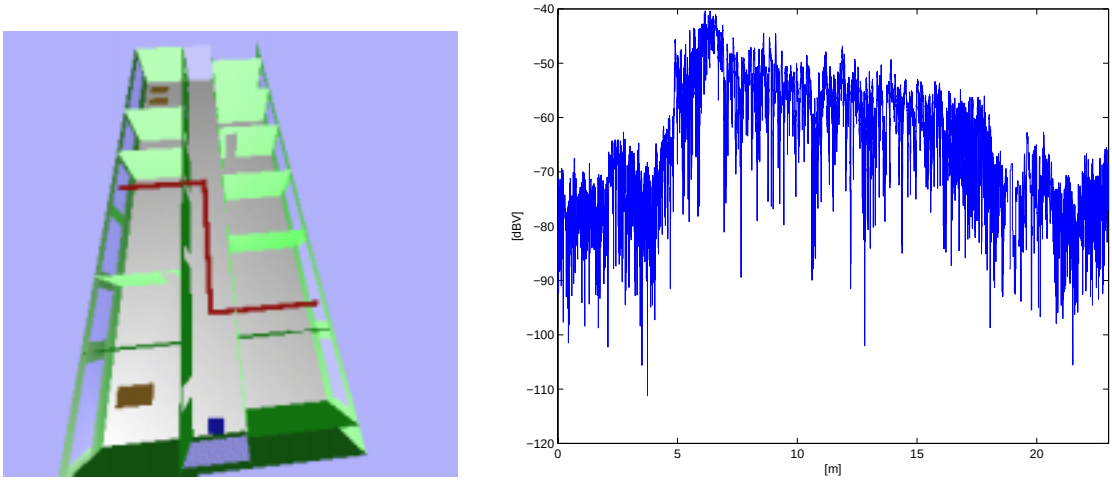

Figure 2: The simulated office environment and the corresponding receiver signal response

the signals in all array elements in diversity reception.

References

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