光ファイバ無線による直角座標系空間多重無線通信の実証
Proof-of-Concept of Rectangular-Coordinate Orthogonal Multiplexing by Radio-over-Fiber

M20助自68

代表研究者 戸 村 崇 東京工業大学 工学院・電気電子系 助教
Takashi Tomura *Assistant Professor, School of Engineering, Department of Electrical and Electronic Engineering, Tokyo Institute of Technology*

共同研究者 ギレルモ カーピンテロ デル バッリオ マドリードカルロス3世大学 電子工学科 教授
Guillermo Carpintero del Barrio *Professor, Department of Electronics Technology, University Carlos III of Madrid*

In this study, we investigate spatial multiplexing as a method to increase the communication speed. In this research, we study the spatial multiplexing as a method to increase the communication speed, as if there are multiple cables between the transmitting and receiving antennas. A conceptual diagram of wireless communication speed is shown in the lower right. The current speed of fixed wireless communication is proportional to the product of the frequency utilization efficiency and the bandwidth used. Therefore, research is being conducted to improve the frequency utilization efficiency and to develop components that can operate in a wide bandwidth, such as multi-level modulation and polarization multiplexing. The speed of spatial multiplexed wireless communication is determined by the product of three factors: multiplicity, frequency utilization efficiency, and bandwidth. This means that the conventional speed can be increased by the multiplicity, and the current communication speed can be dramatically improved. The impact of multiplexed wireless communication is significant because it can be shared with other communication technologies. We have proposed a multiplexing method using spatial eigenmodes with different polarity, and demonstrated two-channel wireless multiplexing communication. The spatial eigenmode can be multiplexed and demultiplexed in a wide bandwidth by magic tee. 2-channel wireless multiplexing characteristics were measured and low crosstalk was confirmed. Changing the transmit power of one channel does not affect the BER of the other channel. This implies that the crosstalk between the two modes is sufficiently low. a maximum total data rate of 11 Gbps was confirmed by two-channel multiplexed wireless communication. The multiplexing scheme proposed in this paper can be applied to high frequencies such as hundreds of GHz, because it can multiplex and decode spatial eigenmodes using only hardware with low crosstalk level. The proposed multiplexing scheme can be applied to high frequencies such as hundreds of GHz.

研究目的

The ultimate goal of this research is to provide ultra high-speed communication lines to depopulated areas. In urban areas of developing countries, high-speed communication using optical fiber is available. However, in rural areas, the network is constructed by wireless communication instead of optical fiber, and people are forced to use low-speed communication. The purpose of this research is to dramatically improve the communication speed of fixed wireless communication, which will lead to the development of tele-teaching, tele-medicine and ICT industries, and to the elimination of regional and information disparities.

概　　要

In this study, we investigate spatial multiplexing as a method to increase the communication speed. In this research, we study the spatial multiplexing as a method to increase the communication speed, as if there are multiple cables between the transmitting and receiving antennas. A conceptual diagram of wireless communication speed is shown in the lower right. The current speed of fixed wireless communication is proportional to the product of the frequency utilization efficiency and the bandwidth used. Therefore, research is being conducted to improve the frequency utilization efficiency and to develop components that can operate in a wide bandwidth, such as multi-level modulation and polarization multiplexing. The speed of spatial multiplexed wireless communication is determined by the product of three factors: multiplicity, frequency utilization efficiency, and bandwidth. This means that the conventional speed can be increased by the multiplicity, and the current communication speed can be dramatically improved. The impact of multiplexed wireless communication is significant because it can be shared with other communication technologies.

We have proposed a multiplexing method using spatial eigenmodes with different polarity, and demonstrated two-channel wireless multiplexing communication. We have measured the characteristics of two-channel wireless multiplexing using a four-mode ROM antenna in the 80-GHz band. The ROM antenna consists of four magic-Ts, a parallel feeding circuit, and a 2 × 2 element sub-array. the magic-Ts are connected vertically and generate four spatial eigenmodes by changing the input port. The parallel feeding circuit feeds the 64 2 × 2 element sub-arrays with uniform amplitude and phase. The total number of array antennas is 256. Fiber optic radio (RoF), which has a high affinity for high frequencies, was used as the radio circuit. Two lasers were used for signal generation, and the intensity was modulated by an optical intensity modulator. The RF signal was generated at 80 GHz, but due to the limitation of the measurement equipment, a 100 GHz PD and a 50 GHz PD were used. At the receiving antenna, the signals were demodulated into baseband signals by SBD. Two modes were used: mode 4, which emits four beams, and mode 1, which emits one beam. As a result of the measurement, low crosstalk was confirmed. Changing the transmit power of one channel does not affect the BER of the other channel. This suggests that the crosstalk between the two

modes is sufficiently low. a maximum total data rate of 11 Gbps was confirmed by two-channel multiplexed wireless communication. However, crosstalk occurred depending on the combination of modes, and interference between modes was confirmed.

The multiplexing scheme proposed in this paper can be applied to high frequencies such as hundreds of GHz, because it can multiplex and decode spatial eigenmodes using only hardware with low crosstalk level. The proposed multiplexing scheme can be applied to high frequencies such as hundreds of GHz. To increase the communication speed, we will increase the frequency to 120 GHz or 300 GHz and improve the frequency utilization efficiency by multi-level modulation. To increase the communication range, two approaches will be taken: the expansion of the non-distant field region by increasing the antenna aperture and the number of elements, and the optimal arrangement of the sub-array spacing.

－以下割愛－