Study on Wireless Communication System using LCX

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Leaky coaxial(LCX)cable antenna

LCX is an antenna which is able to transmit and receive radio signals by the slots opening in shielded conductor of coaxial cable [Fig.1]. Angle of slots alternately changes and the slots opening along a cable generate electromagnetic field. It works as directive antenna since the signals emitted from slot are constructively and destructively interfered [Fig.2].
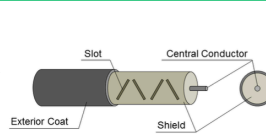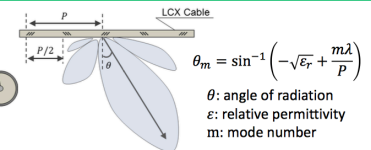

Fig.1 Leaky coaxial cable

$$\theta_m = \sin^{-1}\left(-\sqrt{\varepsilon_r} + \frac{m\lambda}{P}\right)$$

θ: angle of radiation
ε: relative permittivity
m: mode number

Fig.2 Directivity of LCX cable

Beam forming by Okimoto Yuta

1.Purpose
Improvement of frequency utilization efficiency at densely populated area such as underground city and subway stations using beam forming.

2.What's beamforming
A technology that can control beam directivity so that the receiver sensitivity can be optimized at target location by combining the plural radio signal.

3.Method
Beam forming can be realized by arranging plural LCX in parallel closed together, and combine signals according to weight for phase and amplitude.
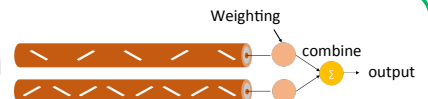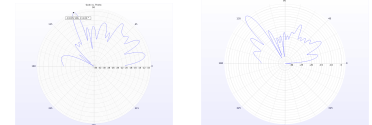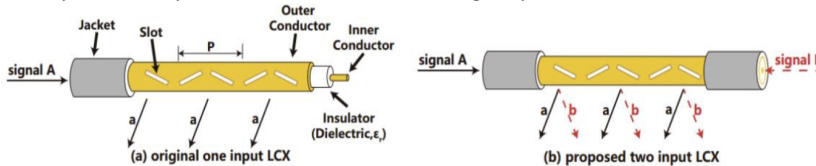

Fig.3 Beam forming model

Fig.4 Directivity analysis

Throughput Measurement of LCX-MIMO System in Linear cell by Zhu Zeyu

1.Introduction
A 2-by-2 MIMO system can be constructed using only one cable.

2.Issue
In real environment, channel response of LCX-MIMO depends on deployment of cable. Throughput performance was measured under the various LCX cable condition such as on the wall and on the floor. The performance of different LCX and different distance between the receiving device and the cable were measured.

3.Result
In terms of throughput, cable set on height 2.18m(wall) has better performance than that on the floor. The 18Deg. LCX achieves better performance compared to that of using 55Deg. LCX in most of measured area.
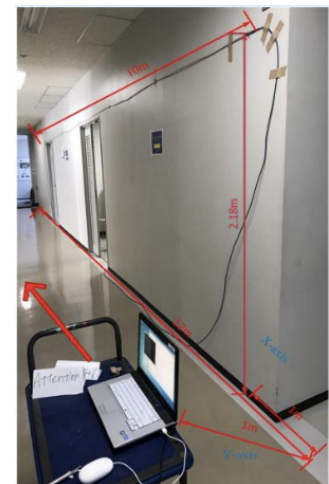
Wireless position detection using MUSIC method in LCX-MIMO system by Yahagi Takumu

1.Introduction
In this study, wireless position detection in LCX-MIMO is proposed. The proposal is based on time of arrival (ToA) to localize radio terminal. Since the Fourier transform has limitation in terms of time resolution when observed frequency bandwidth is limited, multiple signal classification (MUSIC) algorithm is employed in order to improve time resolution for estimating channel response.

2.MUSIC algorithm
MUSIC algorithm is one of high resolution analysis for frequency, angle of arrival, and time of arrival. The algorithm uses eigenvalues and eigenvectors of the correlation matrix and it enables us to achieve higher resolution than IFFT. When a frequency spectrum is obtained as shown in Fig. 3, by applying IFFT and MUSIC method to the spectrum, spectrum like Fig.3 can be obtained. From this figure, it can be seen that the MUSIC spectrum has higher time resolution than the spectrum obtained by IFFT.

3.Method
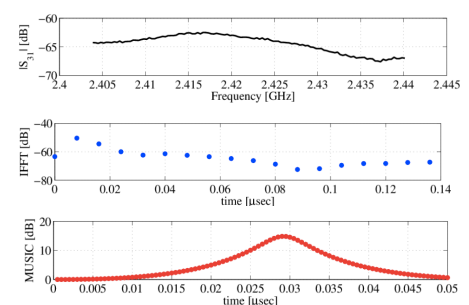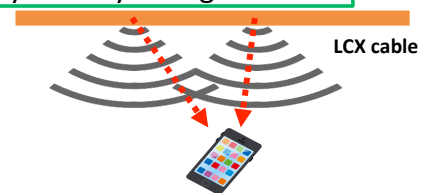Terminal position can be geometrically detected by estimating arrival time of radio waves.

LCX cable

Fig.5 Various spectral characteristics