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Article / Book Information

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種別(和文)	論文要旨
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（博士課程）
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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The target of the study in this dissertation is the realization of miniaturization and high functionalization of radiating elements for array antennas on moving platforms. There are three issues in these antennas: first, miniaturizing antennas reduces their degree of freedom and increases the input impedance, which makes it difficult to obtain the impedance matching; second, since array antenna performances are often degraded when scanned to a wide angle, design technology to realized high performances over the wide coverage is required; third, because the size of wideband antennas tends to become large, the antenna type and the material used must be selected appropriately. In order to design antennas that suit for moving platforms, this dissertation deals with newly proposed design methods for three types of antennas, as shown below.

Firstly, a novel traveling-wave series-fed microstrip antenna array is discussed. A conventional series-fed microstrip antenna array is lack of the degree of freedom, and only way to control radiation power from each element is changing the width of each element. In addition, a meander line is used to compensate the phase distortion because the transmission phase varies with the radiation power from each element. Although the length of the meander line can be arbitrarily selected and makes array design easy, the meander line increases insertion loss and spurious radiation. In the proposed antenna, additional slits placed on the output side of the antenna element are introduced as a new degree of freedom to control the radiation power from each element. Also, the unequal element spacing is applied to compensate passing phases of each antenna element; meander lines that would increase the insertion loss and spurious radiation are not used. Because the phase distribution is adjusted by the element position and the excitation amplitude distribution required to realize a desired radiation pattern changes according to the element position, the amplitude distribution is designed by using a genetic algorithm. A 9-element linear array is designed and tested, and the simulated and measured results agree, thus validating the proposed design.

Secondly, a novel circularly polarized ring microstrip antenna and its design. A conventional ring microstrip antenna maintains good radiation characteristics with a smaller dimension than circular microstrip antennas. But, since the minimum input impedance of ring microstrip antennas quickly increases when the inner/outer diameter ratio increases, an additional matching circuit needs to be embedded, which prevents the inner area from being used for other purposes. In the proposed antenna, the shorting pins, which are discretely disposed on the inner edge of the ring microstrip antenna, are introduced as a new degree of freedom to improve the resonance frequency control. The number and diameter of the shorting pins control the resonance frequency; the resonance frequency can be made almost constant with respect to the inner/outer diameter ratio, thereby expanding the use of the ring microstrip antenna. As an example of a use for the proposed antenna, a dual-band antenna where the proposed antenna includes another ring microstrip antenna is designed and measured, and these results agree well with measurement. Furthermore, the electrical performance for a proto flight model of a satellite positioning system using the proposed antenna is demonstrated. The measurement and designed results agreed well, which proves that the antenna can be put into practical use.

Lastly, a light-weight horn antenna that covers up to 45 degrees is proposed. A conventional metal horn array antenna is low loss but has large weight as well as large element spacing, which prevents wide-angle beam scanning. To solve this problem, an injection-molded horn array antenna, which is compact, low-loss and highly manufacturable, has been proposed. However, the axial ratio was deteriorated during wide-angle beam scanning, because the antenna was designed to be impedance-matched in the front direction, without considering the axial ratio at all. In this dissertation, the mechanism that the axial ratio degrades in the injection-molded horn array antenna is clarified. Besides, the reflection wave that degrades the axial ratio is extracted by converting the expression of the reflection wave from the liner polarization to the circular one. The circular component of the reflection wave can be controlled by the position and depth of the iris placed near the horn array antenna's aperture. By suppressing this component over the wide coverage, the beam scanning characteristics are guaranteed. The proposed method enables a definitive and efficient design of the injection-molded horn array antenna, by utilizing the same degree of freedom as conventional one. A prototype antenna has been fabricated in the millimeter-wave band, and the validity of the design method has been confirmed by measurement.

The antennas and design methods developed in this dissertation contribute to the realization of miniaturization and high functionalization of radiating elements for array antennas on moving platforms and are considered to have wide applicability for communications and radar systems.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).