論 文 の 内 容 の 要 旨

論文題目 A Study on 10 GHz Antenna Based on RF-MEMS Tunable Metamaterials

（RF-MEMS 可変メタマテリアルの 10GHz 帯アンテナ応用に関する研究）

氏 名 Yong Luo

羅 勇

In order to realize smart antenna for IoT (Internet of Things), we propose an active metamaterials-based CRLH (Composite Right Left Handed) antenna using RF-MEMS cantilevers to tune metamaterials properties and control spatial radiation beams. Firstly we design a metamaterials tunable J-shape unit that consist of a pair of symmetry J-shaped patches with length smaller than $\lambda_g/5$, possessing effective electromagnetic homogeneity. Thanks to the microstrip-based implementation that has advantage in directional antenna radiation, and the J-shape unit that compatible to MEMS process, RF-MEMS array could be applied as RF switches to tune metamaterials properties, and consequently active scanning leaky wave antenna could be realized by cascading periodical J-shape units. By actuating RF-MEMS On/Off, antenna dispersion property could be tuned, leading to continuous scanning radiation patterns from backward (around -30º) through broadside (0º) to forward (around +30º) in the frequency band around 9 GHz.

In addition, two interesting topics are proposed. One is to explore the feasibility of digital tuning of programmable metamaterials-based antenna by gradually tuning the dispersion diagram. As eight J-shape patches are integrated in the leaky-wave antenna, and nine different gap-statuses are designed. The dispersion diagram is found to vary the transition frequency from 9.4 GHz to 8.7 GHz with a step of 0.1 GHz, thereby frequency-dependent scanning radiation patterns are realized. Moreover, thanks to the gradually varying dispersion diagram, a status-dependent which also means programmable scanning radiation patterns are acquired in the band from 9 GHz to 9.3 GHz. Another topic is to explore the 2D scanning metamaterials-based antennas, in which phase constant β in two orthogonal directions are tuned, such that half-sphere spatial scanning radiation patterns are able to be realized.