Seminar Radar & Communication WS 2021-22

Karlsruher Institut für Technologie

Electrically small antennas

There are many different types of planar antennas - microstrip antennas, suspended plate antennas, coplanar waveguide (CPW) antennas, planar monopole antennas, and planar inverted-L and inverted-F antennas (PILAs and PIFAs). In this seminar the focus will fall on planar electrically small antennas (ESAs). ESAs have been investigated extensively over the years. An electrically small antenna can be defined as an antenna with physically small dimensions relative to its wavelength. ESAs have the potential to be used in a wide variety of applications and this has led to a resurgence of interest in ESA technologies. While ESAs can exhibit high quality factors, narrow bandwidths and high impedance mismatches, several advances in antenna design technologies have been made that address these challenges. For example, ESAs are widely used with artificial materials to improve their bandwidth and radiation patterns.

The seminar should focus on the theory, principles and challenges of ESAs, as well as how the methods proposed in current literature to address the limitations of ESAs. Topics to address can include the Chu-Harrington limit, the Harrington bound, the use of metamaterials for gain, efficiency and bandwidth improvement and miniaturization and the Fano-Bode limit.

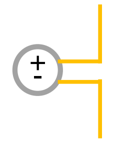

Fig. 1 Short dipole

Fig. 2 Metamaterial-inspired CPW-fed compact antenna. See [1] for further details.

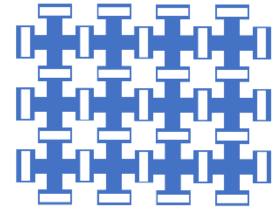

Fig. 3 Example of fractal ground plane pattern. See [2] for further details.

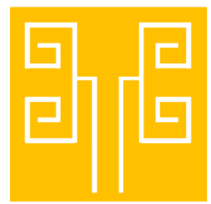

Fig. 4 Electrically small slot antenna. See [4] for further details.

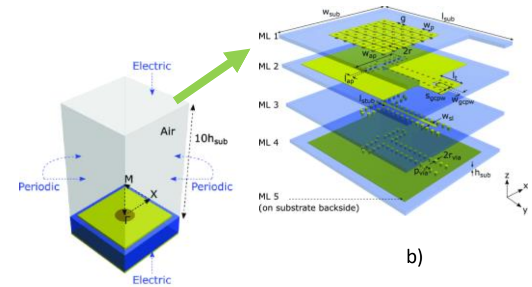

Fig. 5 a) Simulation model of mushroom electromagnetic bandgap (MEBG) unit cell b) Multilayered structure of 6×6 MEBG antenna with SL-to-GCPW feed. See [3] for further details. © Akanksha Bhutani (IHE)

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[1] H. Singh, S. Kalraiya, M. Meshram and R. Shubair, "Metamaterial inspired CPW-fed compact antenna for ultrawide band applications," International Journal of RF and Microwave Computer-Aided Engineering, vol. 29, no. 8, 2019, doi: 10.1002/mmce.21768.

[2] M. Rahimi, F. Zarrabi, R. Ahmadian, Z. Mansouri and A. Keshtkar, "Miniaturization of antenna for wireless application with difference metamaterial structures," Progress In Electromagnetics Research, vol. 145, pp. 19-29, 2014, doi: 10.2528/pier13120902.

[3] A. Bhutani, B. Goettel, J. Mayer, M. Pauli and T. Zwick, "122 GHz Aperture-Coupled Mushroom EBG Antenna in LTCC Technology," 2019 13th European Conference on Antennas and Propagation (EuCAP), Krakow, Poland, 2019, pp. 1-5.

[4] W. Liu, L. Xu and H. Zhan, "Design of 2.4 GHz/5 GHz planar dual-band electrically small slot antenna based on impedance matching circuit", AEU - International Journal of Electronics and Communications, vol. 83, pp. 322-328, 2018. Available: 10.1016/j.aeue.2017.08.040.