Distributed Unit Cell Control of the SMRS Antennas for the Beam Pattern Synthesis and Shaping

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There have been some researches on the SMRS (Sinusoidally Modulated Reactance Surface) antennas (A. M. Patel and A. Grbic, "A printed leaky-wave antenna based on a sinusoidally modulated reactance surface," *IEEE Trans. Antennas Propag.*, vol. 59, no. 6, pp. 2087–2096, 2011.) since it was known that periodic modulation of surface impedance generates a leaky wave radiation. (A. Oliner and A. Hessel, "Guided waves on sinusoidally modulated reactance surfaces," *IRE Trans. Antennas Propag.*, vol. AP-7, pp. 201–208, 1959.). The SMRS antenna is categorized as a periodic leaky wave antenna in which one of floquet mode radiates directive beam and its beam angle is controlled with the wave's phase constant (β) and beamwidth can be adjusted with leakage factor (α). One of the most salient characteristic of this SMRS antenna is that it allows the independent control of phase constant and leakage factor in some allowable parameter range.

Based on this characteristic, we applied the antenna synthesis method (C. A. Balanis, *Antenna Theory,* Ch 7, 3rd ed. New York: Wiley, 2005) to the SMRS antenna so that we can synthesize the desired antenna beam pattern with the independent control of the SMRS antenna's unit cells. The leaky wave antenna's radiation pattern is calculated with the Fourier transform of the antenna's aperture illumination and we tried to compose the SMRS antenna's aperture illumination as cosine distribution with discretized nine unit cells in order to reduce the sidelobe level. The nine unit cells are controlled with different modulation factors so that can mimic the continuous cosine amplitude distribution while keeping the phase constant of each unit cells to have same radiation angle for the antenna pattern synthesis as shown in Fig.1.

With the proposed idea, we simulated the antenna radiation pattern and compared with the calculated radiation pattern (Fig.2.) whose aperture illumination is the red line as shown in Fig.1. The simulated result verifies that the distributed aperture illumination can be adopted to the SMRS antenna to synthesize the desired beam pattern.
The detailed design procedure and further issues are to be discussed at the conference.

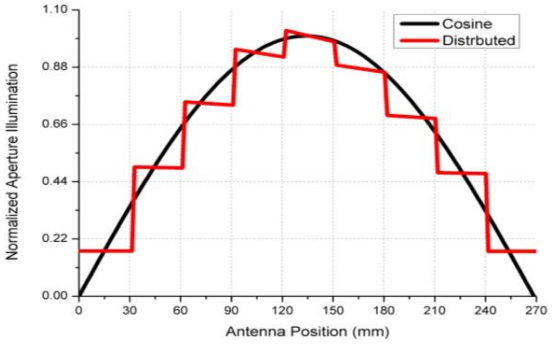

Figure 1. Cosine and distributed aperture illumination

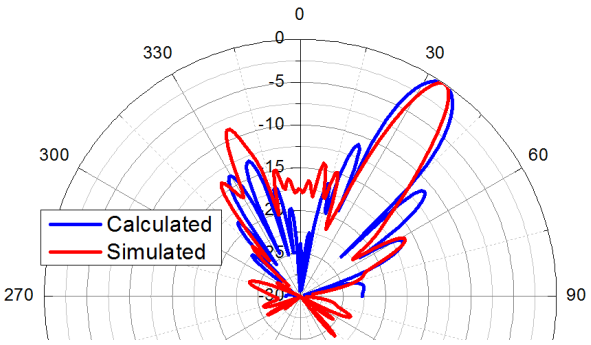

Figure 2. Calculated and simulated radiation pattern