An Electronic Beam-steering Antenna with Active FSS for 5G Applications

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There have been increasing demands put on the antenna system in order to meet the emerging requirements for 5G communication systems with respect to data rate, latency, and power consumption. Massive multiple-input multiple-output (MIMO) technology has been one of the most commonly used solutions to accommodate these problems as it enables the antenna to have high gain and the function of beam-steering. However, the phase shifters and the feeding network often cause a MIMO antenna to have very complex control circuitry, which adds to the cost, losses, and design difficulties for engineers (X. Pang, et al, *China Communications*, vol. 11, issue 11, 2014).

Much attention has been drawn to frequency selective surfaces (FSS) since their appearance in the late 1960s (T. K. Wu, Frequency Selective Surface and Grid Array, John Wiley, 1995). One of the major applications of a FSS is to use it as an antenna radome to control electromagnetic wave transmission and scattering (I. Russo, et al, *Proceedings of the Fourth European Conference on Antennas and Propagation*, 2010).In the present work, a novel FSS system is proposed for 5G cellular beam-steering applications. The FSS is a multi-layered structure where metallic screens are sandwiched between dielectric slabs. The unit cell in the metallic screen is designed for the FSS to work as a band-pass filter with reconfigurable phase shifts. With electronic devices embedded into the screens, the transmission phase of the emitted wave through each column of the FSS can be tuned from 0 to 360 degrees. Therefore, by properly configuring the phase difference between adjacent columns, the active FSS is capable of steering beams electronically. In order to boost the gain of the system, a horn antenna is used as the feed antenna for the FSS. In this configuration, it can provide satisfactory gain and bandwidth for 5G communications. The experimental and simulated results for the proposed antenna will be presented.