On the Features of Curved Passive Electromagnetic Skins

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Abstract: In this communication, the features of curved passive smart electromagnetic skins working at millimeter waves to be mounted on street lights or stop light poles are presented and compared to those of the classic planar solution.

The foreseen characteristics of the next-generation communication systems make it necessary to define new paradigms for the network. While the use of mm-waves or sub-THz frequencies seems to be very promising due to the extremely high bandwidth that their use can guarantee, they suffer from higher losses, that are responsible for the degradation of the coverage. To address this issue while maintaining network simplicity, cost-effectiveness, and low power consumption, it becomes fundamental to consider the propagation environment as an additional design parameter. This is possible thanks to the introduction of Smart Electromagnetic Skins (SESs), i.e., very thin surfaces able to provide a not specular reflection to reach blind spots or cover desired areas. Although conventional solutions consist of the use of planar reflecting surfaces [1], recently an alternative configuration that makes use of curved passive electromagnetic skin has been introduced [2]. One of the advantages of such a configuration is the possibility of integration into light or traffic light poles which makes its installation simpler. Furthermore, the SES can be rotated on the pole to maximize the link with the base station. The field re-radiated by the SES is not affected by the contribution of the walls, which could be not negligible [3]. Finally, several SESs, with different orientations, can be mounted on the same pole to cover different areas, with the incident signal arriving from the same direction, or to redirect in the same area the field radiated by different base stations.

With reference to the configuration shown in [2], a new reradiating element (see Fig. 1) that incorporates the radome is here investigated with the aim of reducing the SES manufacturing complexity and mounting. The new element combined with the curve geometry of the SES reduces the presence of higher-order Floquet modes.

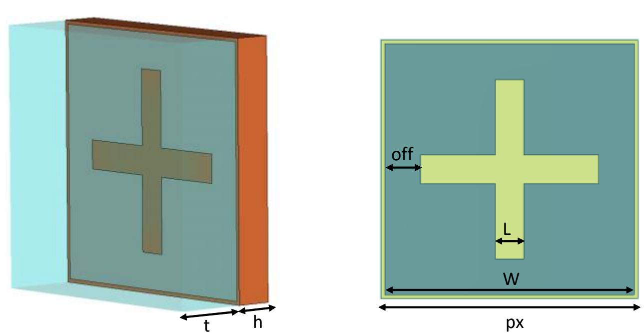

Fig. 1 - Reradiating element geometry (Diclad527 substrate $\varepsilon_r = 2.55$, $\tan\delta = 0.0022$, $h = 0.508\text{mm}$, Lexan radome $\varepsilon_r = 2.8$, $\tan\delta = 0.01$, $t = 1\text{mm}$, $px = 3.6\text{mm}$, $1.5\text{mm} < W < 3.5\text{mm}$, $L = 0.4\text{mm}$, $\text{off} = 0.2\text{mm}$)

The SES is then designed in such a way that it can cover different 5G millimeter wave bands with a simple small rotation. Thus it allows the use of the same SES in different Countries.

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