A Broadband Dipole Array Based on Bandstop Frequency Selective Surfaces

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In this paper, an ultra-wideband tightly coupled dipole array based on bandstop frequency selective surfaces (FSSs) with an integrated feed is reported. The designed infinite array will feature a bandwidth of 10:1(1GHz – 10GHz) with active VSWR < 3. Different from the conventional tightly coupled dipole array which is achieved by utilizing the lossy resistive sheets, the proposed ultra-wideband antenna is achieved by using the lossless bandstop FSSs. Compared with the antenna with lossy resistive sheets, the proposed one features very high radiation efficiency across the entire band. Specifically, a broadband microstrip line to parallel stripline transition is designed and employed to form the feeding network, which can provide unbalanced to balanced transformation allowing the unbalanced fed ultra-wideband antenna to be excited with 50Ω coaxial cable.

Ultra-wideband antennas have been applied to many areas such as low power communication systems, advanced wideband radars and so on. Tightly coupled dipole array, whose elements are tightly capacitively coupled to their neighbors, has emerged as an attractive option for these applications. They provide wide bandwidth in a low profile setting, facilitating integration on mobile platforms such as aircraft. So far, a tightly coupled dipole array with resistive sheet that operates across a 21:1 bandwidth has been reported [W. F. Moulder et al. IEEE Trans. Antennas Propagation, vol. 60, no. 9, pp. 4166–4172, 2012]. However, its radiation efficiency is comparatively low due to the lossy resistive sheet used in this design. To address this critical issue and maintain the broad bandwidth, we introduce a new ultra-wideband tightly coupled array based on bandstop FSSs, which can be easily fabricated by multi-layer PCB technique. The FSSs can not only expand the bandwidth but also improve the radiation efficiency. Its feed (consisting of a microstrip line to parallel stripline transition) provides unbalanced to balanced transformation as well as impedance transformation so that the whole antenna can be directly excited with 50Ω unbalanced coaxial cable. Figure 1 shows the general schematics of proposed antennas with (shown in the right) and without (shown in the left) the integrated feed. It is found that the combination of radiators, FSSs and feeding structures can enable the operation across a 10:1 bandwidth (infinite array, VSWR < 3), with the radiation efficiency over 95% across the whole operating frequency band.

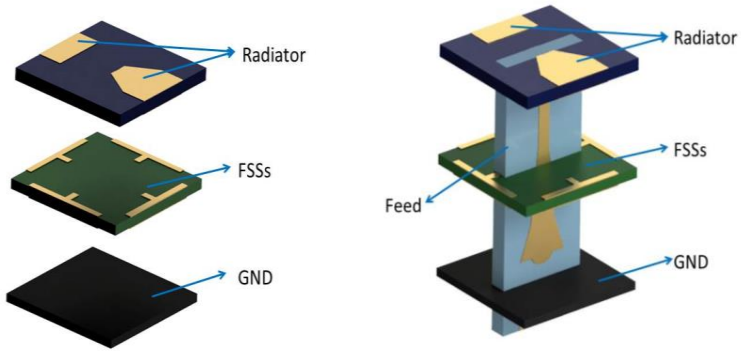

Fig 1. Schemetic of proposed antennas without (left) and with (right) integrated feed.