



## Estimation and Control of Total Array RCS of Microstrip Patch Array with Hybrid HIS-based Ground Plane

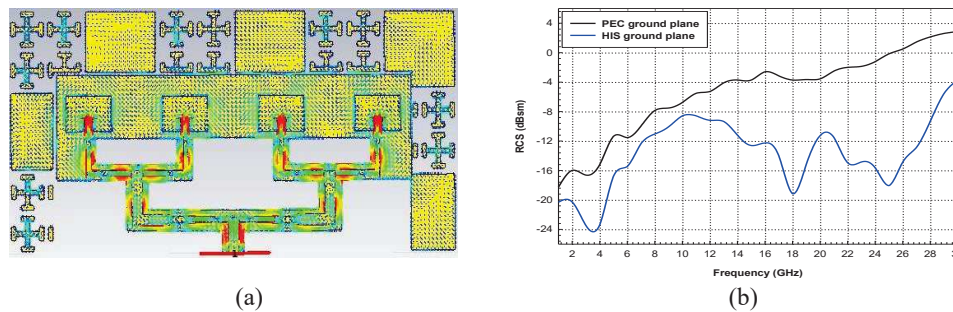
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For a radiating structure such as a patch array placed on an aerospace platform, the radiation mode RCS plays a significant role when compared to the structural mode RCS. It is due to the fact that the structural RCS of a patch array is computed when the antenna impedance is perfectly matched to the feed structure. To achieve a perfectly matched state is practically not possible. The corporate feed structure in the antenna array itself contributes to most of the mismatches. It has been corroborated that a high impedance surface (HIS) plays an important role in controlling the structural RCS of an antenna. The challenge remains to compute the radiation mode RCS of the antenna array. The combination of JC element and square patch arranged in a chessboard configuration is able to provide RCS reduction based on the principle of phase cancellation. However, this configuration can only provide narrow-band RCS reduction.

The computation of radiation mode RCS of patch array with HIS-based ground plane requires a prior knowledge of the patch antenna impedance. The impedance of the patch antenna can be calculated analytically [1] in terms of the patch dimensions, substrate thickness and dielectric constant of the substrate. Another method is that an antenna resonating at a specific frequency can be modelled using an equivalent circuit approach. The HIS layer consisting of artificial magnetic conductor (AMC) elements needs to be modelled separately for an antenna array using equivalent circuit model [2]. However, for complex structures consisting of different elements with a hybrid ground plane, it is not possible to compute the antenna impedance from equivalent circuit approach.

In this paper, the implementation of hybrid ground plane along with the chessboard configuration has been exploited towards wideband structural RCS reduction. A novel method has been proposed to calculate the antenna impedance of each patch element in a multi-resonant array structure and hence the radiation mode array RCS. The motivation behind the work being carried out is to achieve significant reduction in both in-band and out-of-band structural RCS. Moreover, efforts have been put while designing so that there is no degradation in the antenna radiation characteristics.



**Figure 1.** (a) Surface current distribution over 4-element patch array with hybrid HIS-based ground plane  
 (b) Specular structural RCS of patch array

1. C.A. Balanis, *Antenna Theory, Analysis and Design*. 3rd ed., John Willey & Sons, ISBN: 0-471-66782-X, 1117 p., 2005.
- 2 F. Costa, A. Monochio and G. Manara, "An overview of equivalent circuit modeling techniques of frequency selective surfaces and metasurfaces," *ACES Journal*, vol. 29, no. 12, pp. 960-976, December 2014.