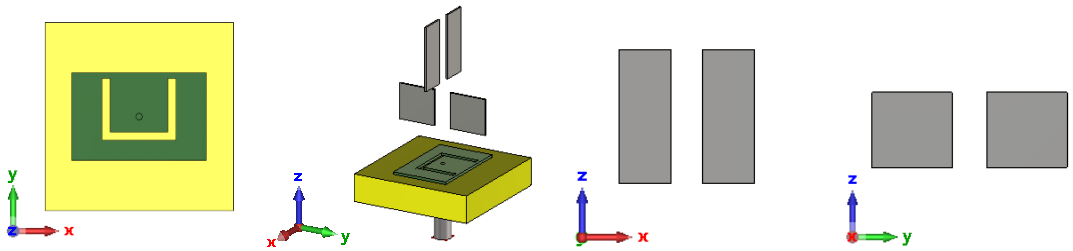
Scanning Range Enhancement of a U-Slot Microstrip Array over a Wide Frequency Range

Sina Hasibi Taheri[1], Ali Lalbakhsh[2]
[1] Macquarie University, Sydney, NSW, 2109
email: sina.hasibitaheri@hdr.mq.edu.au
[2] Macquarie University, Sydney, NSW, 2109
email: ali.lalbakhsh@mq.edu.au

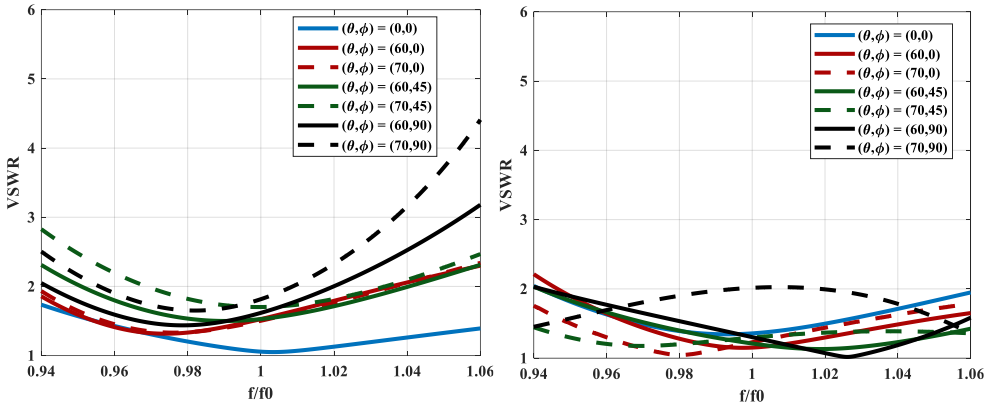
The growing need for ubiquitous communication has shifted researchers' focus toward the beam-scanning array concept. Steering the pattern toward the extreme angles increases the mutual coupling between array's elements. Such unwanted coupling effects contribute to mismatching antenna impedance, resulting in severe power loss. Therefore, arrays suffer from degradation of transmission power, over 90% in extreme cases, as their main beam is tilted beyond the broadside direction [1]. Unlike methods based on modifications in the antenna array [2], one effective method is utilising a specialised superstructure above the source to improve mutual couplings at large scanning angles [3]. Although most existing methods are to increase the transmitted power of the antenna array over some angles, these improvements are limited to single frequency or highly narrow bandwidth operations. Additionally, they mostly come at the cost of degrading other antenna parameters, such as decreasing the transmitted power in other radiation planes or increasing the chance of scan blindness [4]. This work proposes a non-planar wide-angle impedance matching (WAIM) structure to control the reflection coefficient and improve the scanning range of a U-slot microstrip array up to 70 degrees at all the radiation planes. Fig. 1(a) depicts one unit-cell of the array, designed for X-band range (around 10 GHz) at the broadside. To prove the concept, two sets of two vertical metallic strips are designed and optimised to be placed orthogonally on top of the antenna at different heights at the $\phi = 0^{\circ}, 90^{\circ}$ planes (Fig. 1 (b-d)).



(a) (b) (c) (d)

Fig. 1. (a) Top and (b) perspective views of a unit cell of microstrip array, (c, d) metallic strips

Fig. 2 illustrates the active VSWR of microstrip array before and after adding the matching structure. It is apparent that the matching structure guarantees a VSWR below 2 and extends the scanning range up to 70 degrees at E, H, and D-planes over 12% of the operating frequency of the array.



(a) (b)

Fig. 2. Plot of simulated VSWR for (a) before (b) after addition of matching structure

References

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