

## Documents

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**Design of Quad Element MIMO Array with EBG Structure for Mutual Coupling Reduction**

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**Abstract**

Multiple Input Multiple Output (MIMO) array antennas that may transmit radio waves in various patterns and polarizations have been increasingly important in current telecommunication systems. However, the mutual coupling effect is the major drawback of the MIMO system. Electromagnetic Band Gap (EBG) is a good solution for planar arrays to reduce the effects of mutual coupling. A simple EBG structure has been proposed in this paper to reduce the mutual coupling effect for a quad element (2×2) MIMO array. First, a single inset-fed microstrip patch antenna has been designed that resonates at 4.2 GHz with minimum return loss as low as -40 dB. A rectangular shape EBG structure with a dimension of 6 × 13 mm has been implemented between the radiating patches. Each EBG unit cell consists of 3 rectangular shape slots with a dimension of 2×3 mm. The simulation result shows that the antenna can radiate around 95% of its power to the receiver and gives a good directive pattern as well. The quad-element MIMO array with the EBG structure has a minimum return loss of less than -50 dB and maximum isolation of more than 20 dB. Therefore, a quad-element MIMO array with the proposed EBG structure can provide better performance in 5G applications. © 2023 IEEE.

**Author Keywords**

EBG structure; inset fed; MIMO array; patch antenna; rectangular shape

**Index Keywords**

5G mobile communication systems, Antenna arrays, Antenna feeders, Energy gap, Microwave antennas, MIMO systems, Slot antennas; Electromagnetic bandgap (EMG), Electromagnetic bandgap structures, Inset-fed, Multiple input multiple output array, Multiple inputs, Multiple outputs, Mutual coupling effects, Quad elements, Rectangular shapes, Returns loss; Microstrip antennas

**References**

- Qamar, Z., Park, H.-C.  
(2014) *Compact Waveguided Metamaterials for Suppression of Mutual Coupling in Microstrip Array*,
- Qamar, Z., Riaz, L., Chongcheawchamnan, M., Khan, S.A., Shafrque, M.F.  
**Slot combined complementary split ring resonators for mutual coupling suppression in microstrip phased arrays**  
(2014) *Iet Microwaves, Antennas and Propagation*, 8 (15), pp. 1261-1267.  
Dec
- Lee, J.Y., Kim, S.H., Jang, J.H.  
**Reduction of Mutual Coupling in Planar Multiple Antenna by Using 1-D EBG and SRR Structures**  
(2015) *Ieee Trans Antennas Propag*, 63 (9), pp. 4194-4198.  
Sep
- Sajjad, H., Khan, S., Arvas, E.  
**Mutual coupling reduction in array elements using EBG structures, " 207 7**  
(2017) *International Applied Computational Electromagnetics Society Symposium-Italy, Aces 2017*, pp. 1-2.
- Mishra, M.  
(2020) *Low Mutual Coupling Four-Port Mimo Antenna Array for 3. 5 GHz WiMAX*

*Application*, pp. 5-7.  
no. June

- Kumar, N., Usha Kiran, K.  
**Meander-line electromagnetic bandgap structure for UWB MIMO antenna mutual coupling reduction in E-plane**  
(2020) *AEU-International Journal of Electronics and Communications*, 127, p. 153423.  
no. August
- Kumar, N., Kommuri, U.K.  
**MIMO antenna mutual coupling reduction for WLAN using spiro meander line UC-EBG**  
(2018) *Progress in Electromagnetics Research C*, 80, pp. 65-77.  
no. October 2017
- Jiang, T., Jiao, T., Li, Y.  
**Array Mutual Coupling Reduction Using L-Loading E-Shaped Electromagnetic Band Gap Structures**  
(2016) *Int J Antennas Propag*, 2016.
- Babu, K.V., Anuradha, B., Bhushana Rao, K.C.  
**Reduction of mutual coupling by desegregated with EBG structure for microstrip antenna array radar applications**  
(2017) *International Conference on Signal Processing, Communication, Power and Embedded System, Scopes 2016-Proceedings*, pp. 317-320.
- Asadullah, G.M., Islam, M.S., Islam, M.R., Sahad, A.J., Sakib, M.A.T.  
**DGS-Based Quad Element Planar Array for WLAN Application with Enhanced Performance**  
(2020) *2020 Ieee Student Conference on Research and Development (SCOReD)*, pp. 274-279.  
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