Design of Switched Multimode Antenna on Bug Platform by Using Characteristic Mode Analysis

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***Abstract* - The establishment of a reliable channel is an important issue in all communication systems in any environment. Among several approaches proposed for this purpose, the exploit of multimode antenna using Characteristic Mode Analysis(CMA) is one of the strong candidates for the communication system in a small platform. In this paper, we will show some design examples of the multimode antenna on a small bug robot where an effective modal excitation structure is proposed. The proposed structure is useful to excite easily a specific mode of multimode antenna. The simulation and experimental results will be demonstrated.**

***Index Terms* —** Characteristic Mode Analysis, Coupler, Booster, Chassis Antenna, MIMO

I. INTRODUCTION

Military use Bug platform has been studied in many literatures and more recently, practical aerodynamic model, especially bug robot model was introduced by Harvard research team [1]. However, the implementation of antenna on the robot for communication has not been demonstrated effectively. It is relatively straight forward idea to attach antenna such as monopole, to robot model directly. However, it makes the bug robot bulky and inefficient. Another approach is to use bug itself as an antenna by using Characteristic Mode Theory (CMT) of the bug robot body. CMT is linear sum of real current modes determined by geometry of model and has property that each mode is orthogonal to the others [2]. To make better use of CMT, designers must consider coupler (booster) structure to excite the desired mode [3]. Recently, intuitive approach with slit structure was proposed [4] on mobile platform. In this paper a novel H-shape structure (see Fig. 1) was proposed to excite the desired mode at 2.4GHz on a bug robot model (69.8mm × 52mm × 11mm)

II. MIMO DESIGN : SIMULATION RESULTS

By using CMA, we can obtain three orthogonal Characteristic Modes on Bug robot model (see Fig. 2-(a)). Based on this, we can determine booster placement location to excite the mode we want to.

The H-shape slot structure are located on top and bottom of the wing support structure to enhance the mode excitation targeted. Our design uses FR4 (= 4.5), copper coating and has a compact size (10.6mm × 7mm). Applying this structure to a bug model, we successfully excited mode 3(see Fig. 2-(b)), constituting 96.12% of total current and holding FBW=12.26% (see Fig. 3).

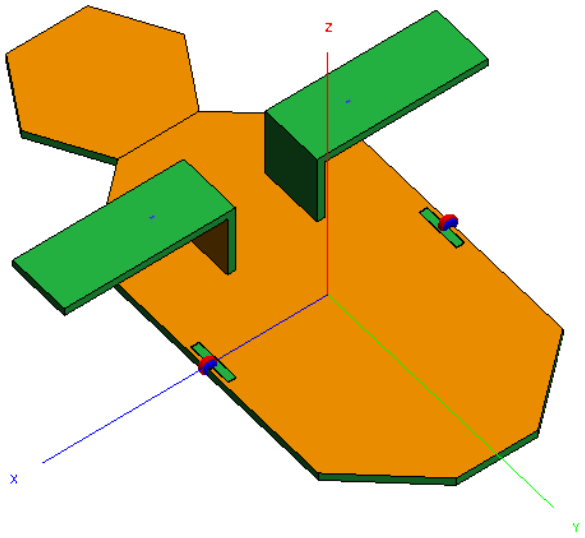
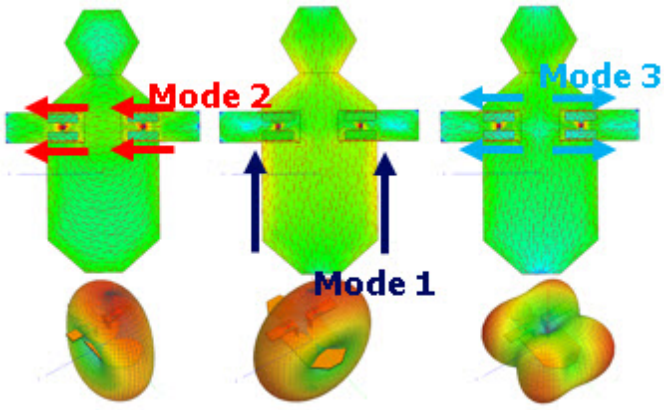
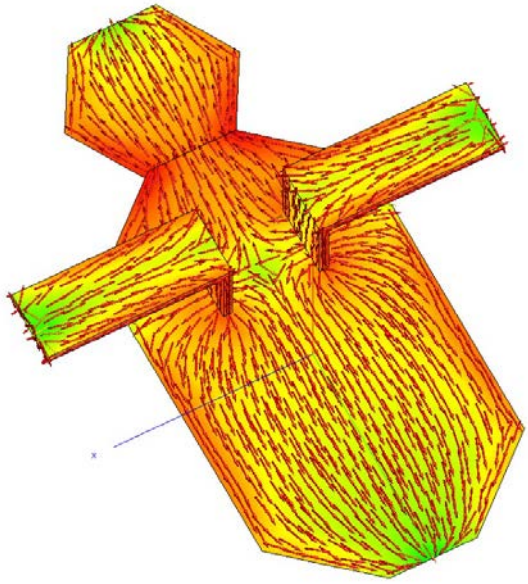


Fig. 1. Proposed coupler applied structure(H-shape Booster)



(a)



(b)

Fig. 2. (a) Characteristic Mode Features (b) Characteristic Current Distribution (Mode 3)

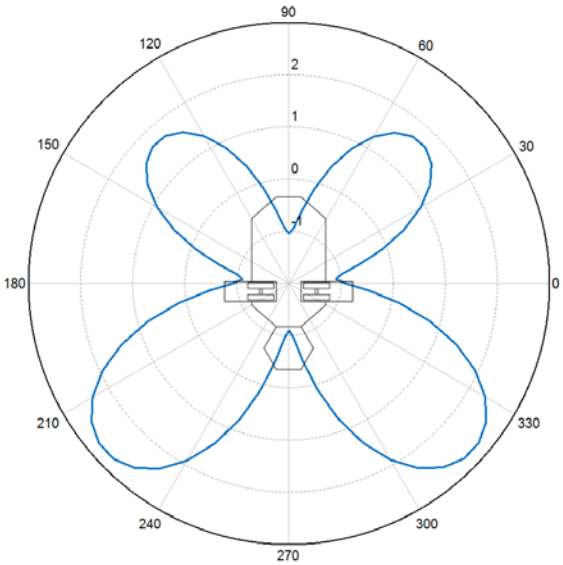


Fig. 3. Simulated E-plane Far-field patterns of proposed antenna

III. Conclusion

In this paper, Practical use of Characteristic Mode Analysis for designing of antenna was presented. According to the concept, we can use robot chassis as an antenna with booster which can excite specific mode needed.

Consequently the integration in the robot chassis with booster (H-shape) remove the need of external antenna for system. By using this structural approach and booster design, can lead the system more durable for operational environment, like desert or jungle.

Acknowledgment

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