

Design of Antenna for Bug Robot Using Characteristic Mode

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A bug robot has been studied in many literatures and more recently, practical aerodynamic model was introduced by Harvard research team (Wood, R. J. IEEE. Trans. Rob. 24, 341–347, 2008). 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, PIFA, etc., to robot model directly. However, it makes the bug robot bulky and aerodynamically inefficient because it should have a separate antenna structure. Another approach is to use bug body as an antenna by exciting Characteristic Mode (CM) of the bug robot body. CM is linear sum of real current modes determined by geometry of model and has property that each mode is orthogonal to the others. To make better use of CM, designers must consider coupler (booster) structure to excite the desired mode (A. Andujar, J. Anguera, and C. Puente, IEEE Trans. Antennas Propag., vol. 59, no. 5, pp. 1668–1677, May 2011.). Recently, intuitive approach with slit structure was proposed (R. Martens, D. Manteuffel, IET Microw. Antennas Propag., Vol. 8, Iss. 12, pp. 887–893, Mar. 2014) on mobile platform but applied it only simple plane to analyze.

In this paper we propose a novel H-shape structure (see Fig. 1) to excite the desired mode (mode3) at 2.4GHz on a bug robot model (69.8mm × 52mm × 11mm). 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, constituting 96.12% of total current and holding FBW=12.26% (see Fig. 2)

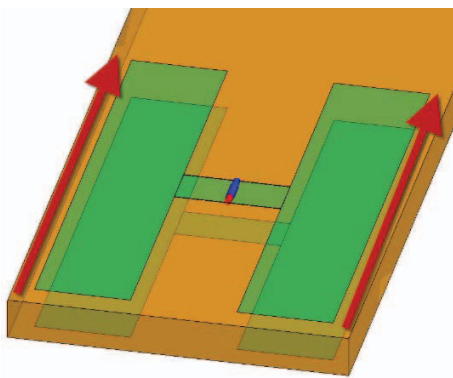


Fig. 1. H-shape Booster

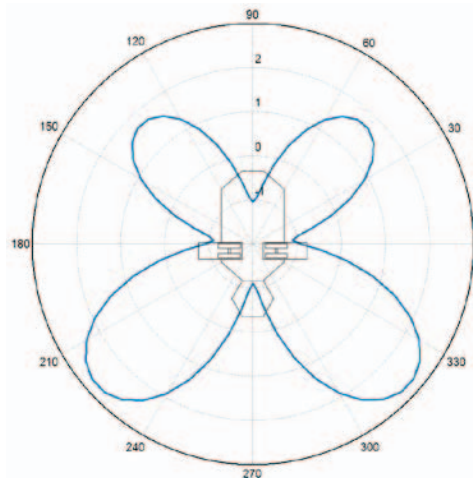


Fig. 2. Simulated E-plane Far-field patterns of proposed antenna