A Backfire Antenna Fed by 2-Element Yagi-Uda

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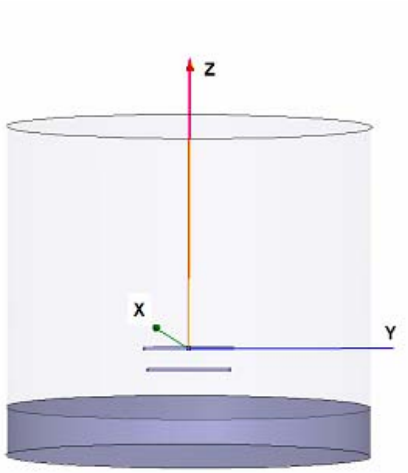
A backfire antenna with a simple structure and a short axial length is presented in this paper. This is a variant of the short backfire antenna (SBA), which has relatively high gain and a shorter length than the classic Yagi-Uda antenna [1]. Through some properties, such as gain and frequency bandwidth, have been improved in the past [2], the cost was a more complicated structure. With good performance and a simple structure the goal of this paper, here a 2-element Yagi-Uda antenna is employed to feed the main reflector. Thus, a 2-element Yagi-Uda (a dipole plus a director) fed backfire antenna is formed. Simulations using Ansoft HFSS show that this antenna has good performance, while the structure is simpler than a short backfire antenna [1].

The structure of the antenna is shown in the figure, where we set the radius of the wires to be 0.01λ, the dipole length is 0.48λ, the director length is 0.45λ, the radius of the main reflector is 1λ, the width of the rim is 0.25λ, the feed gap is 4mm, and the center frequency is 1.0 GHz. The radiation surface shown (the outside cylinder) is not a part of the antenna, but is included as a computational boundary in HFSS.



As a test of the simulation software, we simulated the SBA in [1] by removing the director and adding a small disc on the other side of the dipole, and very good agreement was achieved. Also, as expected, slight changes in the wire's radius and the gap didn't affect the results. Originally, we assumed that the highest gain may be available when the distance between the dipole and the main reflector and between the dipole and the director is set to 0.5λ and 0.12λ, respectively. Then we changed these distances iteratively until the highest gain was obtained. The final values were found to be 0.555λ and 0.110λ, respectively, to yield the highest gain of 11.74 dB, which is equivalently the gain of an 8-element or longer Yagi-Uda. As a check on this value, by finding $HP_H = 42^0$ and $HP_E = 43^0$, the approximate gain is calculated to be 11.58 dB. The input impedance of the antenna at the center frequency was Zin = 49.0 + j120.0 (Ω).

[1] K.M. Chen, D.P. Nyquist and J.L. Lin, IEEE AP, (16) pp. 596-597, 1968
[2] S. Ohmori et al, IEEE AP, (31) pp. 644-646, 1983