Electrical Performance Analysis of Broadband Dipole Antenna under Wind Load

ZHENJI LIU LONGJUN ZHOU LIANG YANG RONG LIU GUOHONG ZHANG LING WANG

Wuhan Maritime Communication Research Institute

ABSTRACT

The complex weather environment has a significant effect on the structural deformation and electrical performance of the broadband dipole antenna. In this paper, an electromechanical coupling analysis method is proposed to analyze the nonlinear response of the Broadband dipole antenna under multi-wind wind load, and the structural analysis of the broadband dipole antenna under wind load is carried out by the nonlinear finite element method, and the electrical performance analysis of the antenna is carried out by the method of moments based on the geometric model of the deformed broadband dipole antenna. The impedance characteristics and pattern of the antenna are calculated under wind load. The calculation results show that the import impedance of the antenna is almost the same, whether the antenna with multi-wind wind load or not. When the antenna is loaded with wind, the antenna pattern has little effect on the low-frequency band and a larger impact on the high-frequency band. The results of this paper provide a basis for the selection and design of the antenna, and the analysis method in this paper has certain reference significance for the same type of antenna.

INTRODUCTION OF ANTENNA AND CALCULATION METHOD

The broadband dipole antenna is mainly composed of elements, side cables, slings, masts, and stay wires. The main dimensions of the broadband dipole antenna are shown in Fig. 1.

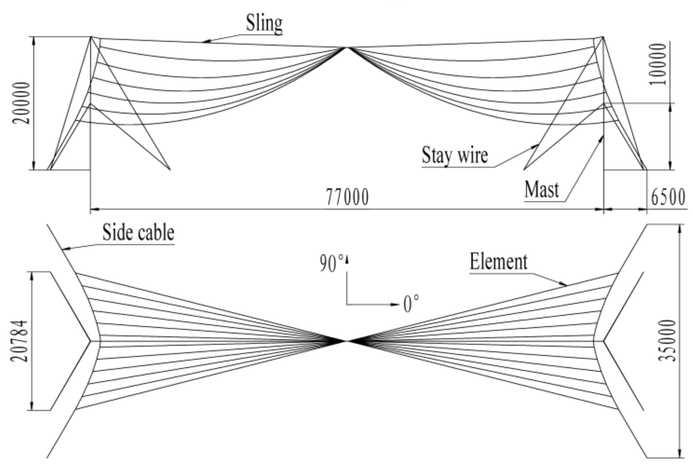

Fig. 1 . Broadband dipole antenna.

Ansys was used to analyze the structural response of the broadband dipole antenna under wind loads .The deformed finite element model can be obtained in ANSYS, and the deformed finite element model can be exported as a geometric model. The moment method is used for electrical performance analysis. The method of moments is a method of discretizing a continuous equation into a set of algebraic equations.

Reconstructing the geometric modeL

The deformed broadband dipole antenna geometry model exported from ANSYS software is shown in Fig. 2. The geometric model is used to transfer data without node and mesh information, so the proposed method can directly import the antenna geometric model into FEKO software without format conversion, which solves the problem of inconsistency between the antenna structural model mesh and the electrical model mesh.

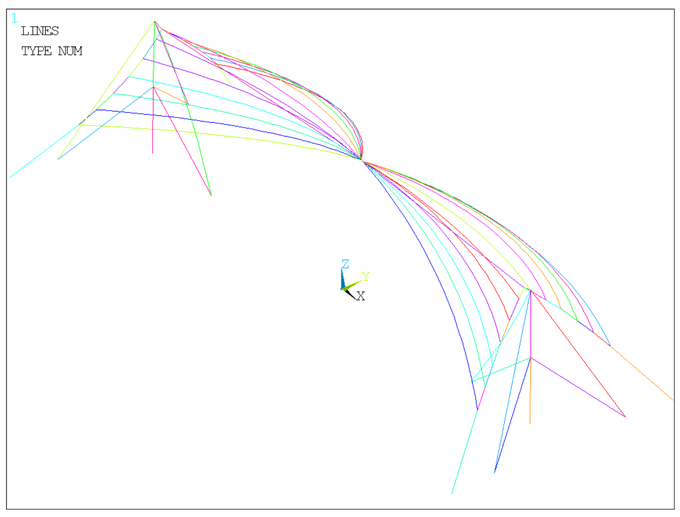

Fig. 2. Deformed broadband broad band dipole antenna.

ELECTRICAL ANALYSIS

The broadband dipole antenna has the broadband characteristic, as 13 elements formed a fan shape on each side of the antenna. The electrical characteristics of the antenna are analyzed based on the geometric model of the broadband dipole antenna after deformation. The calculation is based on the method of moments(MOM), which has high accuracy for the calculation of line antennas.

The electric field integral equation (EFIE) takes the form of an integral representation of the electric field of the antenna surface current density J_S. The current expansion function is substituted into the integration equation, the line integral along the antenna axis is used instead of the area fraction, the weight function uses the high-precision sinusoidal function to obtain the matrix equation, and the current distribution on the antenna can be obtained by solving the matrix equation, and then the input impedance, voltage standing wave ratio (VSWR) and radiation pattern of the antenna are calculated.

RESULT

The broadband dipole antenna has the broadband characteristic, as 13 elements formed a fan shape on each side of the antenna. The antenna is amount to a dipole with a major diameter, so the import impedance of the antenna is smooth.

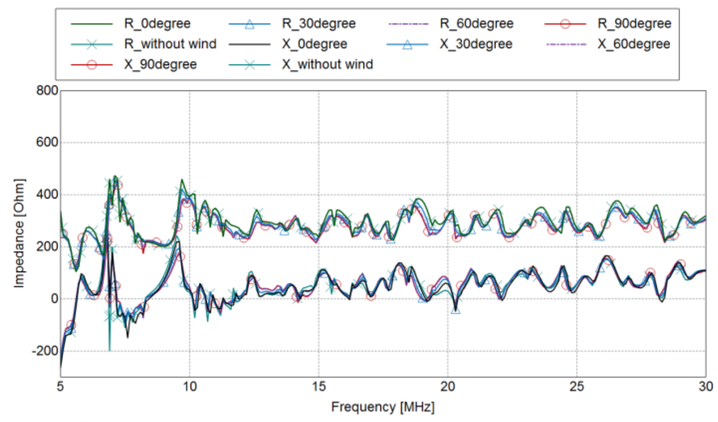

Fig. 3. Import impedance of broadband dipole antenna.

The calculation results show that the import impedance of the antenna is almost the same, whether the antenna has a multi-wind load or not.

The E plane is the maximum radiation elevation plane, and the H plane is the plane of two towers. When the antenna with multi-winds wind load, the pattern of the antenna has little influence at the low-frequency stage, while has a larger influence at the high-frequency stage. The maximum wave directivity change is approximately 3 dB when the wind is 90o direction at 30MHz. The change of pattern is because the antenna elements are slanted to the direction of the incoming wind, just as the dipole antenna is bent, so the direction of each element is changed.

ONCLUSION

The calculation results show that the input impedance of the broadband dipole antenna at a wind speed of 43.8m/s increases by about 20%, and the antenna pattern is biased towards the wind, and the wind load will have a certain impact on the transmission and reception of electromagnetic waves in different directions. Other similar structural antennas can also use this analysis method to analyze the effect of wind loads on the electrical performance of the antenna.

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