Parabolic Dish near Wire Crane

WIPL-D Pro is a frequency-domain Method-of-Moments (further, MoM) based code which enables very accurate EM simulations of arbitrary 3D structures. Owing to application of sophisticated techniques, usage of WIPL-D enables very large structures to be simulated on PCs or inexpensive workstations.

In this application note, WIPL-D Pro will be used in examining the influence of the crane to the radiation pattern of the antenna with parabolic dish.

MoM Efficiency – Wire and Plate Modeling

WIPL-D software applies very sophisticated higher order basis functions (HOBFs) on bilinear surfaces (*Plates*) and truncated cones (*Wires*), which can result in significantly less unknowns comparing to low-order MoM. Also, having *Wire* entities as building elements enables the code to very efficiently model wire-like structures (such is the crane presented in this document), with many times less unknowns than equivalent all-plate models. Owing to this, significantly larger structures can be quickly simulated on inexpensive PCs.

Smart Reduction of Expansion Order

This feature is especially suitable for antenna placement problems. It is based on adaptive reduction of current expansion order over parts of the model which are distant from the antenna or positioned in shadow. This way, the number of unknowns can be significantly reduced, while very good accuracy of calculated radiation pattern or coupling between multiple antennas is preserved.

Description of the Models

Two models will be investigated: a solitary dish antenna above perfectly conducting ground plane (*Dish*) and the dish antenna in vicinity of a crane above perfectly conducting ground plane (*Dish+Crane*). The parabolic dish antenna is located in the vicinity of the tower crane, as it is shown in Fig. 1. The parabolic reflector diameter is 3.57 m and it is fed by a dual-mode horn with a choke. The system is designed for the operating frequency of 2.8 GHz. The crane is 30 m high and its arms are 28 m long, in total. The main radiation direction of the dish is toward the vertical boom, close to the place where the boom and the arms meet.

Results and Simulations

The models are simulated at 2.8 GHz. The radiation pattern with and without the crane is displayed in Figure 2. The results were obtained by MoM simulation with adaptive order reduction. Adaptive order reduction is utilized as *Smart reduction* with *Antenna placement reduction* set to 100%. Parameter *Integral accuracy*, influencing numerical integration which is performed in WIPL-D kernel, was increased to *Enhanced 1*. The simulations were carried out on Intel® Core™ i7-7700 CPU @ 3.60 GHz. Radiation pattern was calculated in 1441x1=1441 points.

Number of unknowns, computer memory required and simulation times are presented in Table 1. Simulation time mainly consists of computer time necessary for matrix filling, computer time necessary for matrix solution and computer time spent in calculating output results.

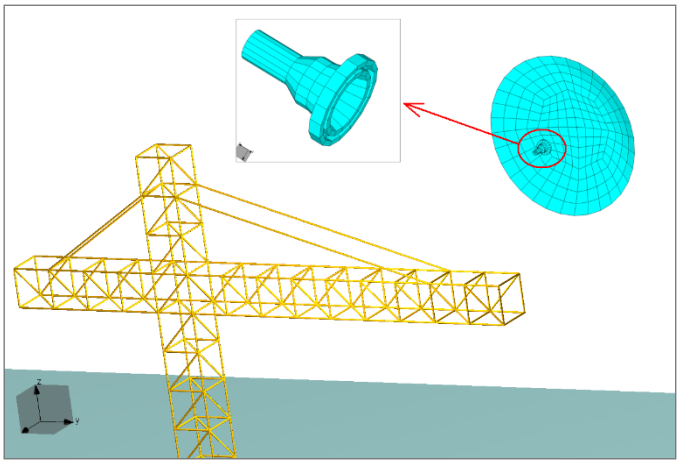

Figure 1. Dish fed by a dual-mode horn antenna in the vicinity of a crane

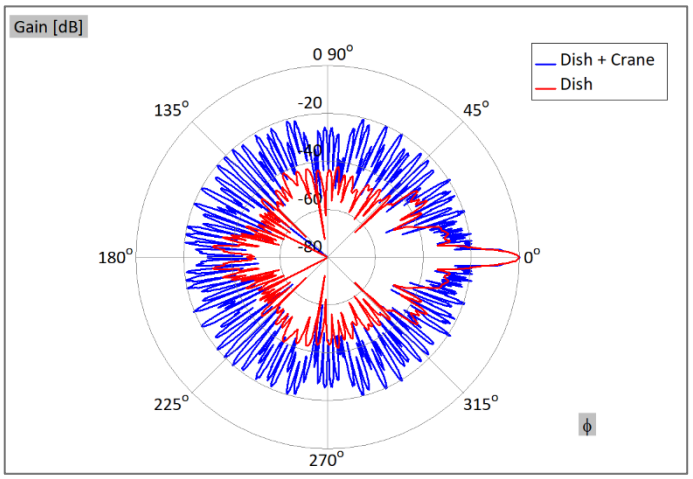

Figure 2. Influence of the crane to the radiation pattern

Table 1. Number of unknowns, computer memory required and simulation time.

Model	Number of unknowns	Memory [MB]	Simulation time [sec]
Dish	5,407	233	6.45
Dish with Crane	11,506	1,010	33.88