Compact Dual-Band Fork Monopole

Introduction to WIPL-D Pro EM Solver

WIPL-D Pro is an EM Solver, based on the Method of Moments (MoM) and empowered with: quadrilateral mash and high-order basis function (HOBFs). A unique combination of HOBFs and Method of Moments allows us to accurately simulate larger models than by using the traditional rooftop-based MoM, since HOBFs decrease number of required unknowns and shorten simulation time.

Model Description

We illustrate the advantages of WIPL-D Pro by using simulation of dual band antenna shown in Fig. 1. This is a simple printed fork-shaped dual-band antenna for Bluetooth and general UWB applications. The antenna is fabricated as fork-shaped radiating patch on one side of the dielectric substrate. A rectangular ground plane is printed at the other side of the substrate (below the radiating patch). The fork-shaped radiating patch is formed by placing a rectangular monopole onto the U-shaped monopole antenna. Rectangular monopole resonates in the Bluetooth band, while the U-shaped monopole antenna resonates over UWB. Dimensions of the model are shown in Table 1.

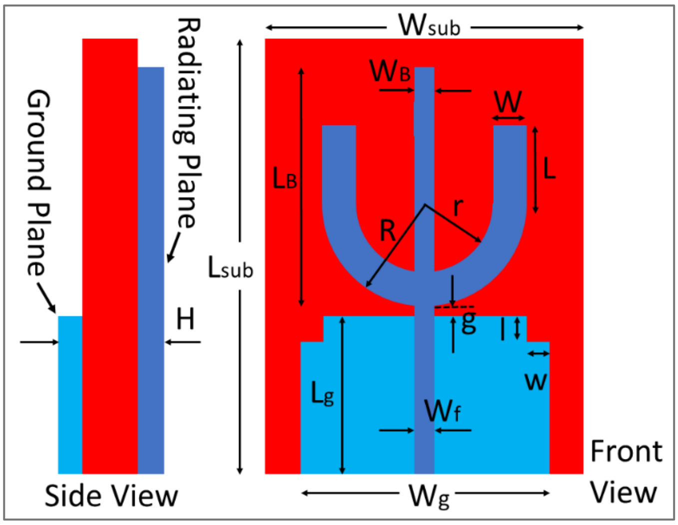

Figure 1. Geometry of dual-band fork-shaped antenna.

We analyze two different models in WIPL-D Pro, with and without coaxial connector (Fig. 2.). Also, we apply symmetry to decrease required number of unknowns. Thus, in Fig 2. is shown only halves of the two models.

For the WIPL-D EM simulations, we have used an inexpensive desktop computer with 4 cores (8 threads Intel® Core(TM) i7 CPU 7700@3.60 GHz.

Table 1. Dimensions of dual-band fork-shaped antenna.

Parameter	Value [mm]
L_{sub}	42
W_{sub}	24
H	1.6
R	10.2
r	4
L_g	12.7
W_g	20.4
g	0.5
W_f	2.4
L	6.2
W	6.2
w	3.5
l	1
W_B	2
L_B	27

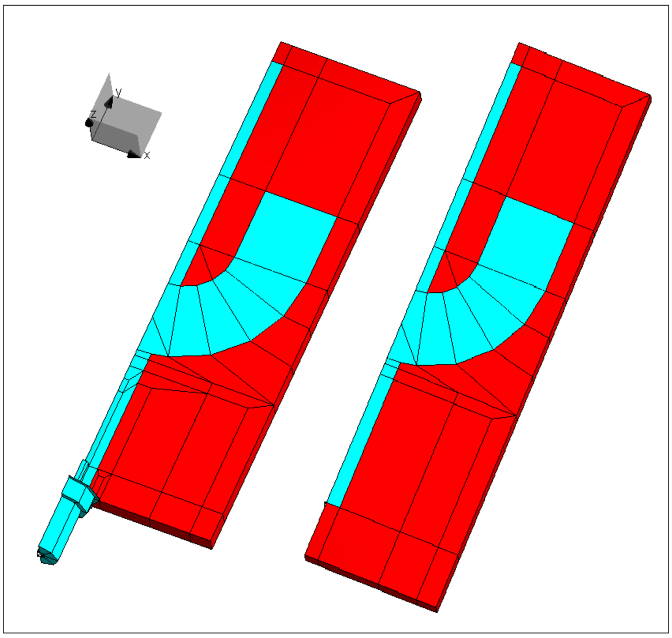

Figure 2. WIPL-D model of dual-band fork-shaped antenna with (left) and without (right) coaxial connector.

WIPL-D Simulations

Comparison of measurement and simulation of two different models is shown in Fig. 3. As we can see, blue line presents result of the simulation model with coaxial connector, while the red line presents simulation of the model without coaxial connector.

Green line presents the measurement. Results of simulation are similar to the measurement. Shapes of all curves are similar, but levels are slightly different. These disagreements are the consequence of the feeding area being complicated for the modelling, while the geometry was not shown in references. The presented results are obtained by using solver default settings. Times for both simulation models are presented in Tab. 2.

Table 2. Number of unknowns and simulation time.

Model	Number of Unknowns	Simulation Time [s] per Frequency
With Coaxial	2060	2.3
Without Coaxial	1528	1.5

Conclusion

We conclude that for the simulation of printed patch antennas and circuits, a simple usage of WIPL-D features, such as Symmetry planes and Manipulation Edging, can yield very fast and accurate solution.

WIPL-D efficient simulation on multicore CPUs allows simulation in seconds at inexpensive desktop and laptop PCs. This eliminates the need for the high-end hardware platforms in order to simulate electrically small and moderate structures, even in wide frequency band. The application note also shows the importance of the feeding are in simulation of the printed models, where most often we have transition between several guide wave technologies (in this case, the geometry of transition from coaxial to microstrip is unknown).

References:

[1] Sanjeev Kumar Mishra, Rajiv Kumar Gupta, Avinash Vaidya, and Jayanta Mukherjee: “A Compact Dual-Band Fork-Shaped Monopole Antenna for Bluetooth and UWB Applications”, IEEE Antennas and wireless propagation letters, VOL. 10, 2011

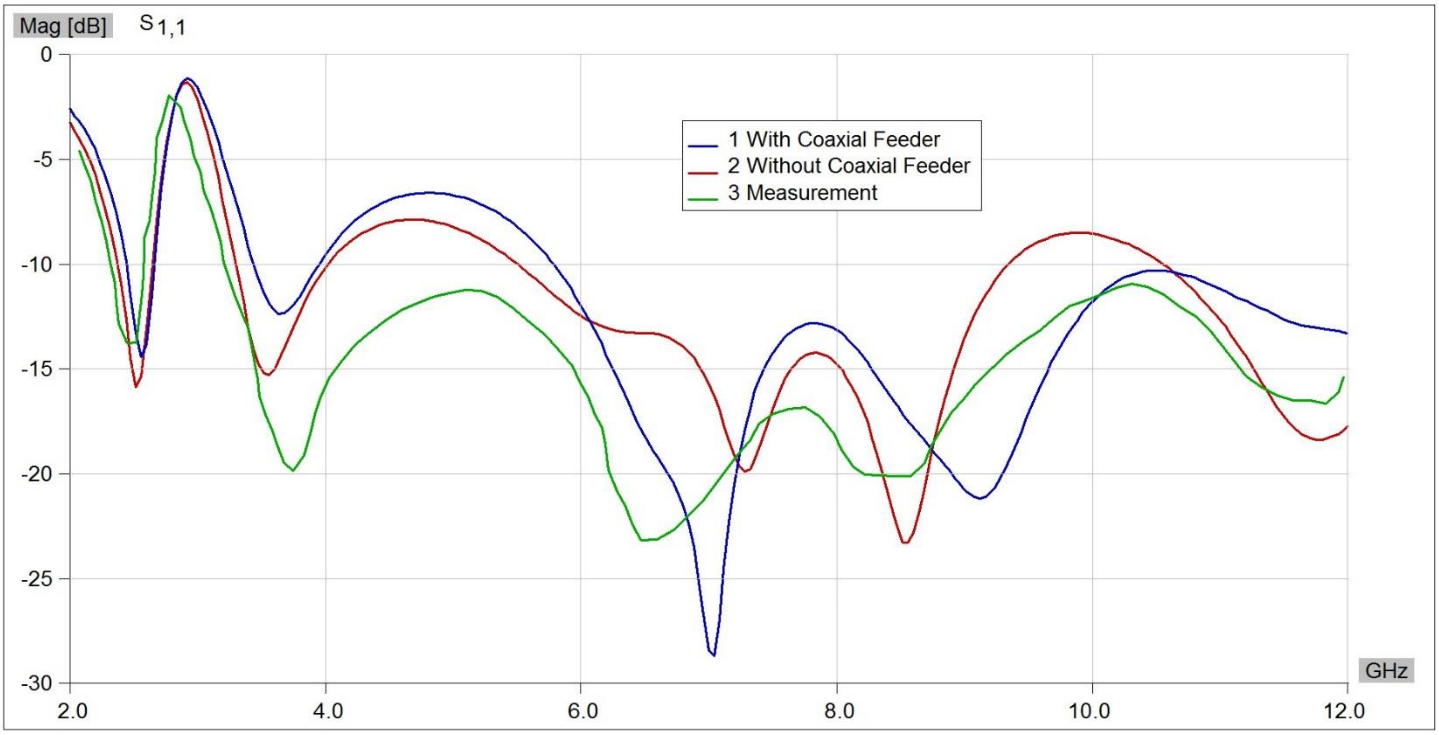

Figure 3. Results of simulation and measurement compared.