Reader's Comment on: Application of the Global Optimization Approaches to Planar Near-Field Antenna Phaseless Measurements [1]

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In [1] the authors are comparing optimization results with a reconstruction of amplitude and phase in the antenna aperture by using direct transformation of complex data measured in the near zone.

In such kind of reconstruction, accuracy or credibility of measured data is very important. Evaluation of the resulting optimization is shown in Fig. 10 [1] for a horn antenna and in Fig. 11 [1] for a rotational paraboloid. Fig. 10 [1] clearly reveals asymmetries of the optimized diagrams and the diagram for comparison. Mathematically, there is no reason for that. For explanation of the differences, it is necessary to look at the set up of the whole microwave measurement. The dimensions of the horn, 136 x 101 mm (length 173 mm) and of the measuring probe, a rectangular waveguide R140 (15.79 x 7.79 mm) are, unfortunately, in conflict. The dimension of the waveguide in the H plane is 65% of the wave length, and 11% of the cross section of the horn (plane H). As a result, measured data about the intensity of the field are rather inaccurate. Somewhat better is the situation in the E plane of the horn, where the ratios of the dimensions are about 7%.

Microwave measurement of the electromagnetic field phase must use as small probe as possible. In our case, it would be reasonable to reduce the dimension of the waveguide by inserting a dielectric material into it.

Another problem with the use of a simple waveguide is its initial diagram which incorporates a very wide angle behind its aperture. The aperture could be equipped with a corrugated soft surface (collar), but its dimension would influence the distribution of the field in front of the aperture. It is, therefore, correct that the authors inserted an absorption plate onto the measuring waveguide. According to the picture (Fig.4 [1]), it should be placed closer to the mouth of the waveguide. In Fig. 1 I am showing the standard diagrams of radiation, calculated for the horn antenna by using Fressnel integrals (for theoretical distribution of the field in the aperture). The accuracy of the authors' theoretical diagrams is good in the area of the main lobe.

Considerably better would be a reconstruction of the diagram for a parabolic reflector. Unfortunately, the authors do not provide sufficiently detailed data about its construction, its focal distance and radiation on the periphery of the reflector. As a result, one cannot use the standard diagram of the reflector.

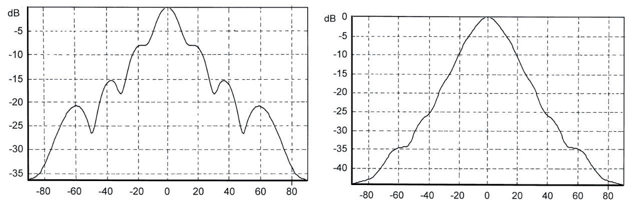

Fig. 1. a) E-plane diagram, b) H-plane diagram.

If we applied, for comparison, directivity data of the antennas, we would, most likely, get different results. Directivity measured on the similar horn antenna is about 19 dBi and directivity of a similar parabolic antenna is about 35 dBi (for -10 dB rim irradiation). The authors provide numerical values of the diagrams and would be best positioned to do the comparison.

In Fig. 2, I am showing, for comparison, diagrams for an equally large parabolic reflector (D = 60 cm), measured in a standard way in the distance of 55 m, and a reconstructed diagram from a complex measurement in the near field, all at the frequency of 10 GHz [2]. Comparison with optimization results in Fig. 11 [1] (for angles +- 20 deg.) is satisfactory because there is a larger difference in the dimensions of the reflector.

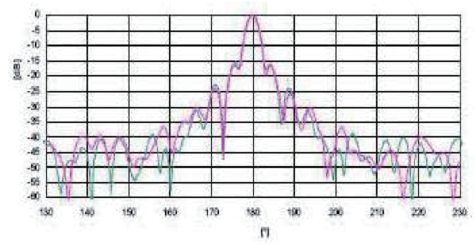

Fig 2. Comparison of outdoor measurements (Polygon) at the distance of 55 m (green) and reconstruction (viol.).

In conclusion, it has to be stated that correctness of the optimization results is not questioned, because they are, essentially, based on measurements affected by the same systemic error of the measuring equipment. I would also like to mention a similar publication of the authors [3] where they worked with much lower frequency of 940 MHz. Instead of physical measurement of a dipole array, they used the computational program Zeland IE3D, which works with the moment method of integration. Such results are considerably more credible.

References

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[3] PUSKELY, J., NOVÁČEK, Z., POKORNÝ, M. Using global optimization approaches to reconstruct radiation patterns. In *Proc. of the 14th Conference on Microwave Techniques*. Prague (Czech Republic), April 23/24, 2008, p. 239-242.

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