

Vitaliy S. Bulygin

**SCIENTIFIC REPORT FOR SHORT VISIT
to University of Rome 3 and University of Rennes in April 2011
in the framework of the ESF Network "Newfocus"**

Topic: "Near field focusing and radar cross section for a finite paraboloidal screen"

Purpose of the visit to Rome: collaboration with Professor G. Schettini

Description of the work carried out during the visit from 10th to 16th April 2010:

- seminar talk presented at the University Rome 3 to Prof. Schettini, students, and staff members and covering my research into the scattering of waves by rotationally symmetric reflectors,
- discussions with Prof. Schettini on the topics of common interest including optimization of the paraboloidal reflector and its sub-reflector geometries for the best focusing that can be an area of closer collaboration,
- attendance at the special sessions on lenses and reflectors and on the ESF Network Project "Newfocus" at the European Conference on Antennas and Propagation.

Purpose of the visit to Rennes: collaboration with Professor R. Sauleau

Description of the work carried out during the visit from 17th to 23rd April 2010:

- discussions with Prof. Sauleau on the full-wave three-dimensional modeling of reflector antennas in the receiving and radiating regimes, and other rotationally symmetric PEC surfaces, using the singular integral equations and Nytron-type discretizations,

Details of the topics discussed in Rome and Rennes:

For the design of various electromagnetic wave focusing and radiating systems it is necessary to have a quick and reliable tool of their computer modeling. One of traditional and still in-demand problems is electromagnetic wave diffraction by the finite PEC rotationally symmetric surfaces located in free space. Here, the receiving and the radiating regimes of reflector antenna are simulated with the incident field taken as a plane wave and a localized given-current field, respectively. Then the most important characteristics of antenna are the focusing ability and the far-field directivity, respectively.

In each case the problem of electromagnetic wave diffraction by reflector is split, using the Fourier transforms in azimuth coordinate, to independent problems for each azimuth order. They are further reduced to the independent sets of two coupled one-dimensional integral equations, a hypersingular and a singular, with varying coefficients. These equations are solved numerically using interpolation-type quadrature formulas (known as Nystrom method) that provide a high rate of convergence. From the solutions of these equations, the near and the far-zone field patterns are obtained. The developed method has guaranteed convergence for arbitrary not axially symmetric primary field.

Using this method, I have investigated the plane wave diffraction by a PEC paraboloidal reflector and computed the radar cross-section and the in-focus field magnitude as a function of the reflector geometry and the wavelength. This has enabled me to perform elementary optimization of paraboloidal reflector by finding the values of the depth of reflector, which provide the largest field magnitude in the focus. I have found that this is achieved for the focal distance to aperture diameter ration equal to 0.25. I have also studied numerically the location of the true maximum of the near electric field (which does not coincide with the geometric focus) and its migration for varying incidence angle, frequency and geometrical parameters of paraboloidal reflector.

From the discussions with Professors G. Schettini and R. Sauleau, I have come to conclusion that a further extension of this work should be the study of the near and far-zone fields of the real-life antennas consisting of a paraboloid and a sub-reflector (first of all, a conical shield) illuminated by various primary fields. This will include the sources in the form of the complex-point Huygens elements (crossed electric and magnetic dipoles), which is a convenient simplified model of a realistic corrugated-horn or horn-lens antenna.

Vitaliy S. Bulygin

**TRAVEL EXPENSES FOR SHORT VISIT
to University of Rome 3 and University of Rennes in April 2011
in the framework of the ESF Network “Newfocus”**

Air ticket from Rome to Paris and from Paris to Rome	EUR 352.98	
Train from Paris to Rennes and from Rennes to Paris	EUR 127.80	(EUR 72+55.80)
Bus from airport to Rome and back	EUR 10	
Visa Charges	EUR 30	(UAH 330)
Train from airport to Paris and from Paris to airport	EUR 19.15	(EUR 10.25+8.90)
Trains from Kharkov to Kiev (1) and from Kiev to Kharkov (2)	EUR 28.9	(UAH 141.8+66+110= 317.8)
Bus from Kiev to Kharkov	EUR 11.46	(UAH 126)
<hr/>		
Total:	EUR 580.29	

Bulygin 1/4

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	Rome Ciampino to Paris Orly (Terminal Sud) Dep 17 April 2011 15:15 Arr 17 April 2011 17:15 Flight 4248 Check in opens 17 April 2011 13:15 Check in closes 17 April 2011 14:35
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To
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EZY4248	17APR	12

Boarding Group
2

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 TGV PLEIN TARIF LOISIR-ECH/REMB PAVANT JOUR DU DEPART

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Visa Category : Gratis scientist
Barcode No : kvfr100320111737
Visa Fees : 0,00
Date of Birth : 03/06/1985
Nationality : Ukrainian

Courier Charges : 50 U
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