PhD THESIS ABSTRACT

„ ELECTROMAGNETIC COMPATIBILITY STUDY CONCERNING GROUND TO AIR MISSILE SYSTEMS”

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Ground-based air defense represents, along with military aviation, one of the two major components of the national territory defense system. The process of acquiring new ground-to-air missile systems, intended to work together with the weapon systems already in the army's equipment, as well as in a complex electromagnetic environment, already ultra-populated with the emissions of other military and civilian equipment, requires taking into account consideration, from the purchase planning stage, of the constraints and limitations imposed by the need to ensure electromagnetic compatibility. Thus, the acquisition of a new ground-to-air missile system must consider, along with its performance, the behavior of the system and its potential as a source of electromagnetic disturbances.

The configuration of a ground-to-air missile system includes subsystems and equipment with large dimensions that constitute important limitations in the evaluation from the point of view of the disturbing electromagnetic potential, with the help of the usual anechoic chambers. Under these circumstances, the use of alternative methods of modeling and simulating the operation of these equipment, as well as the practical realization of small-scale models that allow experimental research to be carried out and the results of which can be extrapolated, are available solutions that offer also the advantage of low costs. From this perspective, the PhD thesis presents a scientific tool that allows the rigorous determination of the spatial distribution and levels of disruptive electromagnetic fields emitted by a ground-to-air missile system, depending on the configuration and characteristics of the emitted radiations sources from its configuration. This useful tool can be used both as a scientific benchmark and as a reference by decision makers when selecting a new missile system for purchase.

In order to achieve these goals, it was first necessary to take over, process, often develop and adapt the mathematical formalism presented in the specialized literature, up to its "useful" form that would make possible the most accurate description of the directivity performance of the analyzed antenna system and then allow its implementation in a suitable programming environment that numerically and graphically evaluates these performances. Thus, useful tools were made for the calculation and graphical representation of the most important parameters of the directivity of antennas - the directivity function and the array factor’s function, the directivity and the gain, the opening angles at -3 dB of the main lobe of the directivity characteristic or the characteristic of the array factor, the level and positions of the secondary lobes, and so on.

From the point of view of electromagnetic compatibility issues, the most important subsystem of a ground-to-air missile system is the multi-purpose radar that uses a circular aperture phased array. In order to model it, the mathematical formalism specific to linear arrays of phased antennas, uniformly distributed, first uniformly then non-uniformly excited, was first developed in a unitary manner. Based on this, phased plane arrays, uniformly distributed and uniformly and non-uniformly excited, with rectangular/square aperture and finally those with elliptical/circular aperture were then approached. The theoretical developments and the calculation and plotting programs have been made so that the experience gained by modeling the linear arrays can then be used for the modeling of the planar antenna arrays.

Efforts were directed to the essential directive properties of antennas that intervene in electromagnetic compatibility issues: directivity function and characteristic, array factor function and characteristic, directivity coefficient.