

PhD THESIS ABSTRACT  
„STUDY OF ANTENNA ARRAYS MADE FROM  
ADVANCED MATERIALS”

*Author:* **eng. Marius Gabriel ȚURCAN**

*Email:* gabriel.turcan@mta.ro, tel: +40 740 274 156

*PhD Supervisor:* **prof. univ. dr. eng. Ioan NICOLAESCU**

Reducing the size and weight of mobile terminals is a major trend in mobile/Wi-Fi communication technology. Antenna design requirements include low cost, compact size, and a wide frequency band. To meet these demands, designers have developed compact, broadband antennas with very high efficiency. Among these we can list: the asymmetric antenna, the dipole, the inverted F antenna, the microstrip antenna, etc.

An alternative to those presented above is represented by antennas made of advanced materials, which have garnered attention in various applications due to their attractive features in terms of light weight, small dimensions and a high degree of flexibility in choosing dimensions, for a given frequency and given dielectric constant.

The main objective of the thesis was the analysis and synthesis of antenna arrays made of advanced materials.

The study included three stages. Initially, the most common shapes of dielectric resonator antennas were studied, namely: hemispherical, cylindrical and rectangular. For each of these shapes, the relationships for the calculation of the resonance frequency and the radiation factor,  $Q$ , were optimized. Also, a solution was identified to improve the bandwidth of antennas made of advanced materials, consisting of perforating the dielectric material

In the second stage, the mutual interaction between the elements of an antenna array with dielectric resonators was studied, as well as the frequency behavior of the antenna arrays excited by two different methods: rectangular slot, and probe.

In the last stage, the study focused on identifying a solution for scanning the radio wave beam of antenna arrays. The proposed phase shifter scheme, intended to replace the traditional two-bit phase shifter, was used in the practical construction of a linear antenna array. The array, consisting of four antennas with cylindrical dielectric resonators, was able to sweep the radio wave beam in five distinct directions ( $-35^\circ$ ,  $-18^\circ$ ,  $0^\circ$ ,  $+18^\circ$ ,  $+36^\circ$ ).

The objective of the thesis was achieved, the validity of the proposed mathematical relationships being proven by the experiments carried out. Also, the proposed phase shifter schemes performed their functions in very good conditions for the proposed architecture.

The array architecture proposed in this thesis can be used in road traffic applications, for locating and tracking vehicles, or "automotive radar", i.e. "short-range radar" (SRR), for monitoring the "blind spots" of a vehicle.