Abstract

Moment Method Analysis of Mutual Coupling between radiating elements of an array antenna is the subject matter of this thesis. This analysis is applied on two basic structures : one is the mutually interacting diaphragms inside a waveguide and the other is the mutually interacting radiators. Both this type of problems require the evaluation of the circuit behaviour of the devices i.e, diaphragms or radiators. For getting a narrowband bahaviour from capacitive or inductive circuit elements, basic circuit elements are needed to provide the required characteristics and their study is carried out for successful design of the RF Switches.

The array elements behave differently in an environment where each is coupled to its neighbors. Performance evaluation of radiating element should be done by taking mutual coupling into account. The impedance match offered by the radiators also depend on this mutual interaction. So, the radiators should be chosen keeping in mind their wide angle impedance matching property. Different radiating structures giving good radiation performance individually must satisfy the low mutual coupling criterion as well.

The behaviour of different radiating structures as sensors show some peculiar behaviour which should be looked into. Particularly the impedance matching requirement of the sensors for getting a good amount of power coupled to itself without disturbing the environment significantly needs the combination of the diaphragm modelling technique with the radiator modelling technique.

This thesis provides a fairly completely and accurate analysis of these problems. Softwares have been developed for the determination of various basic quantities involved. The thesis is broadly divided into the following heads :

- Chapter 1 presents an extensive survey of the literature on waveguide radiators and diaphragm problems, including the mutual coupling and wide angle impedance matching technique, beginning from 1950s. The gaps in the works reported so far, as well as the unexplored areas in the concerned fields are also touched upon.

- The evaluation of scattered electromagnetic field inside waveguides and inside different cavity structures are presented alongwith the modelling of simple waveguide diaphragm in Chapter 2.

- Chapter 3 is concerned with the complex diaphragm structures that comes into the picture when a narrowband RF filter design is taken up. A thorough analytical framework to handle such structures is presented in this chapter.

- Theoretical Modelling of a single radiator, free from any interaction from nearby radiators is presented in Chapter 4. The field scattered into the free space due to the aperture magnetic current source is derived in this chapter. The analysis is done by the Modern Numerical Technique that gives excellent accuracy in diaphragm modelling.

- The mutual interaction of coupled radiators is the subject matter of the 5th Chapter, where the Wave Analysis of the radiators is brought to its logical conclusion by determining their equivalent network representation.

- The behaviour of the radiators studied so far are reviewed again in Chapter 6 when they are operating in actual array environment and generating the desired beamshapes required from an array antenna. The Wide Angle Impedance Stabilisation objective is given top priority while evaluating the theoretical model under dynamic condition.

- The behaviour of the radiating elements in the receiving mode is studied in Chapter 7 and the problems associated with impedance matching of the waveguide sensors is reviewed critically here.