

# Dielectric Resonator Antennas, Theory, Design and Applications

Half a day short course for APS 2007

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**Abstract:** Recently, interest in dielectric resonator antennas has increased because of their attractive features such as small size, high radiation efficiency (98%), wide bandwidth, and high power capability for radar applications and base stations. The dielectric resonator antenna is made from high dielectric constant materials and mounted on a ground plane or on a grounded dielectric substrate of lower permittivity. The short course will start by an overview for the development of the dielectric resonator antennas. The theory of operation will be discussed step by step to provide basic understanding. The discussion is provided in simple forms to satisfy audience of different background levels. Design curves will be provided for the circular disc and hemisphere dielectric resonators. Use of these models with other geometries is discussed.

Different excitation mechanisms are demonstrated such as the probe, slot, image line and waveguides. Applications in dielectric resonator arrays are provided with discussion on the mutual coupling level and the wide scanning capabilities of the dielectric resonator array. The array bandwidth limit is discussed based on the element size and the spacing between the array elements.

The problems related to the practical implementations are considered. Results of a numerical study pertaining to the effect of an air gap, between the dielectric disc and the ground plane or an air gap surrounding the feed probe, on the input impedance and resonant frequency of a cylindrical DRA operating in the  $TM_{01\delta}$  mode or  $HEM_{11\delta}$  mode as a function of dielectric constant will be presented. Some of the numerical results are validated experimentally.

Techniques for broadband applications are discussed. Several examples are provided. Finally, Techniques for size reduction of the DRA are presented to demonstrate the flexibility of the DRA to satisfy the required small size for some applications.