# ANTENNAS AND PROPAGATION

## *Modeling, Simulation & Measurements*

Edited by

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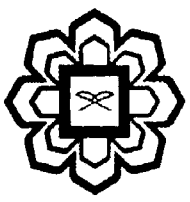

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# Chapter 12

# Leaky-Wave Array Antenna

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AHM Zahirul Alam[1] and Md. Rafiqul Islam[1]

## 12.1 Introduction

The newly introduced field of metamaterial has led to designs of antennas based on the composite right/left-handed (CRLH) transmission line (TL). Although the CRLH TL based antennas were able to significantly reduce antenna sizes [1]-[2], its gain is very low. The reason for this can be narrowed down to the small footprint of the antenna. In this paper, gain enhancement for the CRLH TL based antenna is being proposed. The gain enhancement is achieved by leveraging on the leaky-wave phenomenon that is excited at some frequencies within the structure. The fast-wave region where leakage radiation occurs can be identified from the dispersion diagram and the fields within the structure. Studies made on the unit-cell of the single element CRLH TL based leaky-wave antenna showed that the antenna operates in the fast-wave region at frequencies between 2 GHz and 3.1 GHz. In this chapter, improvement of the gain is achieved by arranging the CRLH TL based single element antenna into an array of 3 x 1 configurations.

## 12.2 Theory

A leaky-wave antenna is an antenna that radiates power from the traveling leaky-wave, along its length. The leaky-wave antenna is usually constructed so that 90% of the power leaks along the length of the antenna. An important factor that plays a role in determining the amount of power that leaks along the length of the leaky-wave antenna is the leakage constant, $\alpha$. The leakage constant depends on the amount of leakage from the antenna per unit length. A high value of $\alpha$ implies a high leakage rate, which allows for 90% leakage to take place within a smaller antenna aperture, as compared to a smaller value of $\alpha$. This smaller antenna aperture also results in a larger beamwidth [3-4].

## 12.3 The geometry of the antenna structure

The return loss of the UWB without slot antenna with the variation of 'L', the feedline position from the edge of the substrate is shown in Figure 12.1 by maintaining the partial ground width G=7.6mm and feedline width W=1.8mm. The ultra wide band operation is possible for L=3.325mm which is not located at the centre, that is, asymmetric feedline results ultra wideband operation. The figure also shows that the return losses for the L=4.325mm and L=6.325mm are same, because the feedline distance from both edges of

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