Summary

Ultra-wideband (UWB) is a radio technology that can be used at very low energy levels, for short-range high-bandwidth communications, by using a large radio spectrum. Due to its high speed rate, this technology is nowadays one of the most promising solutions for communications. Maximum data that can be transmitted per second over a communication channel can be high since the UWB signals have large bandwidth. Recently the printed antennas for UWB applications have also become a topic of sustained investigation in the fields of wireless communications and radar applications, due to such attractive features as transmitting and/or receiving electromagnetic energy in shorter duration and avoiding both frequency and space dispersion.

There are already some solutions for low profile UWB elements in the literature; however, they have some deficiencies such as they can not ensure the wide bandwidth and the small electrical size features at the same time and/or they have complex shapes so that the manufacturing process of these antennas can be difficult and costly. It is also important for the antenna elements to work well in array environments. Hereafter we can derive our prime research question: How can we design optimal UWB elements for array environments? The research question has been answered by introducing two (quasi-) magnetic types of antennas. Coplanar Waveguide (CPW) lines have been used for feeding the antennas allowing for wider impedance bandwidths. With these features the "Eared" antennas and the "Tulip" loop antennas have been investigated in detail. All calculated results were confirmed via measurements. To the author's knowledge these antennas have the widest impedance bandwidth with the electrically smallest sizes compared to other similar types of printed and low-profile antennas described in literature. A feasibility study on adding a ground plane to be used with the elementary radiators has also been done in this dissertation. In this study the "Tulip" loop antenna has been used together with the properly designed Artificial Magnetic Conductor (AMC).

One of the goals of this research was designing UWB elements for

(linear) array environments. Thus, the linear array performances of "Eared" antenna and the "Tulip" loop antennas have been investigated. All computed results were confirmed via measurements. It has been proven that these antennas can be used in array environments. A method to predict the electrical performances of large arrays from the results of smaller arrays has been developed and the electrical performances can be well predicted without doing lengthy simulations and/or measurements. The validity of the method was confirmed via measurements.

Impulse Radio (IR) is a method of transmitting UWB signals without carrier. One goal in this research is to design antennas for IR applications. Thus, the suitability of antenna elements to Impulse Radio applications has been investigated and quite successful results have been obtained for the designed IR UWB band antennas.

With all studies conducted in this dissertation, electrically smaller, repeatable and wide bandwidth antenna elements with stable radiation patterns have been developed. This dissertation adds a successful contribution to further UWB antenna (array) developments.