

Chapter 5

Beam Forming Algorithm with Different Power Distribution for RFID Reader

A. K. M. Baki

Independent University, Bangladesh

Nemai Chandra Karmakar

Monash University, Australia

Uditha Wijethilaka Bandara

Monash University, Australia

Emran Md Amin

Monash University, Australia

ABSTRACT

It is possible to achieve higher BE and lower SLL of array antenna by implementing different amplitude or phase distribution technique in the array antenna. The phase errors of the system should also be kept to a minimum in order to maintain lower SLL and higher BE. The phase errors can come from any of the stages: signal detection, MW/RF generation, amplifier/attenuator, phase synchronization, phase shifter, et cetera. The phase error can be reduced by using non-uniform element spacing. In this chapter some methods of SLL reduction and increase of BE by adopting some edge tapering concepts and minimization of phase errors by implementing non-uniform spacing of array elements are discussed. The spectrum below 10 GHz frequency will likely be congested, and the spreading of millimetre wave technology in different emerging wireless applications as well as associated increase in energy consumption will be witnessed in the near future. In this chapter some new and better beam forming techniques for optimization between side lobe levels and beam efficiency are discussed. Different frequency bands of RFID systems are also focused on in this chapter.

1. INTRODUCTION

The antennas used in some applications such as RFID systems, WiMAX systems, and collision avoidance radar, must have very low side lobes. Array antenna technology with higher beam ef-

iciency (BE) and lower side lobe level (SLL) is required in order to increase the coverage area of RFID systems, transmission bit rate and at the same time decrease the energy consumption and interference levels. The antennas used in some applications such as RFID systems, WiMAX

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systems, and collision avoidance radar, must have very low side lobes. Array antenna technology with higher beam efficiency (BE) and lower side lobe level (SLL) is required in order to increase the coverage area of RFID systems, transmission bit rate and at the same time decrease the energy consumption and interference levels. It is possible to achieve higher BE and lower SLL of array antenna by implementing different amplitude or phase distribution technique in the array antenna. The phase errors of the system should also be minimum in order to maintain lower SLL and higher BE. The phase errors can come from any of the stages: signal detection, MW/RF generation, amplifier/attenuator, phase synchronization, phase shifter etc. The phase error can be reduced by using non-uniform element spacing. Methods of SLLs reduction and increase of BE by adopting some edge tapering concepts and minimization of phase errors by implementing non-uniform spacing of array elements are presented. The spectrum below 10 GHz frequency will likely be congested and the spreading of millimetre wave technology in different emerging wireless applications as well as associated increase in energy consumption will be witnessed in the near future. A few new beam forming techniques for optimization between SLLs and BE are discussed. Different frequency bands of RFID systems are also focused.

Radio Frequency IDentification (RFID) is a wireless tagging technology that allows a target to be automatically identified at a distance without a direct line-of-sight, by transmitting data through electromagnetic exchange. RFID has gained worldwide popularity in numerous applications such as inventory tracking, animal tagging, security surveillance and authenticity verification (R. Want, 2004). RFID systems are becoming ubiquitous and the growth of RFID uses is rising tremendously. In some sophisticated applications, fast and energy efficient tag reading is desirable, especially when the number of tags is high (D. K. Klair, K. W. Chin, and R. Raad, 2010). In such situations, the RFID cannot read

all the tags and most of the transmitted energy from the RFID reader is wasted.

RFID systems can be classified based on their frequency band of operations, such as:

1. **Low frequency (LF):** 125-134 KHz;
2. **High frequency (HF):** 13.56 MHz;
3. **Ultra high frequency (UHF):** 433 MHz, 860-960 MHz;
4. **Microwave (MW):** 2.4 GHz, 5.8 GHz;
5. **Millimetre wave (mm-Wave):** e.g., 60 GHz and 77 GHz (Pekka Pursula et al., 2008);

For UHF RFID system, different regions are using different frequency sub-bands:

1. **USA and Canada:** 902-928 MHz;
2. **Australia:** 920 to 926 MHz;
3. **Japan:** 950 MHz;
4. **Europe:** 965-868 MHz;

The main components of a chipless RFID system are a reader antenna and a passive chipless RFID tag. The reader antenna reads the backscattered radio frequency signals from the chipless tag. The block diagram of an RFID reader system is shown in Figure 1.

Adaptive antenna with higher gain and lower side lobe levels (SLL) is required for RFID systems. Adaptive antenna can decrease the energy consumption, interference levels and increase the range of RFID systems. By controlling the phases and amplitudes of antenna elements it is possible to achieve higher beam efficiency (BE) and lower SLLs. Phase errors of antenna elements cause higher SLL and lower gain. In this chapter some phase error reduction technique will be discussed. Edge tapering of array antenna can reduce SLLs and enhance the antenna gain. Although there are some technical demerits of full edge tapering. Some new and better beam forming techniques for different frequency bands by using edge tapering concepts will be discussed in next sections. Design and development process of low

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