Directivity improvement of a circular antenna array

Julian Imami

Abstract— Technology has increased its influence in all aspects of our life. For this reason in nowadays a lot of researches are done in all fields of technology. This paper will focus on the antennas that transmit and receive data. During transmission, the oscillating current applied to the antenna by a transmitter creates an oscillating electric field and magnetic field around the antenna elements. Especially their use in mobile technology. Telecommunication industry has lead us from conversations with wireless technology to the use of internet with Wi-Fi. The smart phones that we all have in our hands today are used not only for their basic and initial creation as a mobile communication but involve the use of phones for internet usage. The aim is to improve the directivity of this antennas through the phase only control.

Index Terms— Circular array antenna, frequency of an antenna

1 INTRODUCTION

Nowadays we live in a life full of frenetic changes which involves all fields. Of course from the technological point of view, more is technology involved in a field, more it is changed and affected even from small improvements. In the telecommunication industry we have witness changes which would be unimagined for us if we would thing of them in the past. Telecommunication industry has lead us from conversations with wireless technology to the use of internet with Wi-Fi. The smart phones that we all have in our hands today are used not only for their basic and initial creation as a mobile communication but involve the use of phones for internet usage. From its side through the creation of applications, it give us the possibility to access our pc-s through remote control, communicate with each other not only through voice calls without the usage of our service provider but also the possibility to make video conferences etc. Technological updates changed all fields from the way we make meetings, tests, communicate with each other and all the things which affects our daily life.

As mentioned changes in mobile industry have put all their effort in improving the internet service they offer to the subscribers. Making the connections more secure, more efficient, more featured, more powerful, more effective and less costly. Of course that all this can be done only if they concentrate all their efforts in the root of all this. The base, the core is doubtless the antenna. An antenna is a device which transmits or receives electrical waves. It can be described as an array of electrically elements connected with each other in a way that makes it possible to receive or transmit signal. During transmission, the oscillating current applied to the antenna by a transmitter creates an oscillating electric field and magnetic field around the antenna elements.

In this paper we will focus on how we can make the antennas more efficient. How we can improve them in order to get more powerful, more directive signal with less noise and less interferences. Based on the theoretical information related to antennas, we have full knowledge related to single or simple antennas and more complexed ones named the array antennas. Array antennas assemble simple antennas in different geometrical and electronical configurations. In order to have multi directive antennas is necessary that the antennas interfere in a constructive way in all the desired fields and

destructive in all the other fields (which create interferences and make the antenna less efficient).

In this paper we will take in consideration the circular array. Circular arrays are one of different types of array antennas which are widely used in nowadays. Circular array is one of the types of antennas which have a high interest in practice. They are widely used in radio localization. It takes its name from the way that the radiating elements are located in the space. The different elements are located in the space in a way that every element can replace the other in a rotation around the axis. For this type of array antenna we can say that the end of the array wraps around to the start of it. The elements positioned in a circular way form a circle with circumference ϱ.

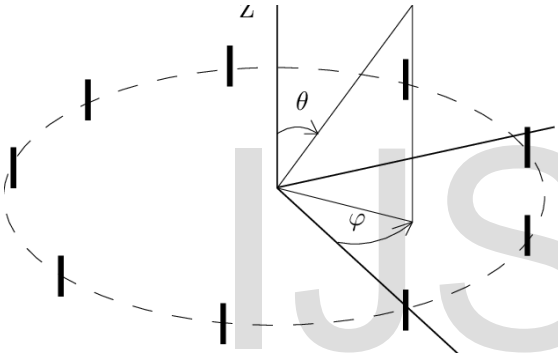


Fig. 1. Circular array antenna schema.

Fig. 2. Circular array antenna in real.

2 EXECUTION

In this paper we will show the results of test that we made in a circular array antenna. Our aim is to identify a better pattern with the phase only modification. The antenna that we chose for the test is a circular array with 100 elements that scan a beam pencil in an angel of 60 degrees. In this excitation we have used 31 masks which directs from -30 degrees to +30 degrees of beam.

The elements of the antenna that we took in consideration are from sources of Huygens. This elements are considered ideal in order to not keep in consideration the coupling. The space between the elements is half of the wave length. For this reason the coupling cannot be kept in consideration for this example. The method that we applied is based on the re-configurability and beam scanning with phase-only control.

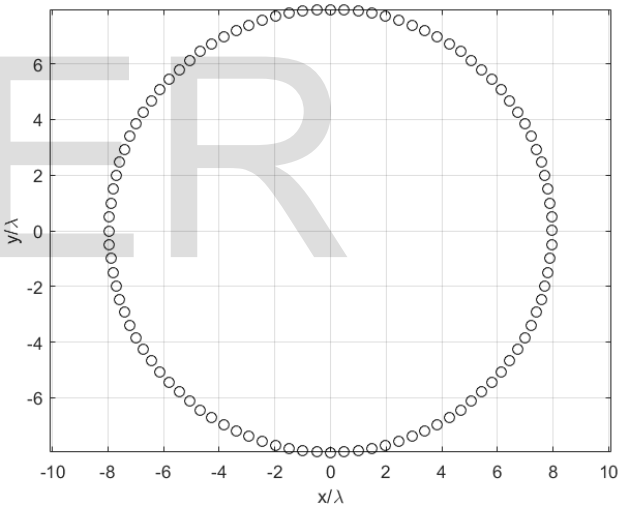


Fig. 3. Circular array with 100 elements.

In this excitation we will use 31 different masks which yield 31 algorithms. Since we are going to use a method with phase only control it is important to underline the fact that the given amplitude will not change, it is not part of the changes that will produce different excitations. The amplitude will be constant during all our tests. In this way with the fixed amplitude given we make possible the optimization of this amplitude. The disadvantage in the other hand is the fact that since the amplitude is fixed, assigned since the beginning it couldn't be optimized with a better one. In the excitation we impose the amplitude and also an upper DRR bound.

The initial diagram, and the diagram related to amplitude and phase that we have used are given as per below:

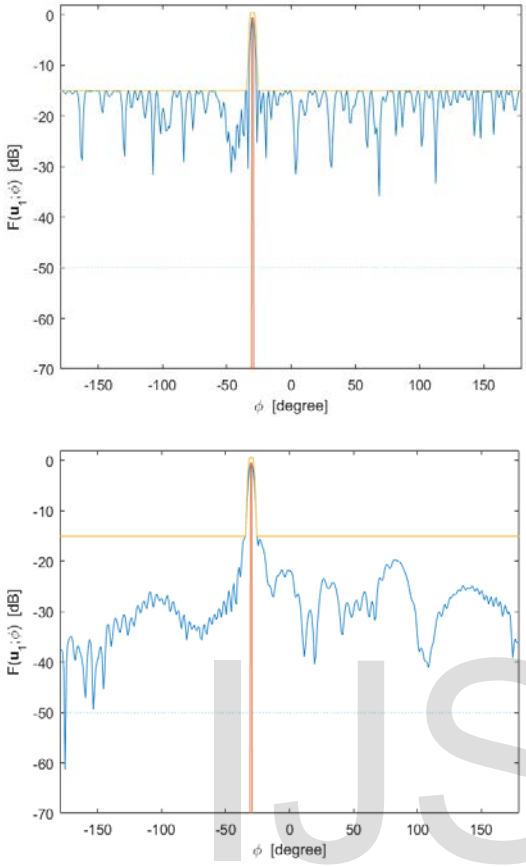
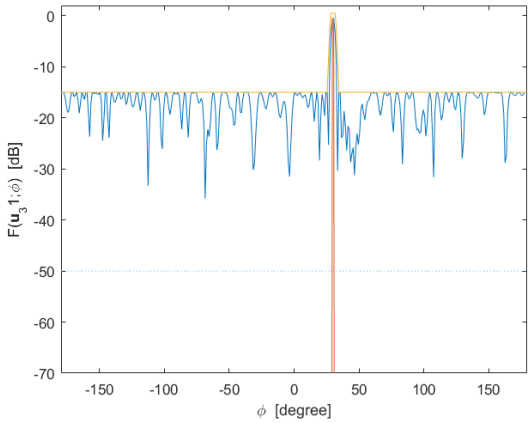


Fig. 4. The initial diagram related to amplitude and phase.

At the end after applying the 31 masks we have got the below diagrams:



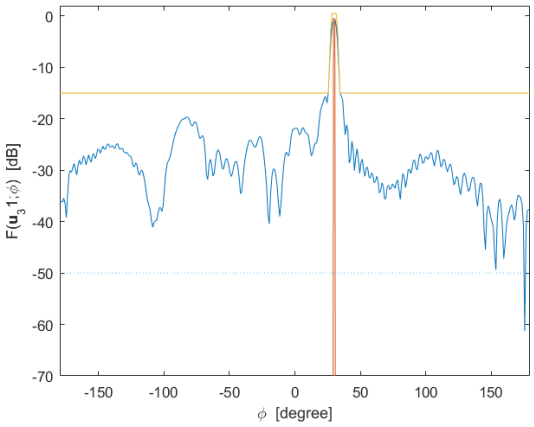


Fig. 5. The diagram related to amplitude and phase after mask applied.

And also we have the images as per below related to central diagram related to amplitude and phase:

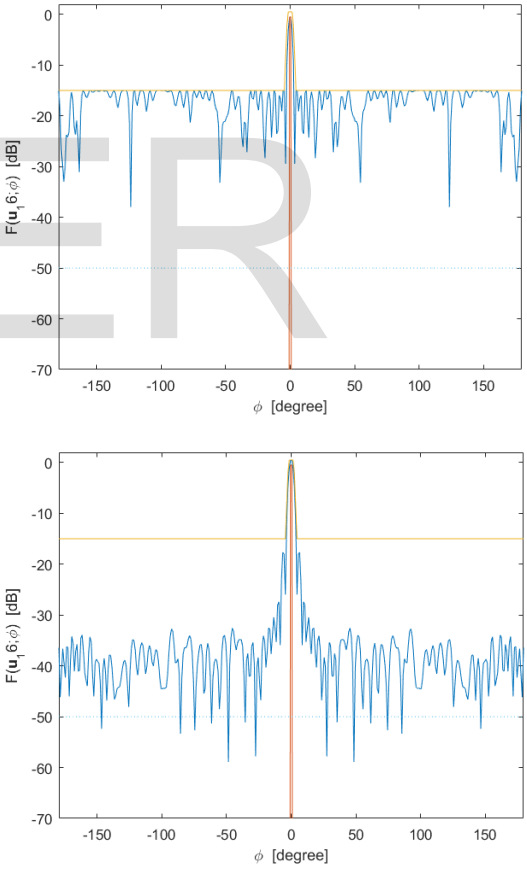


Fig. 6. Central diagram related to amplitude and phase.

3 CONCLUSIONS

In this paper we have focused on improving the antenna directivity based on the amplitude and phase control. We have utilized a circular array

antenna with 100 elements that scan a beam pencil in an angel of 60 degrees. In this excitation we have used 31 masks which directs from -30 degrees to +30 degrees of beam. In the diagrams we have shown the results of improvements in directivity from changes in phase and by keeping the amplitude fixed, and a given DRR upper bound.

The set of 31 masks used has yield 31 array patters which belongs to the masks. We have selected 31 masks close to each other in order to solve the prescribed problem. The algorithm is relatively easy to implement and has allowed us to use the phase only configurability of shaped patterns.

REFERENCES

[1] *https://www.researchgate.net/figure/uniform-circular-array-composed-of-nine-antenna-elements_fig1_228689817*

[2] *https://radiodirectionfinding.wordpress.com/radio-direction-finding/*

[3] *https://books.google.al/books?hl=it&lr=&id=xhZRA1K57wIC&oi=fnd&pg=PA1&dq=history+development+of+antennas&ots=nGbOn0ADvQ&sig=cJIo-PSrIFG0G6x_T0b3JPmAgFY&redir_esc=y#v=onepage&q=history%20development%20of%20antennas&f=false*

[4] *https://books.google.al/books?id=xdCfBwAAQBAJ&pg=SA14-PA3&lpg=SA14-PA3&dq=where+are+used+anntenass+why?&source=bl&ots=Yd02GhLEGO&sig=9W4KYnnhBzjJUH47ok-t4LV2-eE&hl=sq&sa=X&ved=0ahUKEwirkdOG1KXcAhVIblAKHQcuDusQ6AEIWTAG#v=onepage&q=where%20are%20used%20anntenass%20why%3F&f=false*

[5] *http://www.ece.mcmaster.ca/faculty/nikolova/antenna_dload/current_lectures/L01_Intro.pdf*