ADAPTIVE BEAMFORMING USING MACHINE LEARNING

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INTRODUCTION

With the increasing requirements in mobile communications and military applications, better coverage, higher capacity and better transmission quality are required. Therefore, antenna arrays are preferred when single element antennas are insufficient.

The aim of this study was tried to be optimized with artificial intelligence in order to direct the radiation pattern of the antenna arrays in the desired direction and to make the side lobes smaller.

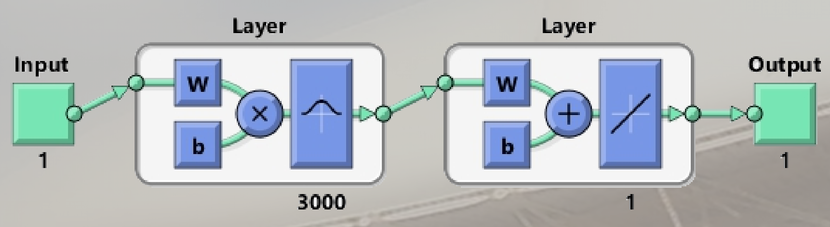
METHODOLOGY

The radiation graph of array antennas is obtained as:

''PATTERN = ELEMENT FACTOR * ARRAY FACTOR''

Here, to obtain the actual radiation graph, 'Element Factor' is determined as isotropic antenna and only the 'Array Factor' output is obtained.

In this study, the designed array antenna is on the planar plane. And LMS and Radial Basis Function Neural Network is used to optimize. RBFNN is a two-layer NN structure. And the hidden layer contains hundreds of Gaussian activation neurons.



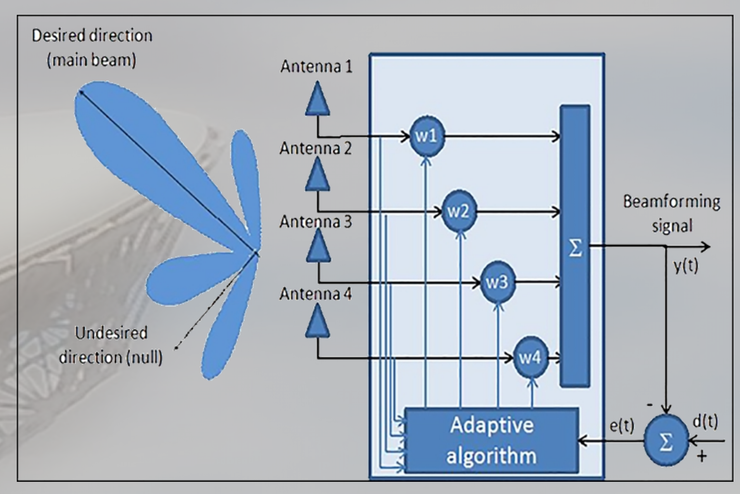
Some antenna parameters received from the user via the GUI are used in the array factor formula to obtain a radiation graph. Then it was optimized using RBFNN and the outputs were transferred to the GUI.

DESIGN REQUIREMENT

In order to meet the requirements of far distance communication, it is necessary to design high gain antennas in many applications.

Antenna gain is increased by increasing the electrical size of the antenna. Another way to increase antenna dimensions is to place the radiation elements in a certain geometrical arrangement. This structure is called an array antenna.

The total electric and magnetic fields of the antenna arrays are obtained by the vectorial sum of the electric and magnetic fields radiated from each element. In order to obtain a radiation pattern in the desired direction, the radiation fields of the antennas forming the array must be collected in the desired direction and cancel each other in other directions.



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❖ **We thank Prof. Dr. Özlem ÖZGÜN for her invaluable contributions to our project.**

SIMULATION RESULT

Two GUIs are designed for this project. The first interface is created for linear array, the second for planar array. In the GUI on the right, the antenna is placed on the plane in line with the values received from the user and radiation graphs are obtained. Since the Desired angle is set to 45 degrees, the main lobe is oriented towards that angle and the interferences are nulled. The interface image on the left shows the design for the planar array. Here, unlike linear, 3D radiation graph is obtained.