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Correction of array failure using grey wolf optimizer hybridized with interior point algorithm

Key words: Failure correction; Grey wolf optimizer; Interior point algorithm; Sidelobes; Deeper null depth level

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Motivations

1. Detection and correction of faulty arrays in beamforming are practical issues and have many applications in satellite, radar, and mobile communication systems.

2. Due to large size of antennas, there is always a chance of failure of single or multiple sensors. The failure of sensors can damaged the whole radiation pattern.

3. Sensor failure can affect the entire pattern, and communication becomes impossible.

4. The replacement of faulty sensors in satellite is not possible and it is a big challenge for the researcher to continue the desired communications.

Main idea

1. The main aim of this study is to recover the issues of faulty patterns in terms of reduced sidelobes, deeper null depth level, and dislocation of nulls from their original locations.

2. We have designed a new fitness function and grey wolf optimizer along with interior point algorithm to achieve the reduced sidelobes, deeper null depth level, and positions of nulls reverse to their original locations by adjusting the current weights of active sensors in the array.

3. The proper setting of parameters used in the fitness function have a deeper effect on the radiation pattern.

Method

1. The array factor of healthy array gives the original Chebyshev pattern and if any element in the array fails, the whole pattern disturbs.

2. Assumed that sensor w_5 are damaged, the power pattern is impaired in terms of SLL, NDL, diminishing of nulls, and dislocation of the nulls from their original locations. By designing a new fitness function, we have achieved a deeper null depth level and sidelobes using the grey wolf optimizer along with interior point algorithm .

Major results

1. Recovery of four nulls using proposed method.

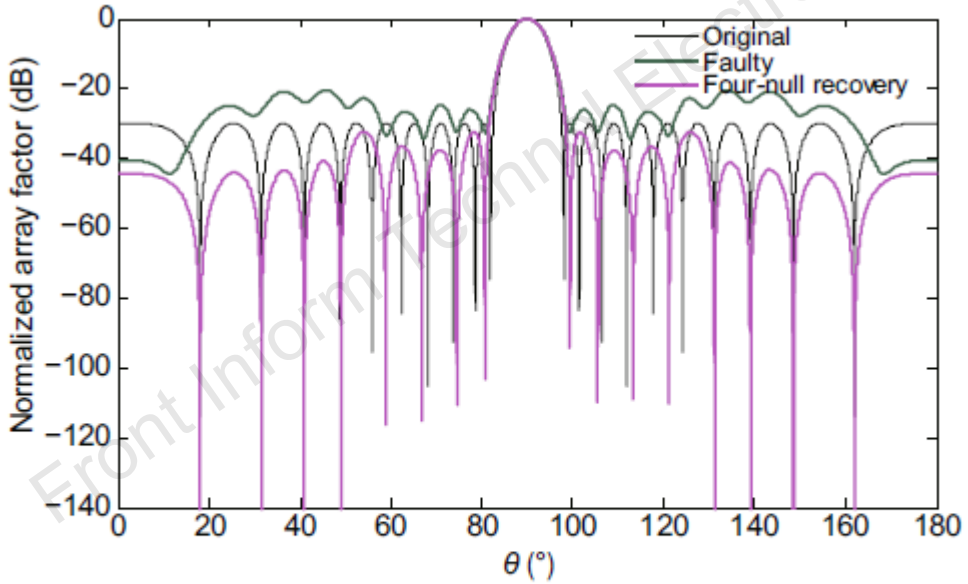

Fig. 6 The original, faulty, and four-null recovered radiation power patterns (References to color refer to the online version of this figure)

Major results

2. Recovery of five and six nulls using proposed method.

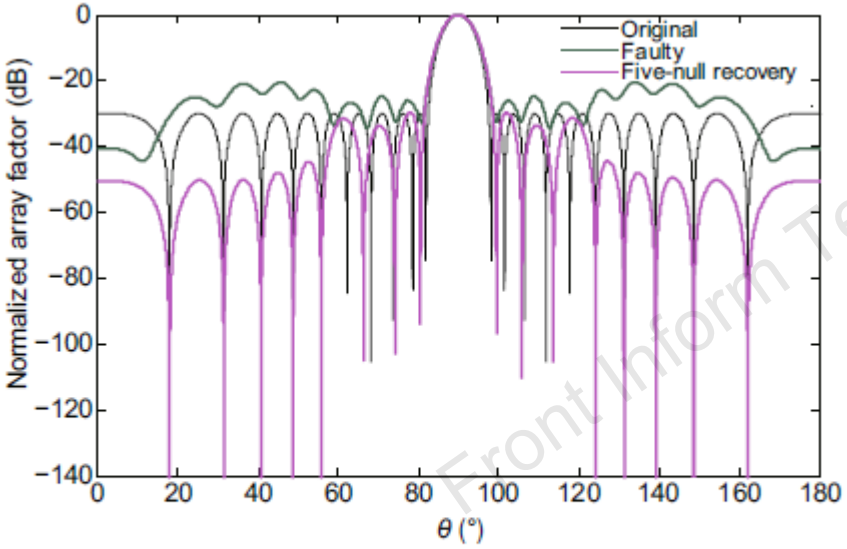

Fig. 7 The original, faulty, and five-null recovered radiation power patterns (References to color refer to the online version of this figure)

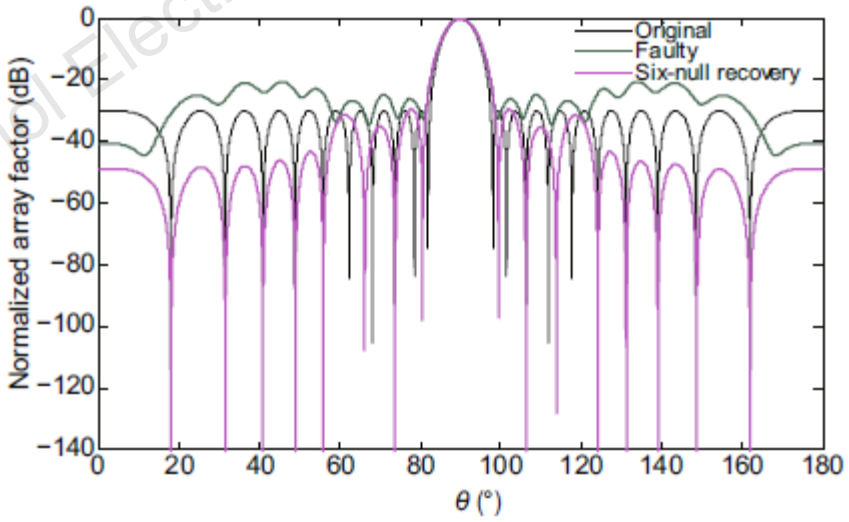

Fig. 8 The original, faulty, and six-null recovered radiation power patterns (References to color refer to the online version of this figure)

Conclusions

1. The proposed fitness function correct the damaged patterns in terms of side lobes, null depth level, and placement of nulls back at their desired locations using the nature inspired GWO hybridized with IPA.

2. The fitness function consists three factors which are necessary for failure correction problem, and the proper fittings of the parameter gives the desired pattern.

3. The hybrid algorithm gives better results in terms of sidelobes, null depth, and placement of nulls at their desired locations.