Shafqat Ullah Khan, Ijaz Mansoor Qureshi, Fawad Zaman, Wasim Khan, 2017. Detection of faulty sensor in array using symmetrical structure and cultural algorithm hybridized with differential evolution. *Frontiers of Information Technology & Electronic Engineering*, **18**(2):235-245. http://dx.doi.org/10.1631/FITEE.1500315

Detecting faulty sensors in an array using symmetrical structure and cultural algorithm hybridized with differential evolution

Key words: Cultural Algorithm; Differential evolution; Linear symmetrical sensor array

Corresponding author: Shafqat Ullah Khan
E-mail: shafqatphy@yahoo.com
ORCID: http://orcid.org/0000-0003-1969-1289

Motivation

- Detection of damaged sensors in a phased antenna array is an important research area in radar and satellite communication.
- The antenna array with a large number of radiating sensors has a possibility of getting failures for single or multiple sensors.
- Detection of damaged sensors in an antenna array is definitely a main task to be addressed in array testing.
- Several techniques are available in the literature to diagnose the position of damaged sensors from the measurement of healthy and degraded radiation but the proposed method required half number of samples.

Main idea

- The symmetrical structure has two advantages.
- First instead of finding all damaged patterns, only $(N-1)/2$ patterns are needed.
- Second we required to scan the region from 0 to 90 degree instead of 0 to 180 degree.
- Obviously the computational complexity can be reduced to half.

Method

1. Consider a uniform linear array composed of *N* sensors
2. Now if some sensors in the array become damage, the radiation pattern disturbs.
3. The target is to diagnose the faulty sensors to correct the damaged pattern.
4. For the detection of faulty sensors a cost function is designed, which compares the faulty patterns with a given configuration of faulty sensors and its minimum result will give us the location of faulty sensors.

Major results

- The proposed method detect faster the location of faulty sensor than the tradition method

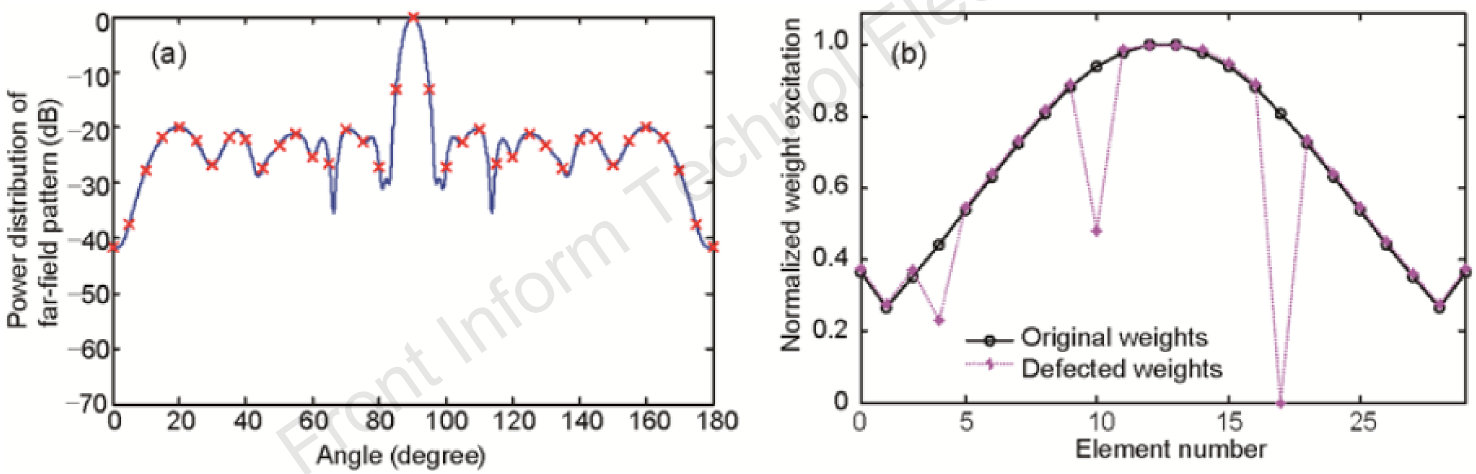

Fig. 10 Defective array pattern with fault at the 4th, 10th (50%), and 17th (100%) sensors with 35 sample points (a) and its fault diagnosed by the conventional method (Choudhury *et al.*, 2013) (b)

Major results (Cont'd)

- The proposed method can detect the location of faulty sensors with half number of samples and scanning angles

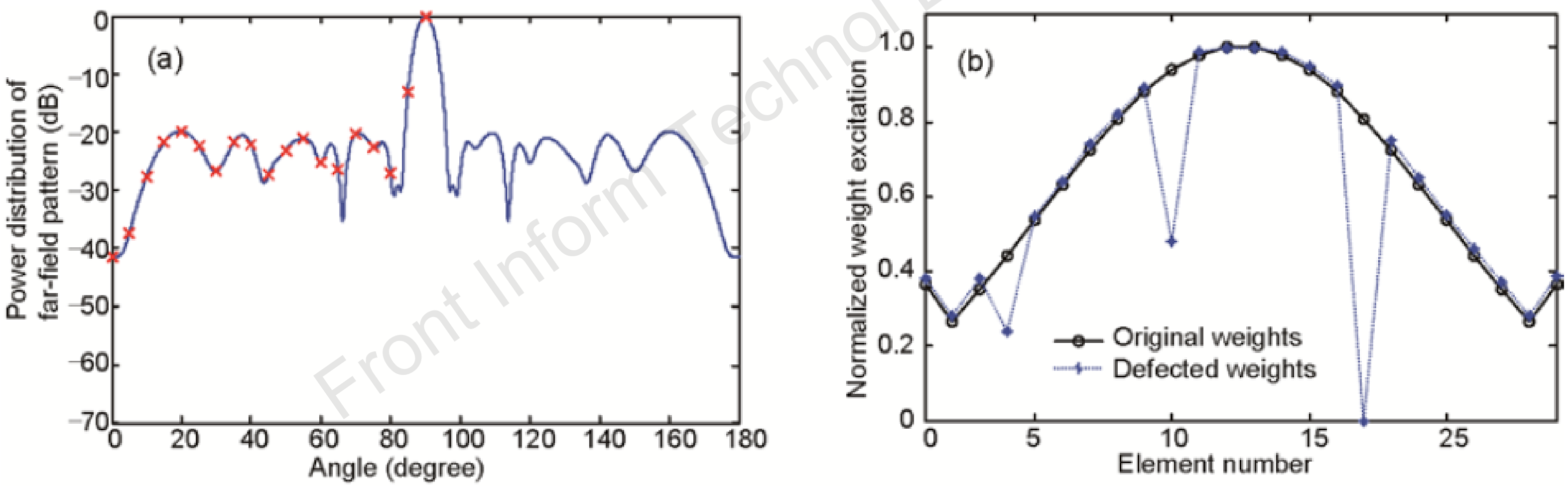

Fig. 11 Defective array pattern with fault at the 4th, 10th (50%), and 17th (100%) sensors with 19 sample points (a) and its fault diagnosed by the proposed method (b)

Conclusions

- The method is computationally efficient for finding fully as well as a partially defective sensors in a linear array.
- The method requires half pattern and scanning angles for the detection of faulty patterns.
- The decision of fully or partially faulty sensor is made on the basis of the cost function. If C_m>0.5, the sensor is fully faulty and if C_m≤0.5, then the sensor is partially faulty.
- The minimal of cost function will gives the location of faulty sensors.