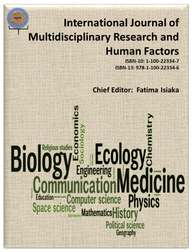

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Modelling Energy and Matter Formulation Using Pattern Synthesis and Generic Algorithm

Fatima ISIAKA[*1]
Department of Computer Science, Nasarawa State University, Keffi, Nigeria.
Email : fatima.isiaka@outlook.com

Zainab ADAMU[2]
Department of Computer Science, Ahmadu Bello University, Zaria, Nigeria.
Email : zadamu31@gmail.com

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[*1]**Corresponding Author : Fatima Isiaka**
Correspondent Email : fatima.isiaka@outlook.com

[2]**This Author equally contributed :**
To this paper,
Sponsor : Nasarawa State University, Keffi, Nigeria.

Abstract

Recent research has investigated the simulation of energy and matter as solar radiation or insolation that enters the earth's atmosphere as energy and becomes unavailable for the ecosystems as the energy is then absorbed by inorganic matter or reflected into the atmosphere. Energy is a most important part of our ecosystem and measuring its tendency for substance preservation is very crucial for environmental purposes such as health resolutions and a solid ecosystem. Measuring its conversion rate to matter is essential to life and all living organisms around it. The sun can be termed to be the source of energy available to the Earth either directly or indirectly, and energy choices and decisions also impact the Earth's natural systems in many ways. But we won't be aware of this to understand its importance and mechanism only when demonstrated physically or in a virtual simulation. This paper tends to simulate the effect of energy conversion to matter and how it can be applied to physical processes and demonstrate its importance and fulfillment of our natural environment. The method adopted here applied a pattern synthesis and generic algorithm that converts energy to matter for energy preservation and application.

Keywords : Ecosystem, Energy, Matter simulation, Generic algorithm, Pattern synthesis, Organic molecules

1 Introduction

The energy based on solar is the kind generated by the sun and it is about thirty percent of the solar energy that reaches the Earth's surface and is reflected into space ; the rest of the energy is absorbed into Earth's atmosphere. The flow of energy must balance just as the incoming and outgoing energy of the earth's surface, and the flow of energy into the atmosphere must be balanced by the equal flow of energy out of the atmosphere and back into space. The clouds, vapour, aerosols, and ozone unswervingly absorb twenty-three percent of incoming energy to the ecosystem.

The total inflow of energy matches the outgoing thermal infrared as observed from the top of the atmosphere ; the remaining fraction of the energy migrates to the earth's surface. The radiation energy (Figure 1) warms the earth's surface and this radiates some of the energy back out into the form of infrared waves. As they rise through the atmosphere, they are captured by conservatory gases such as water vapour and carbon dioxide. The conservatory gases trap the heat that reflects up into the atmosphere, and in this way, the gas acts like the glass walls of the greenhouse (conservatory), and this keeps the earth warm to sustain life. This process is generated based on the formation synthesis and this paper demonstrates its formation to matter, a substance that occupies space and possesses rest-mass, most especially as distinct from the original energy it is formed from.

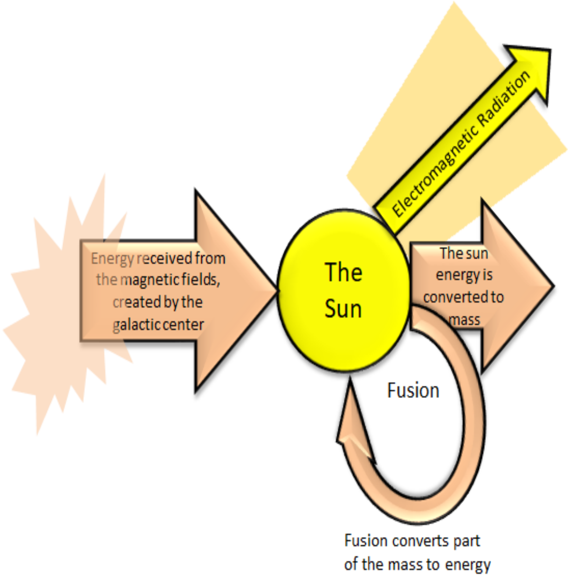

FIGURE 1 – Effect of energy from solar radiation on earth cursed by fusion.

The pathways of radiation through the atmosphere involve a loss of radiation (beam patterns) through reflection and absorption, the radiation is made up of visible wavelengths (thin light) and wavelengths that people cannot see with the naked eye, mostly called infrared light these forms dust particles or matter and absorbed by ozone and ecosystem.

2 Literature Review

The ecosystem is a constant flow of matter and energy from one place to another, this section discusses the importance of energy and matter formation and its cycle that takes place within the atmosphere [*Andreae and Crutzen [3], Burago [6], Chernyshenko [8], Kleidon [13], Monteith and Unsworth [16], Ryden and Lundin [18], Sen [20], Smil [21], Taube [22], Warneck [27]*]. The environment of an ecosystem includes air, water, soil, and weather systems; ecosystems can be sparsely populated or complex and full of life, and lots of complex flow of matter and energy [*Decker et al. [9], Legesse et al. [14], Miller [15], Osborne [17], Walter [25], Walter and Breckle [26]*]. The matter formed is the physical stuff that the universe is made of i.e. the things that one can touch and weigh on a scale and this takes up space. This also includes gases like carbon dioxide, azimuth, and oxygen. Energy could be described as the resources necessary for any kind of physical work, including that from sun rays. The faster one throws a substance like a ball, the more energy is generated and also the hotter a cup of liquid is, the more energy it has. Matter and energy are the same in a different form, we can also express matter as the solid form of energy [*Chen et al. [7], Goodstein [11], Jeans [12]*].

2.1 Matter and Energy Changes and Flow

The energy we absorb is a big part of how life forms both animals and plants live, the energy we use to move the bodies and direct the organ's functioning comes from the intake of food and air [[*Anand [2], Berthoud [4], Sembulingam and Sembulingam [19]*]. This brings inner energy to the body and for living. The human form also has inputs and outputs of energy, the light energy from the sun, makes a plant turn the light into energy into glucose sugar [*Amthor [1], Brett et al. [5], Flexer and Mano [10], Transeau [23], Walker [24]*]. The same is also true for light energy from the sun is turned into matter and can be utilised for various purposes like rays on solar panels. This paper is aimed at analysing its formation based on beam patterns through both generic algorithm (GA) (Figure 2) and pattern synthesis (PS) (Figure 3). The beam patterns are reflected by the point vector $\overrightarrow{X}_{ij}$ into the solution space x_{ij}. From the initial population, one can arrive at the termination criteria.

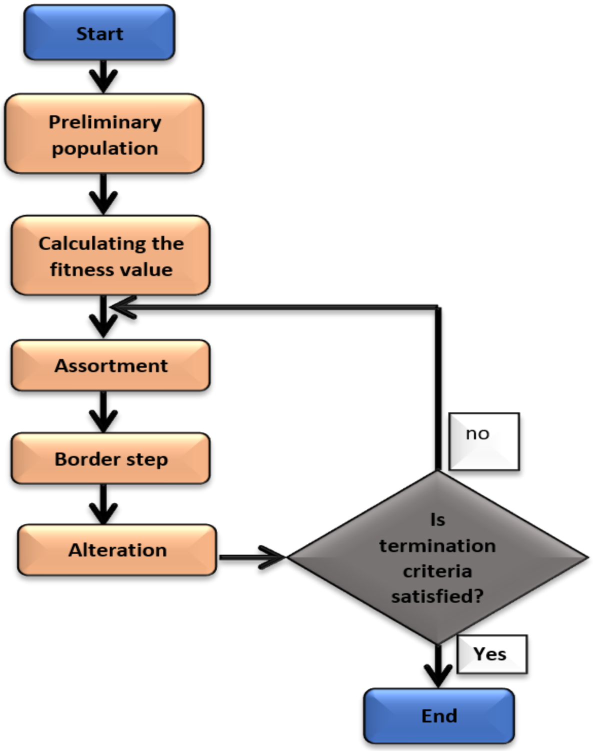

FIGURE 2 – The pattern synthesis algorithm for matter formation.

3 Method

The method used here uses the phased array system toolbox in Matlab that simulates the formation of energy to matter through beam patterns using the Generic algorithm (GA) and the pattern synthesis for the array separation process. The phased array design applications are required to determine a process to taper element responses so that the resulting beam pattern satisfies certain criteria, the performance criteria involve the main lope location, side lobe levels, and null locations.

3.1 Removal of interference with side lobe canceller

One of the main criteria for synthesizing the beam patterns is pointing a null shell toward the given arrival direction. This process helps to suppress the interference from the direction and increases the signal-to-interference ratio. This interference is not always malicious, for instance, to increase the signal-to-interference in an airport radar system, suppression of interference from a close radio station will be required from the position of the radio station as a side lobe cancellation process used to remove the interference.

4 Result

The demonstrations given below show how the design and the weights of the radar that scans between thirty and minus thirty degrees (-30^{oC} and 30^{oC}) and keeps a null forty degrees (40^{oC}). If the radar uses a ten-element ULA which is parallel to the ground the radio interference will arrive from a forty degrees azimuth (40^{oCA}).

Figure 4 above shows the resulting beam patterns for look directions from −30 degrees azimuth to 30 degrees azimuth, in 5 degrees increment. It is clear from the zoomed figure below that no matter where the look direction is, the radar beam pattern has a strong null at the interference direction.

The pattern synthesis can also be used as a windowing function, with another frequent problem for designing a phased array that matches the desired beam pattern to a specification that is handed to home appliances, its requirements are expressed in beam width and side lobe level. The procedures for addressing a problem of beam width are : observing the desired pattern and deciding on array geometry, the choice of an array size based on the desired beam width, designing tapers that are based on the desired side lobe level, and iterating an adjusted length of parameter obtained from the given steps specified to obtain the best matching pattern. To obtain the matter formation, Figure 6 shows an example that illustrates the four steps that define the desired patterns.

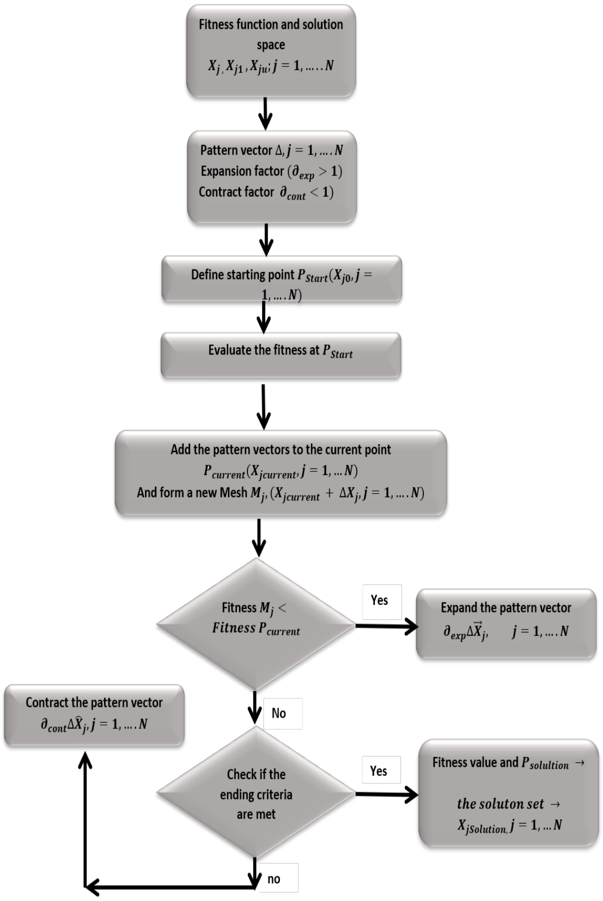

FIGURE 3 – Generic algorithm for beam pattern formation.

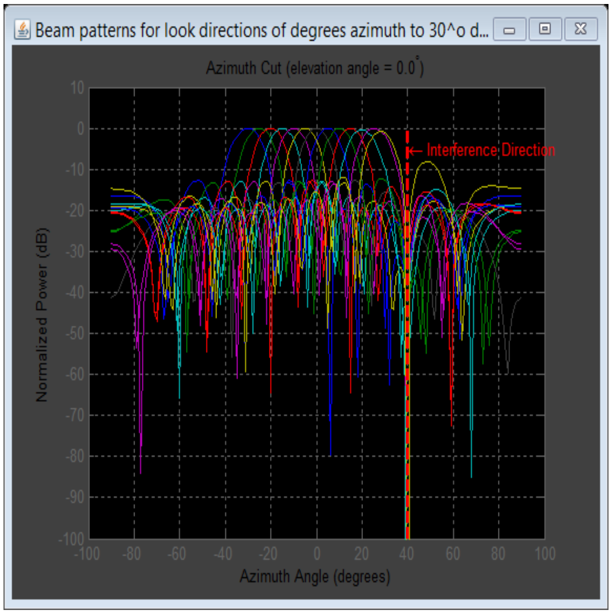

FIGURE 4 – Beam patterns for look directions of degrees azimuth 30^{oC} .

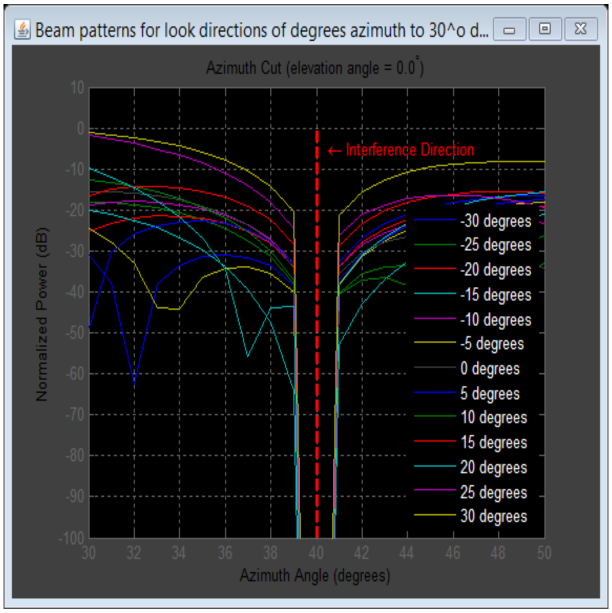

FIGURE 5 – Beam patterns for look directions of degrees azimuth to -30^{oC} in azimuth angle.

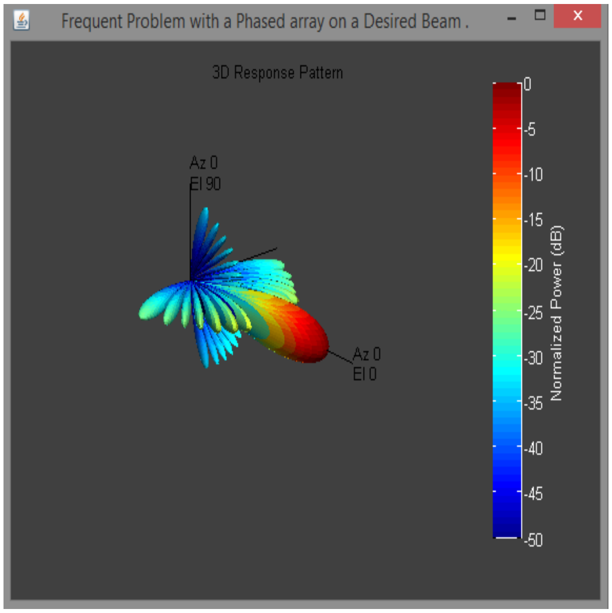

FIGURE 6 – A 30^{oC} response beam for the formation of solid matter from the pattern synthesis.

The 3D radiation patterns exhibit some symmetries in both azimuth and elevation cuts. Therefore, the pattern may be best obtained using a uniform rectangular array (URA). It is also clear from the plot that there is no energy radiated toward the back of the array. To determine the size of the array, one needs to avoid grating lobes, the element spacing is set to half wavelength. For a URA, the sizes along the azimuth and elevation directions can be derived from the required beam widths along azimuth and elevation directions, respectively. In the case of half-wavelength spacing, the number of elements along a certain direction is given approximately as :

$$N = \frac{2}{sin\theta_\delta} \tag{1}$$

where θ_δ is the beamwidth along that direction. Figure 7 shows the synthesized array exceeds the beam width requirement of the desired pattern. The side lobes are larger than the desired pattern. The side lobes can be reduced by applying a windowing operation to the array. The URA can be considered to be the combination of two separable uniform linear arrays (ULA), the window can be designed independently along both the azimuth and elevation directions using familiar filter design methods.

Figure 7 below shows the resultant windows for azimuth and elevation direction, where the resulting side lobe level is lower compared to the previous design but still does not satisfy the requirement. Error rates on parameters can used to create the final design.

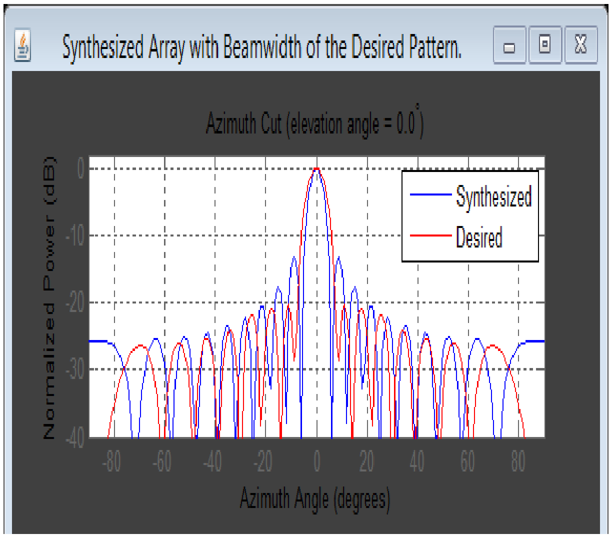

FIGURE 7 – Elevation cut for azimuth angle of 0.0^{O}.

Figure 9 shows the beam width and side lobe levels of the synthesized pattern match the desired specifications. The figure also illustrates the desired 3D pattern, the synthesized 3D pattern, the resulting array geometry, and the taper.

4.1 Array thinning using the Generic algorithm (GA)

Many array synthesis problems can be treated as optimization problems, especially for arrays with large apertures or complex geometries. In those situations, a closed-form solution often does not exist and the solution space is very large. For example, for a large array, it is often necessary to thin the array to control the side lobe levels to avoid wasting power delivered to each antenna

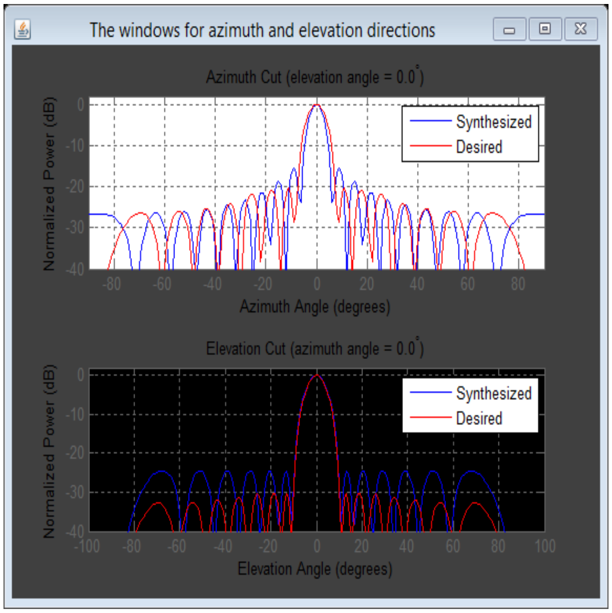

FIGURE 8 – The resultant windows for azimuth and elevation directions.

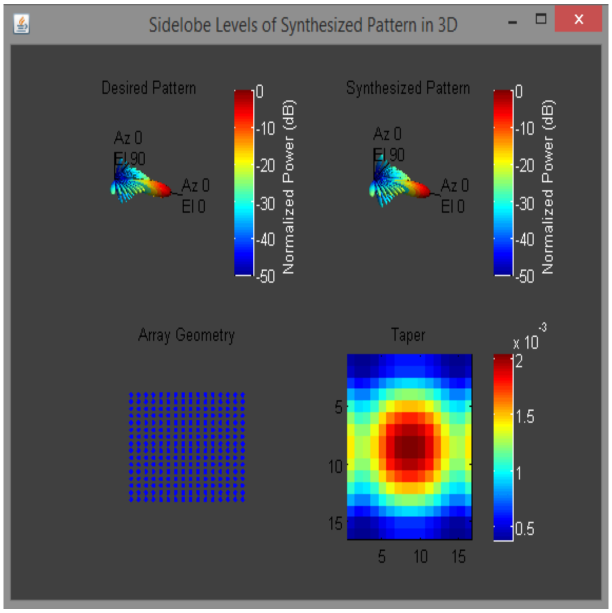

FIGURE 9 – The side lobe levels of synthesized pattern in the 3D beam pattern.

element. In this case, an element can be turned on or off. All possible solutions in a 400-element array would need to be in combinations, which is unrealistic, and a 400-element array is not considered to be a big aperture. Optimization techniques are often adopted in this form of situation.

A frequently used optimization technique is the genetic algorithm. The genetic algorithm achieves the optimal solution by simulating the natural selection process. It starts with randomly selected candidates as the first generation (Figure 3). At each evolution cycle, the algorithm sorts the generation according to a predetermined performance measure (in the thinned array example, the performance measure would be the ratio of peak-to-side lobe level), and then discards the ones with lower performance scores. The algorithm then mutates the remaining candidates to generate a newer generation and repeats the process, until it reaches a stop condition, such as the maximum number of generations. The following Figure below (Figure **??** shows how to use a genetic algorithm to thin a 40x40 URA. The goal is to achieve maximum side lobe suppression in both azimuth and elevation cuts. The beam pattern of the full array is first displayed.

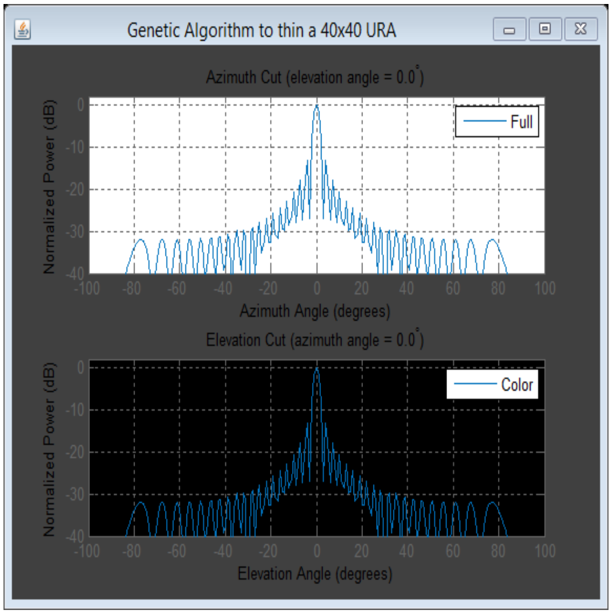

FIGURE 10 – Generic algorithm to thin a 40 × 40 URA.

When the CA is applied, the URA is seen to have symmetry in both rows and columns, thus one can take advantage of this symmetry so that each thinning coefficients candidate applies to only quarter of the array. This reduces the search space of the algorithm. This means that 71.75% of the array elements (1148 of them) are active and the side lobe level is about $9dB$. It needs to be suppressed further. The code below applies a generic algorithm with 30 generations.

Figure 11 shows the resulting beam pattern. It can be seen that the side lobe level has been improved to about $17.5dB$ with a fill rate of 76.5% (1224 active elements). Compared to the first-generation candidate, it uses 5% more active elements while achieving an additional $9dB$ side lobe suppression. Compared to the full array, the resulting thinned array can save the cost of implementing T/R switches behind dummy elements, which in turn leads to a roughly 25% saving on the consumed power. Also note that even though the thinned array uses fewer elements, the beam width is close to what could be achieved with a full array. The final thinned array is shown be-

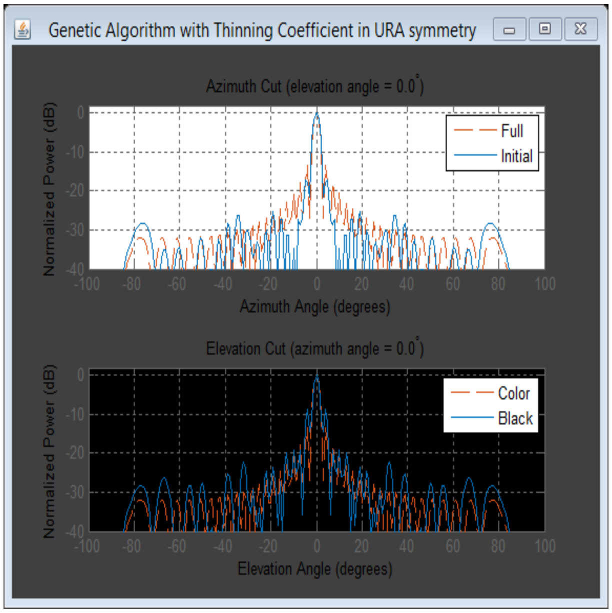

FIGURE 11 – GA with thinning coefficient in URA symmetry.

low with black circles representing the dummy elements.

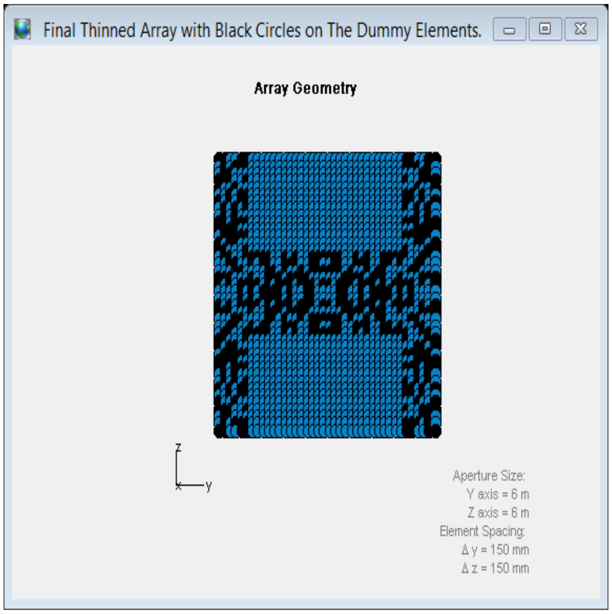

FIGURE 12 – Resultant thinned array with black circles on dummy elements.

It is important to note that the genetic algorithm does not always land on the same solution in each trial. However, in general, the resulting beam patterns share a similar side lobe level. The module used here is based on a very simple genetic algorithm applied to the array synthesis (Figure 2) problem. In real-life scenarios, the genetic algorithm is likely to be more complex. There are also other optimization algorithms used in array synthesis, such as the simulated annealing algorithm.

5 Conclusion

This paper demonstrates the fundamentals of energy and matter formation using both synthesis patterns and generic algorithms, several approaches to perform array synthesis on a phased array were demonstrated, each based on full demonstration from Matlab epitomized examples. In practice, one needs to choose the appropriate synthesis method according to the specific constraint of the application, such as the size of the array aperture, and the shape of the array geometry. This would allow for the synthetic form of solid matter in 3D and how it can be applied in real-life scenarios like embedded substance in panels for solar systems. The future perspective would be to compare these array formations with other algorithms like Markov chains and Synthetic structure randomisation procedures and determine its length of energy flow and magnitude.

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