# Effect of initial population on the genetic algorithm using solar panel alignment

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*Abstract*—It is clear that renewable energies are mostly used now a days in this world because they are pollution free and unconstrained available on earth, one of them is solar energy that comes from sun. With the increase in population the need of electricity is increased, for making load demand or consumer demand equal to production solar energy came into existence for production o electricity. There is a several limitation or problem we face during production of electricity through solar system. The objective of this paper is to investigate effect of initial population from the global maxima and partial shading using genetic algorithm for alignment of solar panel. The distribution of initial population was simulated using GMM having different initial population and time. Analysis of the result showed that the proposed technique is able to detect the partial shading and global maxima efficiently and therefore the system can be used for tracking sun intensity during partial shading or in weather condition and prepare a solar panel for automatic alignment.

*Keywords*— Solar power alignment, Genetic algorithm, Partial shading detection, Global warming.

## I. INTRODUCTION

Energy has been an important component to meet the day to day need of human beings for the success of human culture the energy is not the most important issue. Civilization is only due to intelligence and energy. Human life needs more comfort, it is only possible due to more and more energy. All the industries and factories are run on the bases of energy. There is a rise in demand of energy very rapidly. Before the industrial revolution of the 18th century, there are only two source of energy, human and animal muscles and energy of wind and water available in nature. At that time main source of heat and light is chemical energy. These were significant form of energy used by mankind during its early development period. The population on the earth grew fastly and nature cold no fully support life on the earth. Human life suffer from this problem alot at that time man discover fossil fuel that is present in the pocket of the earth, fossil fuel have much energy density. At that time industrial revolution come into the existence, as now we all know about this modern way of life. The daily energy resources cold not have a need .These modern sources of energy have high temperature efficiencies. The daily energy resources cold not have a need of these high efficiency energies. In 1970 oil is become to a cheap source of energy the production of electricity is an main aim of renewable energy. India is furnished with copious natural and renewable resources of energy namely solar, wind and biomass effort are being made for cheaper and more efficient to make renewable sources. Fossil fuel and nuclear energy replaced totally by no conventional method because of inherent advantages of transportation and certainty of available nuclear energy is quite hazardous if it is not properly controlled [1]. Possible uncertainty of the fossil fuel based resources in coming decades and market price hike of the fuel have renewed interest into the green power generation. There are many harassing power from the renewable energy resources involves technology selection, investment, generation control, power quality and reliability issues, government policies. The renewable energy technologies are much higher compared to a conventional coal-fired power plant. Other technologies are not market proven except hydro and wind power [2].

Fossil fuel are relatively concentrated and pure energy source and technically easy to exploit and provide cheap energy. The urgent thing that we need is that we have to save the fossil fuel and try to generate new sources or alternate instead of that. Such as thorium instead of uranium. Three fundamental interaction of nature are taken into concentration while generating energy are gravity electromagnetism and the nuclear reaction to create force, fusion and fission. Such as solar energy have fusion reaction. Mostly renewable energy are came from sun except, geothermal and tidal. The energy reaching on the earth have 8% UV radiation, 4% visible light and 46% infrared light [3]. The quality of environment is an unforeseen on economic growth, hybrid system is the most possible combination such as micro hydro system solar photovoltaic, wind energy system. Electrical power is generated at power house and then transmitted with the help of transmission lines to the consumers. In the transmission lines losses is the main error that we faced, ever such as voltage instability due to over loading. It is important that we have to reduce the load of transmission lines at distribution level by taking new techniques into existence inserting renewable resources at distribution level known by distribution generation. It has a lot of advantage such as voltage support that may increase overall efficiency [4].

All renewable resources are came into existence because of one most important issue or problem in Global warming, Global energy is day by day due to our quest of higher living standard and increasing world population. Global warming is only due o

fossil fuel when are burned it pollute our environment and fossil fuel lot of poisonous and dangerous acids that cause a big cause of global warming. Due to the global warming the sea level is raised, increases hurricane, tornadoes and flood and spread lot of dangerous diseases, this can disturb the whole world. "Global warming problem is solvable by united effort of humanity". World energy demand will expand by 60% between 2003 and 2030.The atmosphere of the earth bring together solar heat due to green house gases concentration and rise its temperature. This will give rise to more problem such as melting of glacier and polar ice caps, spread a lot of dangerous diseases like as cancer, acidity increases in sea water, overflow of low laying area. India agriculture production will decreases by 38% by 2080 due to drought, but Co2 fertilizitatin will offset it by 9%.

Renewable generating has benefit of enhancing sustainability and reduce green house gas emission.

Solar energy is an uncontrolled source because it is fully dependent on weather condition. Solar energy is generally used on villages and rulers areas [5].Solar energy can be used in two ways solar heat and solar electricity, in solar electrical solar photovoltaic cell that are made up of semiconductor material, that directly convert sunlight into electricity. It is identified that 18000 villages can be electrified through non conventional sources. 140 MW solar thermal/naphtha hybrid power plant with 35 MW solar trough component will be constructed in Rajasthan raising India into the 2nd position in the world in utilization of solar thermal.
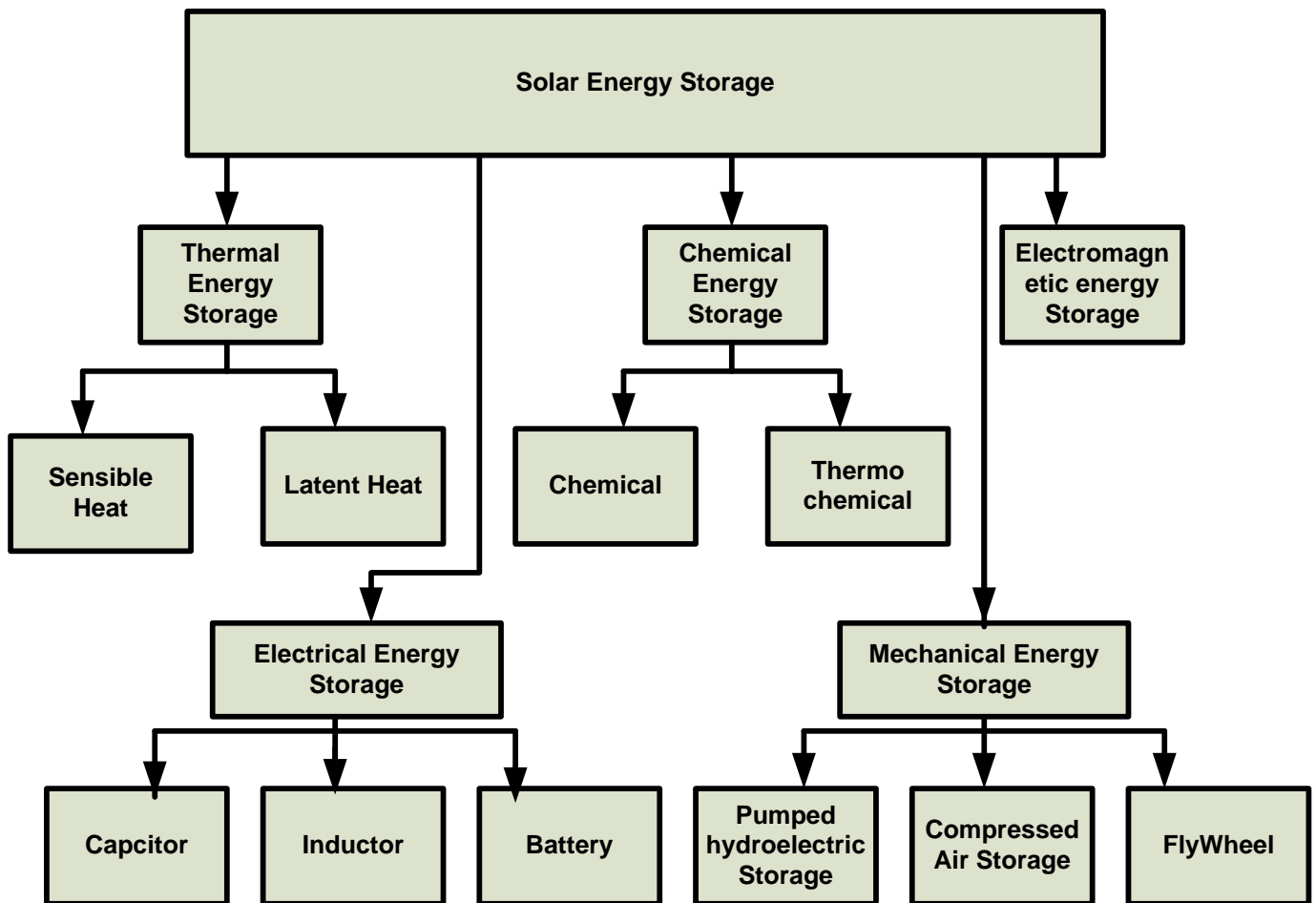


Fig 1 Solar energy system diagram

Solar panel alignment is most important issue for generating electrical energy through solar system, There are different techniques of soar panel alignment, seasonal adjustment of tilt angle is simplest technique of implementation in real. I this technique tilt angle is tilted four times in a year, it is possible when we know about the particular date before that we evaluate

the performance of solar panel. Below equation can evaluate the whole system of this technique[6]

$$H_{day} = HbRb + HdRd + \rho Hb (1 - \cos \beta)|2$$

Fenon gas system is one more method of tracking the sun position but it has a limitation, it track the position of sun in east west direction, that why it is not applicable also weather condition effect this and it is also expensive [3]. The alternate of this problem is that use database of sun position according to

area and season and then tracker is implemented. The position of sun is recorded annually on the database of microcontroller if an error is occurred it does not work properly it is also expensive and complex. All these problems can be detected and the best alternate is find out that is two axis tacker, it track the position of sun all the time and also give signal back it is designed and also implemented. It consist of 4LDRS and two D.C motors with a gear arrangement and control algorithm via Armga328P microcontroller implement on simple and cheap mechanical structure.[7].
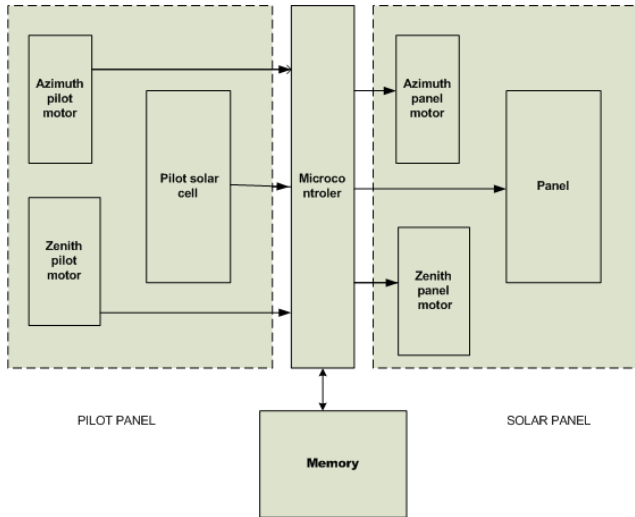


Fig. 2. Block diagram solar tracking system

It has four blocks one is pilot cell block, pilot panel block, microcontroller and memory pilot cell system give signal to the pilot panel system, microcontroller control the whole tracking system and data is stored in the memory that is maxima, and used for next stage, solar panel tracking system used for azimuth and zenith angle [8].All these steps are taken into consideration due to the problem of partial shading. Partial shading is a big issue in the solar power plant. It is more uttered with long string of photovoltaic module, long string have more mismatch problem resulting in reduced power yield. Photovoltaic string have a limitation like a hot sport, reduced safety and increase probability of leakage current through the parasitic capacitance between panel and system ground [9]. Partial shading is due to the single input port [10]. There are different techniques developed for maximum power point tracking. For the improvement in partial shading. The efficiency of the photovoltaic system is low. One of them is perturb and observer method, it is very good technique and easy to implement, but it has limitation that it has energy losses due to oscillation around the photovoltaic panel max power point that why this method cannot cover the maximum global power point. But partial swarm optimization (PSO) can detect this problem at some extent and this technique is difficult to implement [11]. Genetic Algorithm is based on the theory of natural selection process given by Charles Darwin. Optimization is the first step in the process of genetic algorithm and is executed through the exchange of genetic material. Out of a pack of ten DNAs, one best is chosen and is mated with the

random DNA. In the algorithm, mate the DNAs by taking one best and one random DNA out of ten for the best result. The mated DNA is compared with the previous pair and the mutations are carried forward to achieve better results. The genetic algorithm is better as an error in the algorithm disturbs only a part or component of the algorithm or system and rest of the system stays perfect without being disturbed. It finds its application in optimizing the problem, signal processing robotic vision system, medical imaging object localization, stock market and variety of other field. The scope of the paper distribution for simulating the intensity pattern Gaussian mixtures model is limited to the case, where two intensity maxima are present with Gaussian (GMM) is used by using initial method A and B.

## I.METHODOLOGY

A Gaussian mixtures mode is a parametric probability density function represented as a weight sum of Gaussian component densities GMM are commonly used as a parametric model of the probability distribution of continues measurement.

A Gaussian mixture model is a weighted sum of 2 component Gaussian densities given by the equation.

$$p\left(\mathbf{x}|\lambda\right) = \sum_{i=1}^{M} \omega_i g\left(\mathbf{x}|\mu_i, \sum_i\right)$$

where $\mathbf{x}$ is a two dimensional continuous valued data vector, $i = 1, \cdots, M$ , $\omega_i$ the mixture weights, and $g\left(\mathbf{x}|\mu_i, \Sigma_i\right)$ the component densities. Each component density is a $D$-variate Gaussian function of the form,

$$g\left(\mathbf{x}/\mu_i, \Sigma_i\right) = \frac{1}{(2\Pi)^{\frac{D}{2}}|\Sigma_i|^{\frac{1}{2}}} \exp\left\{-\frac{1}{2}(\mathbf{x}-\mu_i)^T \Sigma_i^{-1}(\mathbf{x}-\mu_i)\right\}$$

where $\mathbf{x}$ is a $D$-dimensional valued data vector with mean vector $\mu_i$, and covariance matrix $\Sigma_i$. The mixture weight satisfy the constrain.

The complete Gaussian mixture model is parameterized by the mean vector, covariance matrix and weight from all component densities. These parameters are collectively represented by the matrix. $\sum_{i=1}^{M} \omega_i = 1$

$$\lambda = \left\{\omega_i, \mu_i, \Sigma_i\right\} \ i = 1, \cdots, M$$

In this paper, $\mathbf{x}$ is a two dimensional continuous valued data representing the solar intensities at different azimuth and zenith angles recorded using a initial method A and initial method B. Hence, $\Sigma_i$ simply represents initial population.

The tracking of sun position during whole sunny days are very easy, but if there is partial shading or shadowing in the sky it is difficult to predict or capture or track the position of sun. This problem can be detected by using genetic algorithm is used for this system, because it is easy to implement and also give best and fast results. It has very simple steps for tracking the

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position of sun, Capture the intensity map of the sun by using initial method A and B at different azimuth and zenith angles by taking two Gaussians. For initializing the population 10 DNAs are taken one is best and one is random, one DNA has two gens azimuth and zenith, these angles are used for finding global maxima. Then global maxima is estimated when the improvement in cost function. Fitness can be estimated at different angles of zenith and azimuth by corresponding to initial method A and B. First DNA is the best DNA is obtain by sorting the fitness function, best DNA is obtained from sorted list and mate with any random DNA. At the end mutation is a process in which the next generation population of chromosomes differs from the initial generation, and best result is occurred [12].

## II.RESULT AND DISCUSSIONS

The accuracy of the estimation of global maxima position from the given intensity map was investigated using genetic algorithm. The intensity map shape depends upon the shape of the two Gaussians used in the formulation of resultant mixture densities. The two Gaussians are described by the mean positions, initial population, and weights. It has two method initial method A and initial method B, and two Gaussians GG1 and GG2.
GG1= [90, 180,10,10]
GG2= [80, 140, 20, 10; 180, 240, 60,12]

In the initial method 'A' keep the standard deviation, mean position and weight constant also total generation is 500 and maximum probability is 30 that is also constant and vary the initial population from 5 to 100. In this method single Gaussians is used i.e only GG1.Also the main point is that in this method is %GGG2.
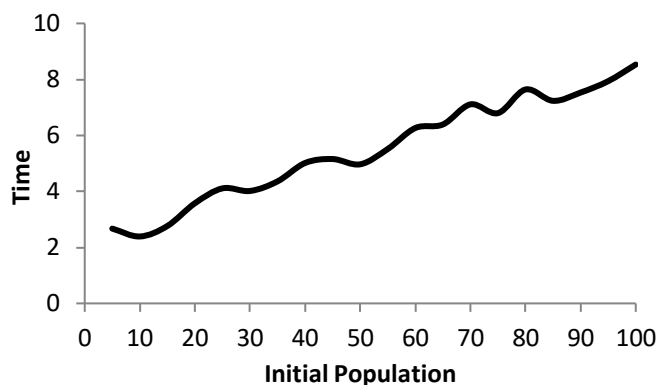


Fig 3 . Effect of initial population with respect to time of Gaussian I on the estimation of azimuth and zenith.

It is clear from the fig 3 that time is increased linearly with respect to initial population. This time is used for the estimation of zenith and azimuth for global maxima. All the process of tracking is depend on time that's why time is most important issue. This fig show the relation between the size of population and time required to execute the code and estimate the optimum

values of zenith and azimuth. With the increase in population execution time is also increased.

TABEL I. Effect of initial population with respect to time on the estimation of global maxima

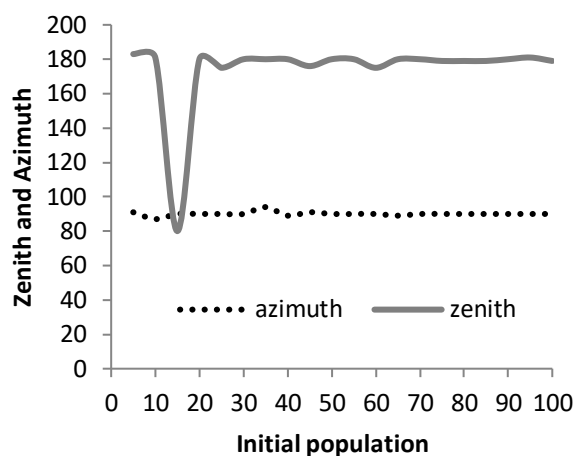| Initial Population | Time(sec) |
|---|---|
| 5 | 2.6719 |
| 10 | 2.3906 |
| 15 | 2.7656 |
| 20 | 3.5781 |
| 25 | 4.1094 |
| 30 | 4.0156 |
| 35 | 4.3594 |
| 40 | 5.0156 |
| 45 | 5.1563 |
| 50 | 4.9688 |
| 55 | 5.5156 |
| 60 | 6.2650 |
| 65 | 6.3966 |
| 70 | 7.1094 |
| 75 | 6.7969 |
| 80 | 7.6406 |
| 85 | 7.2344 |
| 90 | 7.5313 |
| 95 | 7.9375 |
| 100 | 8.5313 |



Fig 4 Effect of initial population on Gaussian I on the estimation of azimuth and zenith.

Fig 4 shows that if the population is more than 40, only then the system is able to trace the azimuth and zenith angle.

TABEL II. Effect of initial population with respect to Azimuth and Zenith on the estimation of global maxima

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| Initial Population | Azimuth | Zenith |
|---|---|---|
| 5 | 91 | 183 |
| 10 | 87 | 181 |
| 15 | 90 | 80 |
| 20 | 90 | 180 |
| 25 | 90 | 175 |
| 30 | 90 | 180 |
| 35 | 94 | 180 |
| 40 | 89 | 180 |
| 45 | 91 | 176 |
| 50 | 90 | 180 |
| 55 | 90 | 180 |
| 60 | 90 | 175 |
| 65 | 89 | 180 |
| 70 | 90 | 180 |
| 75 | 90 | 179 |
| 80 | 90 | 179 |
| 85 | 90 | 179 |
| 90 | 90 | 180 |
| 95 | 90 | 181 |
| 100 | 90 | 179 |

In the initial method 'B' keep the standard deviation, mean position and weight constant also total generation is 500 and maximum probability 30 constant and vary the initial population from 5 to 100. In this method two Gaussians are used. Also the main point is that in this method is %GG1.
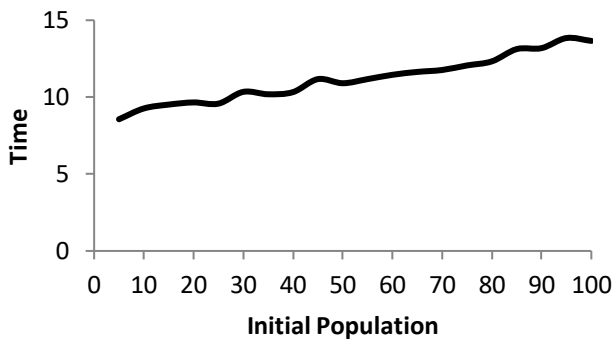


Fig 5 . Effect of initial population with respect to time of Gaussian II on the estimation of azimuth and zenith.

It is clear from the fig 5 that time is increased linearly with respect to initial population. This time is used for the estimation of zenith and azimuth for global maxima. All the process of tracking is depend on time that's why time is most important issue. This fig show the relation between the size of population and time required to execute the code and estimate the optimum values of zenith and azimuth. With the increase in population execution time is also increased.

In this proposed technique it is clear that the time required for execution of code for single Gaussians is four time less as compared to two Gaussians.

TABEL III. Effect of initial population with respect to time on the estimation of global maxima

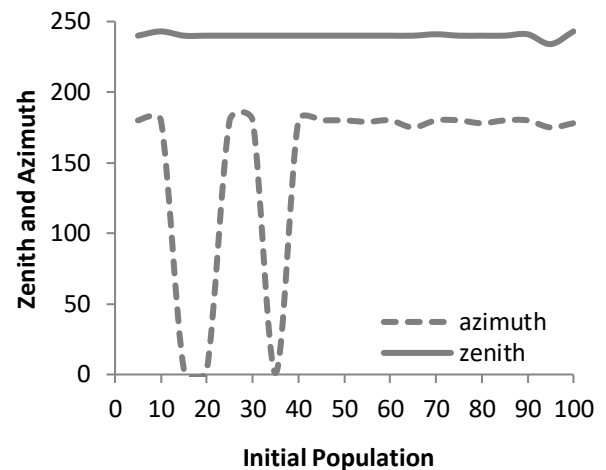| Initial Population | Time(sec) |
|---|---|
| 5 | 8.5626 |
| 10 | 9.2656 |
| 15 | 9.5156 |
| 20 | 9.6563 |
| 25 | 9.5781 |
| 30 | 10.3438 |
| 35 | 10.1875 |
| 40 | 10.3281 |
| 45 | 11.1719 |
| 50 | 10.9063 |
| 55 | 11.1719 |
| 60 | 11.4531 |
| 65 | 11.6406 |
| 70 | 11.7656 |
| 75 | 12.0625 |
| 80 | 12.3281 |
| 85 | 13.1250 |
| 90 | 13.1875 |
| 95 | 13.8438 |
| 100 | 13.6563 |



Fig 6 Effect of initial population on Gaussian II on the estimation of azimuth and zenith.

Fig 6 shows that if the population is more than 20, only the system is able to trace the azimuth and zenith angles.

TABEL II. Effect of initial population with respect to Azimuth and Zenith on the estimation of global maxima

| Initial Population | Azimuth | Zenith |
|---|---|---|
| 5 | 180 | 240 |
| 10 | 180 | 243 |
| 15 | 4 | 240 |

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| 20 | 3 | 240 |
| 25 | 180 | 240 |
| 30 | 180 | 240 |
| 35 | 1 | 240 |
| 40 | 180 | 240 |
| 45 | 180 | 240 |
| 50 | 180 | 240 |
| 55 | 179 | 240 |
| 60 | 180 | 240 |
| 65 | 175 | 240 |
| 70 | 180 | 241 |
| 75 | 180 | 240 |
| 80 | 178 | 240 |
| 85 | 180 | 240 |
| 90 | 180 | 241 |
| 95 | 175 | 234 |
| 100 | 178 | 243 |

### III.CONCLUSION

In the proposed technique the multiple initial population maxima was simulated using GMM and partial shading maxima was estimated using genetic algorithm. The effect of initial population of the constituent Gaussians on the accuracy of estimation of the maxima was investigated by varying initial population and the other parameter constant. The investigation of the results showed it is possible that to find out the position of maxima during partial shading provide initial population of two Gaussians maintain more than 20 and 40. The concept can be applied for the automatic alignment of solar panel for maximum efficiency.

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