International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 9
DOI: https://doi.org/10.17762/ijritcc.v10i9.5691
Article Received: 02 July 2022 Revised: 09 August 2022 Accepted: 18 August 2022 Publication: 30 September 2022

Microstrip Patch Antenna Parameter Optimization Prediction Model using Machine Learning Techniques

Rovin Tiwari
Department of Electronics & Communication Engineering,
Amity University, Gwalior, Madhya Pradesh, India
rovintiwari@gmail.com

Raghavendra Sharma
Department of Electronics & Communication Engineering,
Amity University, Gwalior, Madhya Pradesh, India
Rsharma3@gwa.amity.edu

Rahul Dubey
Department of Electronics & Communication Engineering,
Madhav Institute of Technology & Science,
Gwalior, Madhya Pradesh, India
Rahul.dubey0686@gmail.com

Abstract—Microstrip patch antenna (MPA) plays key role in the wireless communication. The research is continuing going to design and optimization of the antenna for various advance application such as 5G and IOT. Artificial intelligence based techniques such as machine learning is also capable to optimize the parameter values and make prediction model based on the given dataset. This research paper shows the machine learning based techniques to optimize the microstrip patch antenna parameters with the performance improvement in terms of accuracy, Mean Squared Error, and Mean Absolute Error. The antenna optimization process may be greatly accelerated using this data-driven simulation technique. Additionally, the advantages of evolutionary learning and dimensionality reduction methods in antenna performance analysis are discussed. To analyze the antenna bandwidth and improve the performance parameters is the main concern of this work.

Keywords- MPA, Bandwidth, Machine Learning, AI, PCA, MAE, MSE, Accuracy.

I. Introduction

The wireless technology is growing day by day. The antenna plays very important for wireless communication. The current mobile communication and wireless technology is working under 4th generation communication and in very near future the technology is switching into the 5G communication. The microstrip patch antenna (MPA) design is very useful for the electronics gadgets or communication form the small size device. MPA is light in size, small and high gain oriented. There are so many antenna designs and the patterns in the recent years.

The frequency range of the 5G communication is divided into the majorly 2 categories-

Lower frequency range- 3GHz to 8GHz, the current wireless mobile communication is lie at less than 3GHz, the Wi-Fi frequency range is also 2.4GHz. Due to much application there is very high traffic in this frequency range.

Higher frequency range- 18GHz to 100 GHz, the satellite and radar communication is mostly lie in this frequency range. The current technology doesn't meet the constraints of the 5G communication so need some enhancement in the conventional wireless communication optimization algorithm and the physical antenna structure [3].

MPA design and parameters optimization is new dimension among the antenna researchers. Now days, the artificial intelligence based techniques is applicable in the many of the research and practical applications like 5th generation internet based communication or the IOT devices communication application.

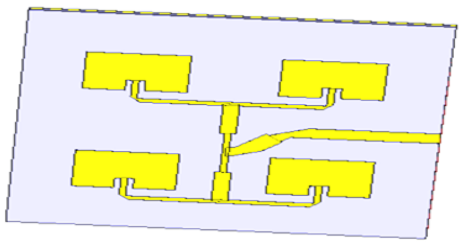


Figure 1: MPA [18]

The recent developed antenna pattern is presenting in the above figure 1. The antenna array (multiple similar small structure in same size or dimension) is using for the current wireless communication application. MIMO has some drawback in terms of the power dissipation and multiple ports cost so the researchers are opting the antenna array patter. In the array structure there is only single port to give the power to the antenna while the MIMO provides the multiple port to give the power to the designed antenna.

There are various techniques for the optimization of the antenna dimension and the performance parameters like

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 9
DOI: https://doi.org/10.17762/ijritcc.v10i9.5691
***Article Received**: 02 July 2022 **Revised**: 09 August 2022 **Accepted**: 18 August 2022 **Publication**: 30 September 2022*

bandwidth, return loss, gain directivity etc. The machine learning technique is more efficient for the optimization and the analysis of the prediction model.

This paper is organized into the V different sections. The section or part I is presents the overview of the MPA, 5G and AI for optimization. The part II of this paper present the literature background. The III section provides methodology discussion. The part number IV provides simulation work and the result discussion and part number V shows the conclusion of this research.

The main objective of our work is-

- To predict or to analyze the antenna bandwidth effectively.
- To implement the different machine learning regression algorithm such as random forest regressor and decision tree regressor.
- To enhance the overall performance for classification algorithms.

II. LITERATURE REVIEW

C. Liu et al., presents machine learning techniques to be used to produce intelligent designs of metamaterials. Some recent efforts have used machine learning methods to effectively design the S-parameters of coding metamaterials. [1]. L. Zhang et al., present a metasurface antenna with dual T-shaped antenna components, and we apply deep learning techniques to improve the antenna's geometric characteristics. The suggested antenna has a resonance frequency between 7.9 and 13 GHz. For 13 GHz, the maximum gain is 16.58 dBi [2].

J. Nan et al., presents the whole fractal antenna structure and the notch structure of the MIMO antenna have both been optimally designed using the proposed model, and their S-parameters are in good agreement with the requirements and design goals. The DBN-ELM method outperforms other common modelling approaches on the same training samples (with an assessed root mean square error of 11.87 percent for the fractal antenna and 3.56 percent for the MIMO antenna) [3].

N. Kurniawati et al., find that three estimators have a small mean absolute error (MAE) for gain, while two have a small mean squared error (MSE). Using a total of eight estimators yields the smallest average and maximum standard errors for VSWR [4]. M. Lan et al., present the numerous transmitters, the channel, and the receiver, and an auto encoder is used to reduce the chance of transmission errors at both ends of the chain. The proposed NN-based transceiver outperforms state-of-the-art approaches in simulations by reducing the chance of transmission errors and showing greater resistance to changes in channel characteristics [5].

G. Gampala et al., involves solving a variant of the original antenna design. Therefore, depending on the convergence criteria of the chosen method and the time spent during each iteration; the overall time needed to optimize a particular antenna design might vary significantly. With the use of machine learning, an antenna designer may create a trained mathematical model that is a faithful reproduction of the original antenna design and then optimize it. When a trained model is used, hundreds of optimization iterations may be executed in a matter of seconds [7].

M. Lan et al., suggested technique uses a deep neural network (NN) to represent the numerous transmitters, the channel, and the receiver, and an auto encoder is used to reduce the chance of transmission errors at both ends of the chain. Furthermore, the confidence interval approach is used to examine the connection between the number of training samples and the chance of transmission errors [8]. M. Chen et al., describe in depth the method of preparing the training data and how an auxiliary detection network drastically decreases the size of the training set. After the training phase is complete, the DOAs may be determined using the most recent input data [9].

X. Li, X. Qiu, et al., presents the ultra wide-band antenna pattern for the IOT application and obtained the better return loss and the bandwidth with improved optimization techniques [10]. P. Yang et al., present a new framework for inexpensive link adaptation in SM-MIMO systems. In particular, we first change the traditional optimization-driven choices for SM-transmit MIMO's antenna selection (TAS) and power allocation (PA) into data-driven prediction issues. In order to get answers that are compatible with statistics, supervised-learning classifiers (SLC) are created [14].

T. Imai et al shows the radio propagation prediction using deep learning and convolutional neural networks is presented by CNNs. This research clarifies the performance of our proposed model [15] M. E. et al by using the findings of an examination of the behaviours of map-parameters input to a CNN. H. Given the growth and variety of available data, powerful processing, and affordable data storage, Machine.'s Learning has garnered a lot of interest as a technique to uncover optimal solutions in a wide variety of domains [16].

R. Tiwari et al., presents the arrays of MPAs, as shown by are another promising area for 5G antenna research and development. This study introduces a novel design for a faulty ground structure microstrip antenna array, which may be implemented in wireless communication devices for usage in a

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 9
DOI: https://doi.org/10.17762/ijritcc.v10i9.5691
***Article Received**: 02 July 2022 **Revised**: 09 August 2022 **Accepted**: 18 August 2022 **Publication**: 30 September 2022*

5G network. CST microwave studio is used to create a digital model of the proposed antenna and run simulations [17].

R. Tiwari et al., the CST studio is used for antenna design, while the Python spyder 3.7 software is used for optimization. We find better performance by analyzing metrics like accuracy, MAE, and MSE. Predictions of antenna properties using the suggested random forest ML approach have a 99.56 percent success rate [18].

It can be seen that the RF classifier has achieved the highest accuracy. This is expected as it has been reported that Random Forest is appropriate for high dimensional data modeling because it can handle missing values and can handle continuous, categorical and binary data [20]. By using machine learning, humans can be facilitated through the automation process with one of the implementations used in everyday life is in the field of customer service where a bot can answer and provide information about an existing activity or program [21].

In [22], the researchers focused on the theoretical comparisons between different auto modeling approaches. Together with Template Matching the author also used Moving Window to find specified object within the image. Template Matching technique is also discussed in [23][24].

III. PROPOSED METHOD

The methodology is described with the help of following work flow diagram-

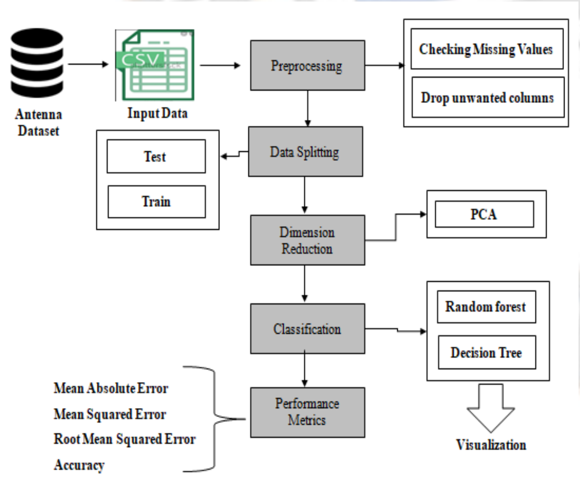


Figure 2: Work Flow

The microstrip metamaterials antenna dataset for this system is gathered from a dataset source [19]. The antenna parameters optimization is performed using the machine learning techniques.
This dataset have some features and parameter name like gain, VSWR, bandwidth, return loss with numerical values. Figure 2 presents the work flow of the proposed research work. Now apply the steps to make the prediction model and optimize the bandwidth parameter of antenna.

The following sub modules are involved in the entire process of optimization of the antenna parameters.

- Data selection
- Pre-processing
- Dimension reduction
- K-means clustering
- Training and testing Data splitting
- Regression Classification
- Result generation and analysis

The steps of the prediction and optimization process is as-

- Load dataset into the python spyder software.
- Now preprocessing of the dataset, here handles the missing values of the dataset.
- Next step to extract the data features in term of the target prediction parameter name and values.
- The dataset is splitted into 2 parts, training and the testing of the data. The 70-80% data is divided into the training phase and 20-30% is for the testing phase.
- Now implement the k-means clustering technique to make group of the data
- Now apply machine learning regression technique such as random-forest-regression (RFR) and Decision-Tree-Regressor (DTR) for making relation between independent and the independent variables.
- Finally the proposed machine learning approach provides the prediction class of the optimized parameter performance such as MAE, MSE, RMSE and accuracy.

Data-selection- The data selection process is considered for analysing the bandwidth. In python, with the help of panda's package we have to read an input data.

Data Pre-processing- It is the process to remove the unsupported format of data values or features.

Dimension Reduction- In this process; implement the feature selection such as principle component analysis (PCA).

Clustering- In this our process, implement the k-means for clustering or make a group.

Data Splitting- For the training of the system, the entire dataset is splitted in to the training and the testing dataset.

Classification- In this process the random forest regressor and decision tree regressor technique is used to

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 9
DOI: https://doi.org/10.17762/ijritcc.v10i9.5691
***Article Received**: 02 July 2022 **Revised**: 09 August 2022 **Accepted**: 18 August 2022 **Publication**: 30 September 2022*

classify the prediction values and the feature. The bandwidth is considered in the y matrix or prediction class.

Result Analysis- The overall performance parameters results is generated using some standard formulas-

Mean-Absolute-Error (MAE) is a use to measure the accuracy of a given model. It is calculated as:

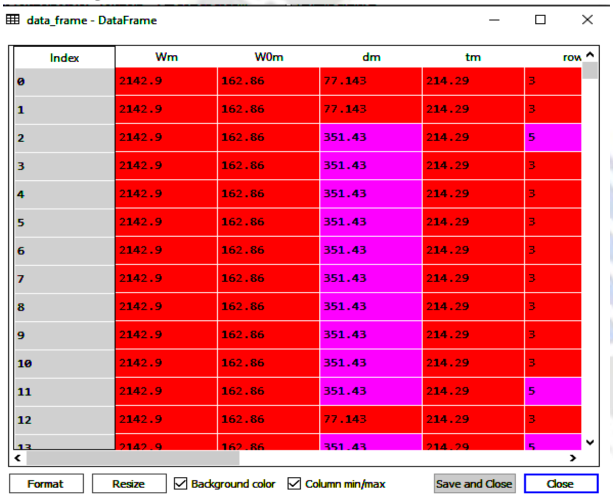
Mean-Squared-Error (MSE) is use to measure the prediction error of a model. It is calculated as:

Accuracy- It provides the overall reliability of the predicated model.

Accuracy = (True Positive + True Negative)/ (True Positive + True Negative + False Positive + False Negative)

IV. SIMULATION RESULTS

The simulation of the research work is performed using Python spyder 3.7 software. The simulation results discussion is as followings-

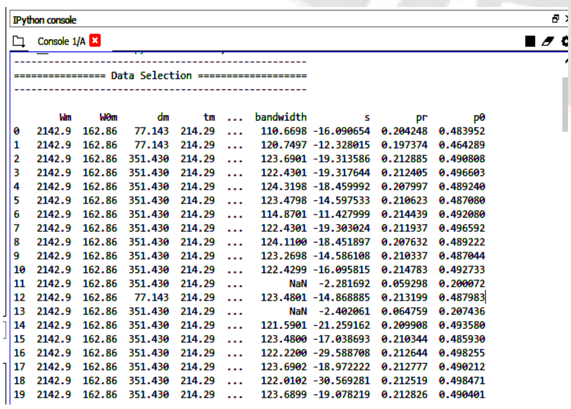

data_frame - DataFrame

Index	Wm	W0m	dm	tm	row
0	2142.9	162.86	77.143	214.29	3
1	2142.9	162.86	77.143	214.29	3
2	2142.9	162.86	351.43	214.29	5
3	2142.9	162.86	351.43	214.29	3
4	2142.9	162.86	351.43	214.29	3
5	2142.9	162.86	351.43	214.29	3
6	2142.9	162.86	351.43	214.29	3
7	2142.9	162.86	351.43	214.29	3
8	2142.9	162.86	351.43	214.29	3
9	2142.9	162.86	351.43	214.29	3
10	2142.9	162.86	351.43	214.29	3
11	2142.9	162.86	351.43	214.29	5
12	2142.9	162.86	77.143	214.29	3
13	2142.9	162.86	351.43	214.29	5

Format | Resize | Background color | Column min/max | Save and Close | Close

Figure 3: Dataset

Figure 3 presents the dataset frame in the python environment. This dataset contain total 572 rows data values. This dataset contain features like gain, VSWR, bandwidth etc.


IPython console
Console 1/A

```
=============== Data Selection ==================
```

	Wm	W0m	dm	tm	...	bandwidth	s	pr	p0
0	2142.9	162.86	77.143	214.29	...	110.6698	-16.090654	0.204248	0.483952
1	2142.9	162.86	77.143	214.29	...	120.7497	-12.328015	0.197374	0.464289
2	2142.9	162.86	351.430	214.29	...	123.6901	-19.313586	0.212885	0.490808
3	2142.9	162.86	351.430	214.29	...	122.4301	-19.317644	0.212405	0.496603
4	2142.9	162.86	351.430	214.29	...	124.3198	-18.459992	0.207997	0.489240
5	2142.9	162.86	351.430	214.29	...	123.4798	-14.597533	0.210623	0.487080
6	2142.9	162.86	351.430	214.29	...	114.8701	-11.427999	0.214439	0.492080
7	2142.9	162.86	351.430	214.29	...	122.4301	-19.303024	0.211937	0.496592
8	2142.9	162.86	351.430	214.29	...	124.1100	-18.451897	0.207632	0.489222
9	2142.9	162.86	351.430	214.29	...	123.2698	-14.586108	0.210337	0.487044
10	2142.9	162.86	351.430	214.29	...	122.4299	-16.095815	0.214783	0.492733
11	2142.9	162.86	351.430	214.29	...	NaN	-2.281692	0.059298	0.200072
12	2142.9	162.86	77.143	214.29	...	123.4801	-14.868885	0.213199	0.487983
13	2142.9	162.86	351.430	214.29	...	NaN	-2.402061	0.064759	0.207436
14	2142.9	162.86	351.430	214.29	...	121.5901	-21.259162	0.209908	0.493580
15	2142.9	162.86	351.430	214.29	...	123.4800	-17.038693	0.210344	0.485930
16	2142.9	162.86	351.430	214.29	...	122.2200	-29.588708	0.212644	0.498255
17	2142.9	162.86	351.430	214.29	...	123.6902	-18.972222	0.212777	0.490212
18	2142.9	162.86	351.430	214.29	...	122.0102	-30.569281	0.212519	0.498471
19	2142.9	162.86	351.430	214.29	...	123.6899	-19.078219	0.212826	0.490401

Figure 4: Data selection

Figure shows the selection of the data process in the python console.

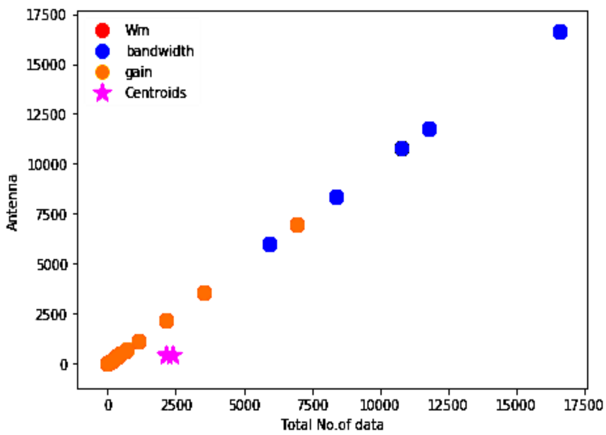
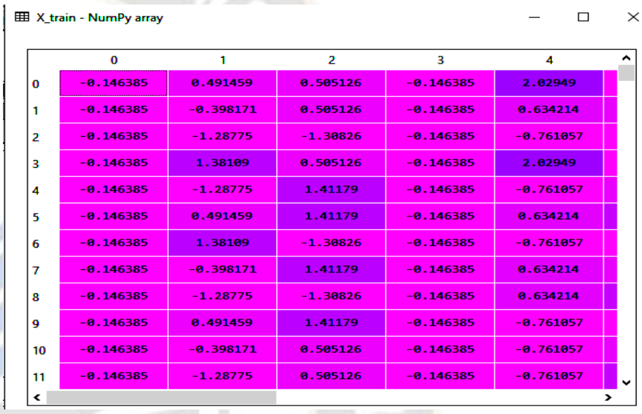


Figure 5: Clustering

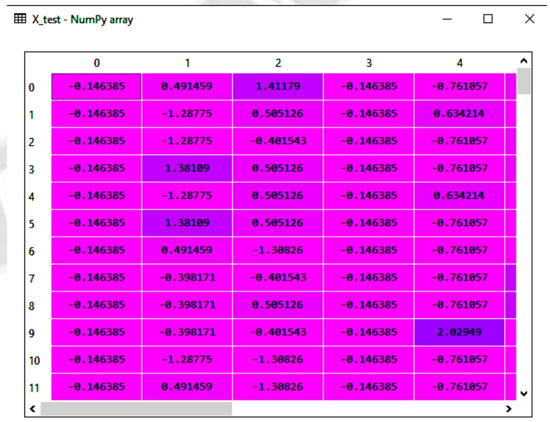
Figure 5 provides the k means cluster algorithm to grouping the data.


X_train - NumPy array

	0	1	2	3	4
0	-0.146385	0.491459	0.505126	-0.146385	2.02949
1	-0.146385	-0.398171	0.505126	-0.146385	0.634214
2	-0.146385	-1.28775	-1.30826	-0.146385	-0.761057
3	-0.146385	1.38109	0.505126	-0.146385	2.02949
4	-0.146385	-1.28775	1.41179	-0.146385	-0.761057
5	-0.146385	0.491459	1.41179	-0.146385	0.634214
6	-0.146385	1.38109	-1.30826	-0.146385	-0.761057
7	-0.146385	-0.398171	1.41179	-0.146385	0.634214
8	-0.146385	-1.28775	-1.30826	-0.146385	0.634214
9	-0.146385	0.491459	1.41179	-0.146385	-0.761057
10	-0.146385	-0.398171	0.505126	-0.146385	-0.761057
11	-0.146385	-1.28775	0.505126	-0.146385	-0.761057

Figure 6: X train

Figure 6 provides the x train data values, the total data are divided into the 2 part, the 70-80% data is used for the training. X train consider 429 data out of 572.


X_test - NumPy array

	0	1	2	3	4
0	-0.146385	0.491459	1.41179	-0.146385	-0.761057
1	-0.146385	-1.28775	0.505126	-0.146385	0.634214
2	-0.146385	-1.28775	-0.401543	-0.146385	-0.761057
3	-0.146385	1.38109	0.505126	-0.146385	-0.761057
4	-0.146385	-1.28775	0.505126	-0.146385	0.634214
5	-0.146385	1.38109	0.505126	-0.146385	-0.761057
6	-0.146385	0.491459	-1.30826	-0.146385	-0.761057
7	-0.146385	-0.398171	-0.401543	-0.146385	-0.761057
8	-0.146385	-0.398171	0.505126	-0.146385	-0.761057
9	-0.146385	-0.398171	-0.401543	-0.146385	2.02949
10	-0.146385	-1.28775	-1.30826	-0.146385	-0.761057
11	-0.146385	0.491459	-1.30826	-0.146385	-0.761057

Figure 7: X test

Figure 7 provides the x test data values, the 20-30 % data is used for the testing. X test consider 143 data out of 572.

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 9
DOI: https://doi.org/10.17762/ijritcc.v10i9.5691
***Article Received**: 02 July 2022 **Revised**: 09 August 2022 **Accepted**: 18 August 2022 **Publication**: 30 September 2022*

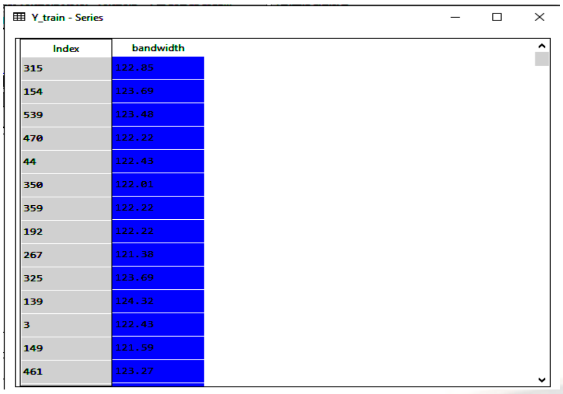


Figure 8: Y train

Figure 8 provides the y train dataset values. The y train is the selected feature of the main dataset. Here y train considers 429 data out of 572.

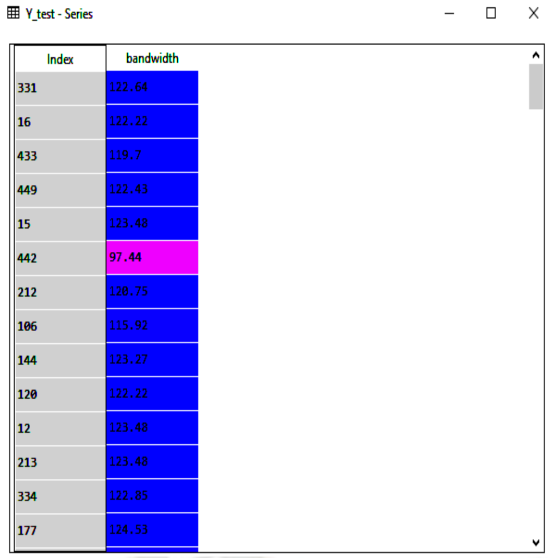


Figure 9: Y test

Figure 9 provides the y test dataset values. This y test data is used for the validation of the machine learning techniques. Y test consider 143 data out of 572.

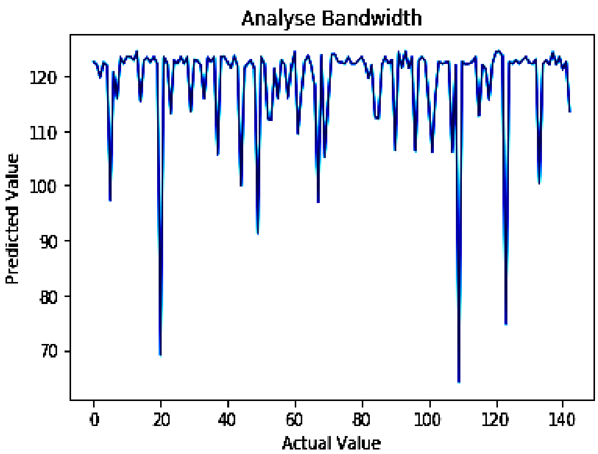


Figure 10: Analyse bandwidth -RFR

Figure 10 provides the bandwidth analysis using the Random forest Regressor (RFR) method. The actual value and predicted value is very closer, it provide the 99.56% accuracy.

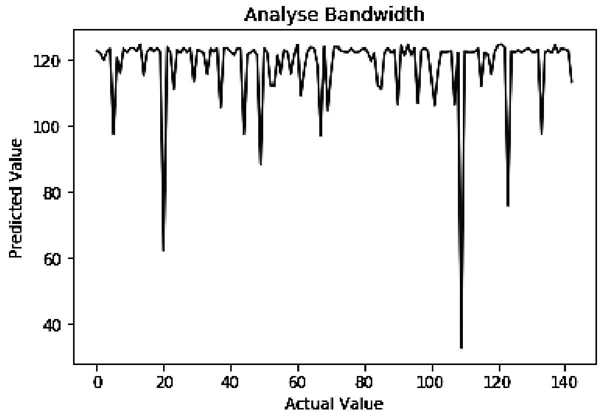


Figure 11: Analyse bandwidth -DTR

Figure 11 provides the bandwidth analysis using the Decision Tree Regressor (DTR) method. The actual value and predicted value is very closer, it provide the 99.80% accuracy.

Table 1: Simulation Scenario

Sr No	Parameter	Value (%)
1.	System Windows	10
2.	PC RAM	8 GB
3.	PC Hard disk	1 TB
4.	Software	Python
5.	IDE	Spyder
6.	Version	3.7

Table 2: Simulation results of RFR

Sr No	Parameter	Value (%)
1	MAE	0.437
2	MSE	5.04
3	RMSE	2.24
4	Accuracy	99.56

Table 3: Simulation results of DTR

Sr No	Parameter	Value (%)
1	MAE	0.198
2	MSE	0.538
3	RMSE	2.24
4	Accuracy	99.80

Table 4: Result Comparison on bandwidth analysis

Sr No	Parameter	Existing Work [1]	Method-1	Method-2
1	MAE (%)	1.4093	0.437	0.198
2	MSE (%)	32.4080	5.04	0.538
3	Accuracy (%)	Not Define	99.56	99.80

V. CONCLUSION

The MPA bandwidth parameter optimization model is presented in this research work. The machine learning based decision tree regressor and random forest regressor techniques is implemented using python software. The simulation results the value of MAE is 0.437% and 0.198% in the proposed techniques while 1.4093% in the existing work. Similar the value of MSE is 5.04% and 0.538 % in the proposed and 32.4080% in the existing. The overall accuracy optimized of the RFR model is 99.56% and DTF model is 99.80%. In the future work, we would want to combine the two separate machine learning techniques implementation to make optimization model. More number of the antenna parameters will be optimized and analyze.

REFERENCES

[1] C. Liu and T. J. Cui, "Intelligent Design of Metamaterials by means of AI Strategies," 2022 sixteenth European Meeting on Radio wires and Spread (EuCAP), 2022, pp. 1-4, doi: 10.23919/EuCAP53622.2022.9769409.

[2] L. Zhang, L. Chen, Z. Yuan and S. Lan, "Enhancement of a Metasurface Radio wire Made out of Double T-molded Recieving wire Components In view of AI," 2021 Worldwide Discussion on Recieving wires and Proliferation (ISAP), 2021, pp. 1-2, doi: 10.23919/ISAP47258.2021.9614410.

[3] Garg, D. K. . (2022). Understanding the Purpose of Object Detection, Models to Detect Objects, Application Use and Benefits. International Journal on Future Revolution in Computer Science &Amp; Communication Engineering, 8(2), 01–04. https://doi.org/10.17762/ijfrcsce.v8i2.2066

[4] J. Nan, H. Xie, M. Gao, Y. Melody and W. Yang, "Plan of UWB Recieving wire In light of Further developed Profound Conviction Organization and Outrageous Learning Machine Substitute Models," in IEEE Access, vol. 9, pp. 126541-126549, 2021, doi: 10.1109/ACCESS.2021.3111902.

[5] N. Kurniawati, D. Novita Nurmala Putri and Y. Kurnia Ningsih, "Irregular Woods Relapse for Anticipating Metamaterial Recieving wire Boundaries," 2020 second Global Meeting on Modern Electrical and Hardware (ICIEE), 2020, pp. 174-178, doi: 10.1109/ICIEE49813.2020.9276899.

[6] M. Lan, J. Huang, H. Zhang and C. Huang, "Plan of Energy Adjustment Gigantic SIMO Handsets through AI," GLOBECOM 2020 - 2020 IEEE Worldwide Correspondences Gathering, 2020, pp. 1-6, doi: 10.1109/GLOBECOM42002.2020.9348239.

[7] S. Skaria, A. Al-Hourani and R. J. Evans, "Profound Learning Techniques for Hand-Signal Acknowledgment Utilizing Super Wideband Radar," in IEEE Access, vol. 8, pp. 203580-203590, 2020, doi: 10.1109/ACCESS.2020.3037062.

[8] G. Gampala and C. J. Reddy, "Quick and Insightful Recieving wire Plan Enhancement utilizing AI," 2020 Global Applied Computational Electromagnetics Society Conference (Experts), 2020, pp. 1-2, doi: 10.23919/ACES49320.2020.9196193.

[9] M. Lan, J. Huang, H. Zhang and C. Huang, "Plan of energy tweak gigantic SIMO handsets through AI," in Diary of Correspondences and Data Organizations, vol. 5, no. 3, pp. 358-368, Sept. 2020, doi: 10.23919/JCIN.2020.9200899.

[10] M. Chen, Y. Gong and X. Mao, "Profound Brain Organization for Assessment of Course of Appearance With Radio wire Cluster," in IEEE Access, vol. 8, pp. 140688-140698, 2020, doi: 10.1109/ACCESS.2020.3012582.

[11] X. Li, X. Qiu, J. Wang and Y. Shen, "A Profound Support Learning Based Approach for Independent Surpassing," 2020 IEEE Worldwide Gathering on Interchanges Studios (ICC Studios), 2020, pp. 1-5, doi: 10.1109/ICCWorkshops49005.2020.9145279.

[12] A. Bharti, R. Adeogun and T. Pedersen, "Gaining Boundaries of Stochastic Radio Channel Models From Rundowns," in IEEE Open Diary of Recieving wires and Proliferation, vol. 1, pp. 175-188, 2020, doi: 10.1109/OJAP.2020.2989814.

[13] X. Wang, H. Hua and Y. Xu, "Pilot-Helped Channel Assessment and Sign Location in Uplink Multi-Client MIMO Frameworks With Profound Learning," in IEEE Access, vol. 8, pp. 44936-44946, 2020, doi: 10.1109/ACCESS.2020.2978253.

[14] T. Shan, X. Container, M. Li, S. Xu and F. Yang, "Coding Programmable Metasurfaces In view of Profound Learning Strategies," in IEEE Diary on Arising and Chose Points in Circuits and Frameworks, vol. 10, no. 1, pp. 114-125, Walk 2020, doi: 10.1109/JETCAS.2020.2972764.

[15] P. Yang, Y. Xiao, M. Xiao, Y. L. Guan, S. Li and W. Xiang, "Versatile Spatial Tweak MIMO In view of AI," in IEEE Diary on Chose Regions in Correspondences, vol. 37, no. 9, pp. 2117-2131, Sept. 2019, doi: 10.1109/JSAC.2019.2929404.

[16] T. Imai, K. Kitao and M. Inomata, "Radio Engendering Expectation Model Utilizing Convolutional Brain Organizations by Profound Learning," 2019 thirteenth European Gathering on Recieving wires and Proliferation (EuCAP), 2019, pp. 1-5.

[17] Pang, K.-A., Abdul-Latip, S. F., & Abdul Rani, H. (2022). Slid Pairs of the Fruit-80 Stream Cipher. International Journal of Communication Networks and Information Security (IJCNIS), 12(1).

[18] H. M. E. Misilmani and T. Naous, "AI in Recieving wire Plan: An Outline on AI Idea and Calculations," 2019 Worldwide Gathering on Superior Execution Registering and Recreation (HPCS), 2019, pp. 600-607, doi: 10.1109/HPCS48598.2019.9188224.

[19] Alqudah, A., Alqudah, A. M., & AlTantawi, M. (2021). Artificial Intelligence Hybrid System for Enhancing Retinal Diseases Classification Using Automated Deep Features Extracted from OCT Images. International Journal of Intelligent Systems and Applications in Engineering, 9(3), 91–100. https://doi.org/10.18201/ijisae.2021.236

[20] R. Tiwari, R. Sharma, R. Dubey. "Double Band Free weight Shape Microstrip Recieving wire Cluster With Surrendered

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 10 Issue: 9
DOI: https://doi.org/10.17762/ijritcc.v10i9.5691
***Article Received**: 02 July 2022 **Revised**: 09 August 2022 **Accepted**: 18 August 2022 **Publication**: 30 September 2022*

Ground Design for fifth Era Wi-Fi Organization". Global Diary of Cutting edge Science and Innovation, Vol. 29, no. 04, June 2020, pp. 6998 - , http://sersc.org/diaries/index.php/IJAST/article/view/28103.

[21] R. Tiwari, R. Sharma, R. Dubey. "Plan of 2X2 Microstrip Fix Radio wire Cluster and Enhancement of Transfer speed utilizing Effective AI Method" Worldwide Diary of Arising Innovation and High level Designing, Volume 12, Issue 08, August 2022, pp. 78-82, DOI: 10.46338/ijetae0822_10.

[22] https://www.kaggle.com/datasets/renanmav/metamaterial-antennas

[23] Mansoor G. Al-Thani, Yin Yang "Machine Learning for the Prediction of Returned Checks Closing Status" in International Journal of Emerging Technology and Advanced Engineering Volume 11, Issue 06, June 2021 DOI: 10.46338/ijetae0621_03

[24] Malvin, Constantine Dylan, Abdul Haris Rangkuti "WhatsApp Chatbot Customer Service Using Natural Language Processing and Support Vector Machine" in International Journal of Emerging Technology and Advanced Engineering, Volume 12, Issue 03, March 2022, DOI: 10.46338/ijetae0322_15

[25] Norhayati Baharun, Nor Faezah Mohamad Razi, Suraya Masrom, Nor Ain Mohamad Yusri, Abdullah Sani Abd Rahman "Auto Modelling for Machine Learning: A Comparison Implementation between RapidMiner and Python" in International Journal of Emerging Technology and Advanced Engineering, Volume 12, Issue 05, May 2022, DOI: 10.46338/ijetae0522_03.

[26] Abd Gani, S. F., Miskon, M. F., Hamzah, R. A., Mohamood, N., Manap, Z., Zulkifli, M. F., Md Ali Shah, M. A. S. "A Live-Video Automatic Number Plate Recognition (ANPR) System Using Convolutional Neural Network (CNN) with Data Labelling on an Android Smartphone" in International Journal of Emerging Technology and Advanced Engineering, Volume 11, Issue 10, October 2021, DOI: 10.46338/ijetae1021_11.

[27] Nguyen Tung Lam "Developing a Framework for Detecting Phishing URLs using Machine Learning" International Journal of Emerging Technology and Advanced Engineering" Volume 11, Issue 11, November 2021, DOI: 10.46338/ijetae1121_08