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Reducing Covid-19 Spread

Analysis of Public Expressions

Highlights

Models of Target Fluctuation

Classification and Visualizing

Discovering Thoughts, Inventing Future

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Efficient Network Traffic Classification and Visualizing Abnormal Part via Hybrid Deep Learning Approach: Xception + Bidirectional GRU

By HanSeon Joo, HaYoung Choi, ChangHui Yun & MinJong Cheon

Ctholic University of Korea

Abstract- Due to a rapid development in the field of information and communication, the information technologies yielded novel changes in both individual and organizational operations. Therefore, the accessibility of information became easier and more convenient than before, and malicious approaches such as hacking or spying aimed at various information kept increasing. With the aim of preventing malicious approaches, both classification and detecting malicious traffic are vital. Therefore, our research utilized various deep learning and machine learning models for better classification. The given dataset consists of normal and malicious data and these data types are png files. In order to achieve precise classification, our experiment consists of three steps. Firstly, only vanilla CNN was used for the classification and the highest score was 86.2%. Second of all, for the hybrid approach, the machine learning classifiers were used instead of fully connected layers from the vanilla CNN and it yielded about 87% with the extra tree classifier. At last, the Xception model was combined with the bidirectional GRU and it attained a 95.6% accuracy score, which was the highest among all.

GJCST-H Classification: C.2.1

EFFICIENTNETWORKTRAFFICCLASSIFICATIONANDVISUALIZINGABNORMALPARTVIAHYBRIDDEEPLEARNINGAPPROACHXCEPTIONBIDIRECTIONALGRU

Efficient Network Traffic Classification and Visualizing Abnormal Part via Hybrid Deep Learning Approach: Xception + Bidirectional GRU

HanSeon Joo [α], HaYoung Choi [σ], ChangHui Yun [ρ] & MinJong Cheon [ω]

Abstract- Due to a rapid development in the field of information and communication, the information technologies yielded novel changes in both individual and organizational operations. Therefore, the accessibility of information became easier and more convenient than before, and malicious approaches such as hacking or spying aimed at various information kept increasing. With the aim of preventing malicious approaches, both classification and detecting malicious traffic are vital. Therefore, our research utilized various deep learning and machine learning models for better classification. The given dataset consists of normal and malicious data and these data types are png files. In order to achieve precise classification, our experiment consists of three steps. Firstly, only vanilla CNN was used for the classification and the highest score was 86.2%. Second of all, for the hybrid approach, the machine learning classifiers were used instead of fully connected layers from the vanilla CNN and it yielded about 87% with the extra tree classifier. At last, the Xception model was combined with the bidirectional GRU and it attained a 95.6% accuracy score, which was the highest among all. Furthermore, with the aim of detecting anomaly parts of the malicious data, the grad-CAM algorithm was utilized and the abnormal parts were detected successfully. Even though our research contains limitations in the number of the datasets, which are not appropriate for the deep learning models and anomaly detection, the novel hybrid approach we made and anomaly detection of the traffic dataset were our foremost achievements.

I. Introduction

a) Background

Information and communication have experienced rapid growth in many ways over the past three generations. In particular, as the 3V (Volume, Velocity, and Variety) of information intensifies, users' freedom to access quality information also increases. Information technologies have brought new changes in both information usage between individuals and in business operations, such as introducing computerization to corporate marketing methods and sales management (Sanaei & Sobhani, 2018). However, as the communication environment develops in this digital transformation process, malicious approaches such as hacking or spying aimed at user personal information, corporate confidentiality, and financial information become a problem (Layton, 2021).

Ransom DDos, which accounts for the largest number of DDoS attacks carried out in 2020, is also achieved through service paralysis attacks that drain the system's resources by creating huge amounts of packets, similar to conventional DDoS attacks, and bandwidth exhaustion attacks that exhaust TCP connections. In addition, numerous global hacking groups are openly attacking and threatening companies in the financial sector and manufacturing industries to compensate for money while hiding in the anonymity of virtual currency. Therefore, detecting large - scale broadband networks and analyzing harmful traffic in advance, along with intrusion detection systems operating on a specific network or set list, is an important technology that can block malicious attacks from the source (Williams, 2021). We call data which causes security problems with bad intentions 'malicious traffic'. Malicious traffic causes security problems for individuals, businesses or countries and damages the device. In order to detect malicious traffic, there must be a technology which can distinguish between normal traffic and malicious traffic (Rose, 2021). The graph below shows a share of global web application attack traffic as of April 2018, by originating country (Statista, 2021).

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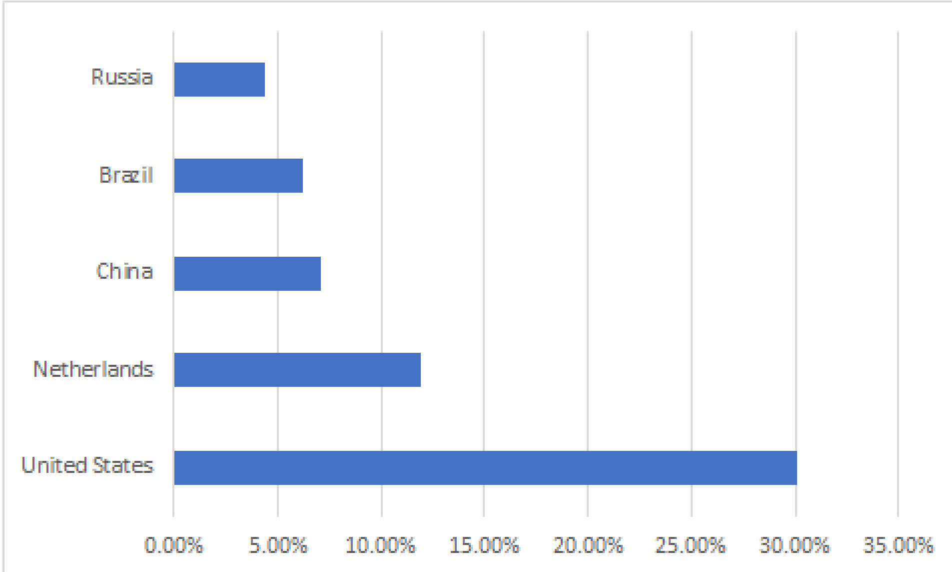

Figure 1: Share of global web application attack traffic as of April 2018, by originating country

b) Objective

Most existing studies classified malicious and normal traffic with csv type files. Therefore, there were limited ways to classify malicious and normal traffic. More AI models can be used by using image files, not just csv files. In order to use more AI models, this study classified malicious and normal traffic with image data, allowing various deep learning models such as CNN, Xception and BI-GRU to be applied. To optimize image files for deep learning models, we preprocessed the images and applied them to diverse AI models. First of all, we applied CNN based models and altered the optimizers such as adam, nadam, sgd, rmsprop in order to find the best optimizers. Secondly, we extracted the features from the image data through CNN and applied it to tree-based Machine learning models, such as Decision Tree Classifier, Random Forest Classifier and Extra Tree Classifier. Lastly, a hybrid deep learning based approach was used, which combines CNN-based Xception and RNN-based BI-GRU.

c) Related Works

Mohiuddin Ahmed and Abdun Naser Mahmood developed a framework for collective anomaly detection using k-means model, to discover abnormal traffics that look legitimate but are in fact targeted to disrupt normal computing environments (in this paper, DoS attack). The experiment results are based on a widely accepted DARPA dataset for intrusion detection from MIT Lincoln Laboratory. Input data extracted from network traffic, <SrcIP, DstIP, Protocol, Payload Length> is used for clustering and the data showed high probability of being DoS attack. CAD's key idea is that a group of traffic flows collectively. The paper identified DoS and other similar attacks as collective anomaly based on x-means clustering, a variant of k-means algo and eight times faster than k-means. CAD's accuracy was compared against CBLOF, LDCOF and k-means algorithms, and the result was 97%, 85%, 93% and 83% respectively (Ahmed & Mahmood, 2014).

Radford et al. demonstrated that network behaviors can be learned from traffic metadata using LSTM RNNs (which is able to detect patterns of traffic indicative of malicious computer system use without the assistance of labeled training data and visibility into each machine's internal state or processes) applied for anomaly detection. The research was motivated by cyber security (whose applications have been shifted from signature based matching methods to machine learning and statistical models) and NLP (communications between networked devices are captured in ordered sequence and the team expected its rule to be similar to grammar). They used a dataset that represents seven days of simulated network traffic with attack behaviors (such as infiltration, DoS, DDoS and SSH attack), from IDS tasks from the University of New Brunswick's Canadian Institute for Cyber security and ISCX. In methodology, each LSTM layer is composed of 50 hidden cells with linear activation, linear activation on the first layer and rectified linear activation on the second layer. Initial embedding layer projects input sequence from V unique tokens into a dense 100-dimensional vector space. Entire dataset was trained with a ten-token sliding window, where each model was trained to predict the subsequent (eleventh) token. As a result, models based on proto-byte sequences produce higher AUC scores than any model based on service port sequence(Radford et al., 2018).

R.Yuan, Z.Li and X.Guan proposed SVM-based ML model for internet traffic classification. The data has been obtained from a backbone router of the campus network of the author's university, 8-hour traffic data on a Gbps Ethernet link within a week. The packets were separated into unidirectional flow depending on five tuples (srcIP, desIP, Prot, srcPort, desPort) and combined into bi-directional flows from the overlapping time spans of the flows. 19 parameters were computed from the packet headers to be the discriminators for the classification algorithms and all parameters are obtainable in real time from the packet header, without storing the packet. SVM model classified the data with 19 parameters, which has been pretreated using logarithm function. 10-fold cross validation analyzed 4 kernel functions' accuracy and RBF showed highest accuracy, 93.38%. The classes with more training samples (WWW and service) had low false negative ratios (0.20% and 0.00% respectively), which is comparatively smaller than classes with fewer training samples. To find an optimizing discriminator, a sequential forward selection method was used and the weighted average of classification accuracy across all traffic classes is 99.42%. 99.42% accuracy has been achieved with regular biased training, 97.17% with unbiased sample. RBF kernel based SVM model is also applicable to encrypted network traffic and real-time traffic identification. Since supervised machine learning has inadequacy in that it requires a large labeled dataset, they look forward to combining supervised and unsupervised machine learning with feature parameters obtainable early in the traffic flow for fleet and precise internet traffic classification (Yuan et al., 2008).

As crimes in computer networks expand, real-time analysis has become essential in network intrusion detection systems (IDS). Enhanced encryption and new ways of avoiding detection led to the need for exquisite classification technology. Traditional method (port based classification) and its advanced method (payload based classification) both showed shortage and thus researchers started to utilize ML in IDS to detect malicious activities. The proposed structure from Noora Al Khater and Richard E Overill is constructed as follows; data collection from real time traffic capture, feature extraction (selection), training with supervised technique and classification using ML. In feature selection, the paper used sub-flow instead of full flow or early arrived packets in the flow in that sub-flow is more time and memory efficient. Supervised algorithms classify rules, build models, and find new unseen examples from new input data. Classification process correlates network traffic patterns with the generating applications. Based on statistical analysis of sub-flows, supervised, semi-supervised, unsupervised algorithms are applied to figure out the extent of robustness and effectiveness of the model. The paper suggests more research on sub flow based ML techniques to decently classify network traffic (al Khater & Overill, 2015).

II. Materials and Methods

a) Data Description

The dataset is collected from the kaggle website, which is available at https://www.kaggle.com/sohelranaccselab/trfffffffffffffffff/metadata. This dataset is described in the research paper "Intrusion Detection using Network Traffic Profiling and Machine Learning for IoT Applications". The given data source includes 856 photos of 518 malicious traffic photos and 338 normal traffic photos. It is supposed to perform binary classification. As the dataset contains less images for the deep learning algorithms, we utilized image data generator function from the Keras for the data augmentation. Furthermore, all of the images in the dataset were divided into 255 for the standardi zation (*MALICIOUS NETWORK TRAFFIC PCAPS-202*, 2021).

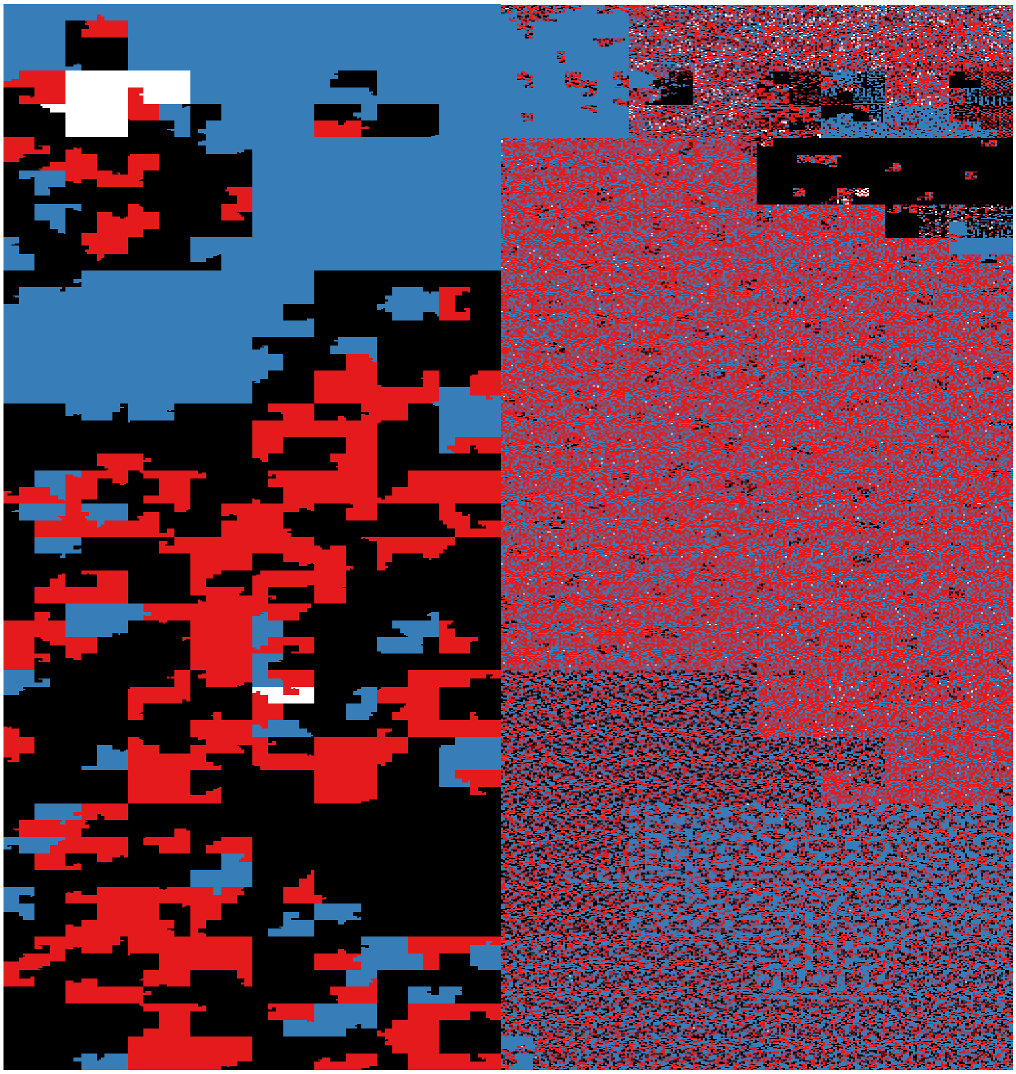

Figure 2: Normal and malicious traffic data from the kaggle website

b) CNN

Convolutional neural network (CNN) is one of the main artificial intelligence(AI) models to recognize and classify images. When the CNN model classifies an image, the image is used as an input and the feature values are extracted by the CNN model as output. Some neurons in the previous layer are connected to individual neurons in the next layer and this local correlation is called the receptive field and forms a weight vector. The regional features are extracted by using a receptive field. Since neurons in the plane share the same weight, similar features at different regions of the input data can be searched. Filter or kernel is the weight vector of CNN which slides over the input vector to create the feature map. The method of sliding the filter horizontally and vertically to make weight vectors is called convolutional operation. The convolutional operation extracts features from the input image in a single layer which is representing a unique feature. Due to the local receptive field, the number of parameters to train decreases a lot. Once a feature is detected, the exact region of a feature becomes less important. Then, the pooling layer reduces trainable parameters in order to speed up the operation, prevent over fitting problems and enable translation invariance. At last, a fully connected layer, which has the same shape as a deep neural network (DNN), executes classification (Indolia et al., 2018).

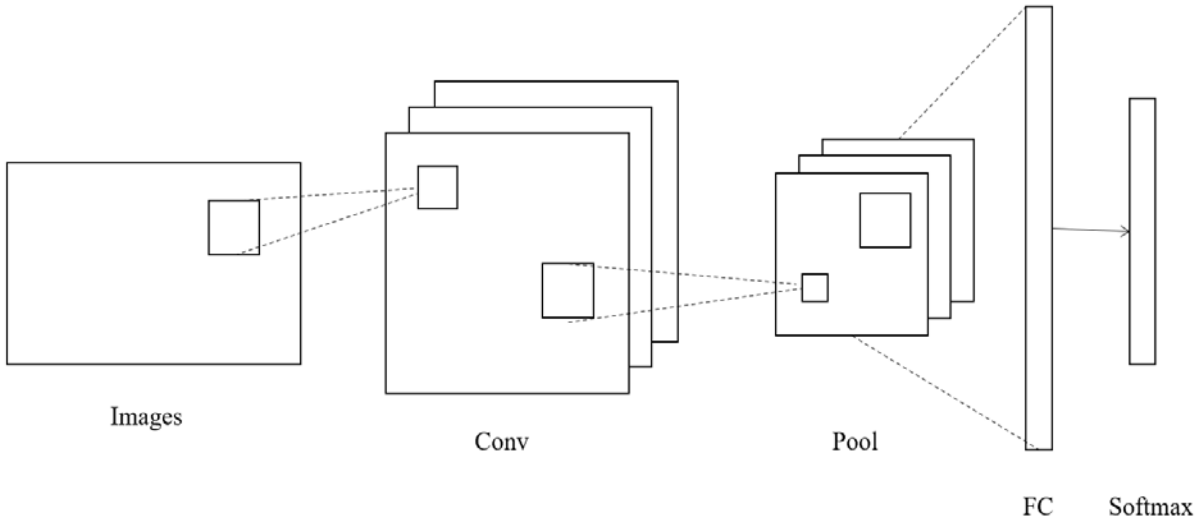

Figure 3: Overview of the convolutional neural network

c) Xception

The Xception model, announced in 2016, is basically based on the Inception model. While the Inception model focused on separating cross-channel correlation and spatial correlation, the Xception model focused on maximizing this through parameter regulation. In turn, the Xception model consists of depth separable connection layers and residual connections. Depth wise separable convolution changes the order of 3x3 operations after the existing 1x1 operation to 1x1 operation after the 3x3 operation. The 1X1 operation is referred to as a point wise operation, and the 3x3 operation is referred to as a channel-wise operation (Wang et al., 2019).

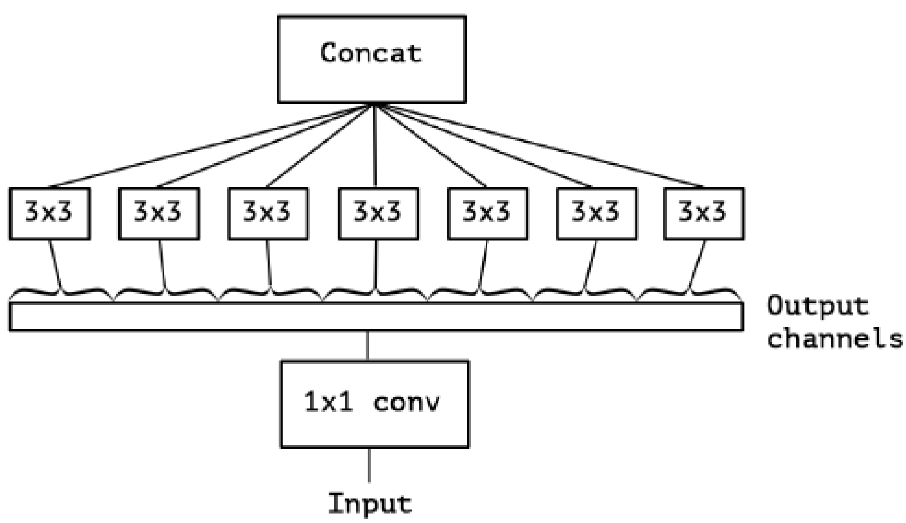

Figure 4: Overview of the Xception model

d) GRU

Vanila neural network, so called as an artificial neural network (ANN) or deep neural network (DNN) mainly consists of 3 different layers, including input layers, hidden layers, and output layers. However, as the ANN and DNN have lower performance in computer vision and natural language processing (NLP), novel algorithms were invented for the higher accomplishment. CNN is the most widely used for computer vision and RNN for the NLP. LSTM and GRU algorithms are representative models of the RNN and they have achieved better performance compared to the vanilla RNN (Cheon et al., 2021). GRU is mainly composed of two gates; reset gate and update gate. The reset gate aims to reset the historical information from the previous hidden layers (Cho et al., 2014). Therefore, after

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multiplying the value (0, 1) by the previous hidden layer, the sigmoid function is utilized as an activation function of the output. The update gate determines a proportion of both present and past information and the output from the update gate regulates the amount of information at present. In the candidate hidden state, it determines what to erase from the previous time step by multiplying the reset gate and the previous hidden state. Lastly, for the final hidden state, it aims to calculate the hidden layer at the present point by combining the result of the update gate and the result of the candidate hidden state(Chung et al., 2014)..

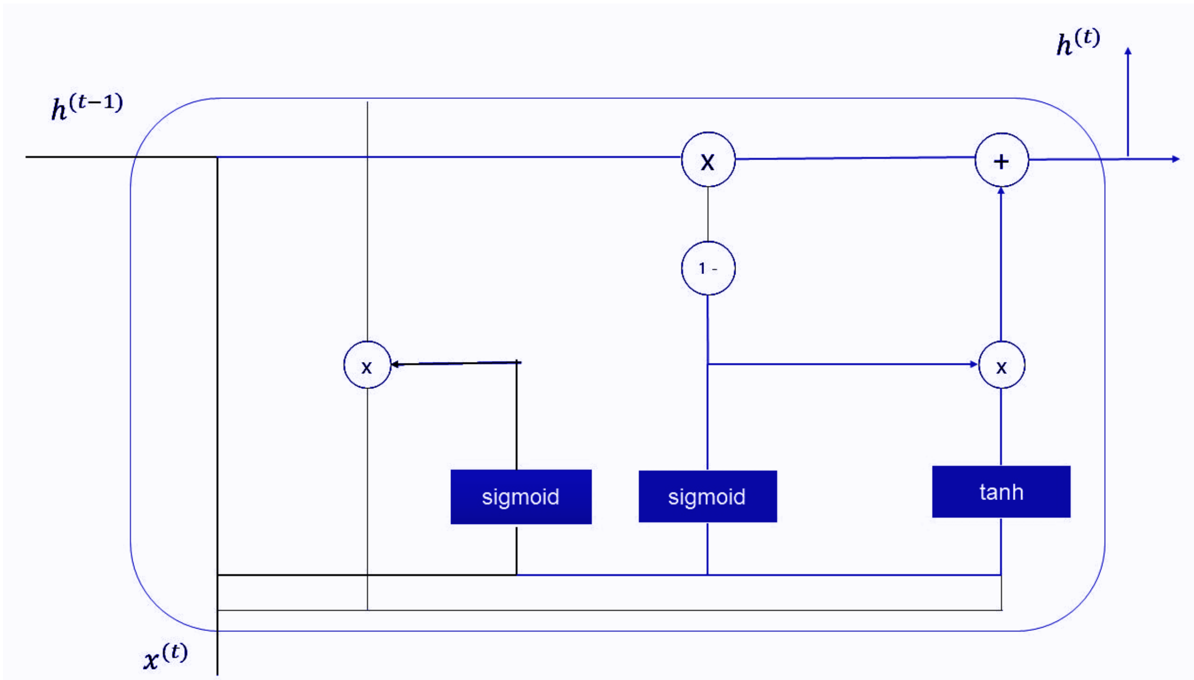

Figure 5: Overview of the GRU model

III. Proposed Model

With the aim of enhancing the performance of our model, we combined Xception model, which is a transfer learning method pre-trained with imagenet dataset, and bidirectional GRU. As the bidirectional model allows an end to end training of whole parameters in the model, it has been utilized for the elevated performance. A lambda layer is used for combining the Xception model and bidirectional GRU because the output dimension of the Xception model and the input dimension of the bidirectional GRU are not compatible. The Nadam and binary cross entropy were utilized as optimizer and loss function, respectively.

IV. Results

a) *Comparison of accuracy scores*

Accuracy scores were derived from the diverse machine learning and deep learning algorithms. In the first experiment, accuracy scores for each optimizer, 'Nadam', 'rmsprop', 'adam' and 'SGD' are extracted from the vanilla CNN and the highest one is 86.2% from 'Nadam' optimizer. Various machine learning classifiers were used instead of fully connected layers of the vanilla CNN for the second experiment. Decision tree classifier brought out 71%, random forest classifier yielded 86% and extra tree classifier achieved 87% of accuracy score. Lastly, while the Xception model with 'adam' attained 62 % of accuracy score, the 'Xception + Bi-GRU' model brought out a 95.6% accuracy score, which was the highest one. Furthermore, as shown by the two graphs below, training accuracy is gradually increasing while training loss is gradually decreasing, which shows that training is done flawlessly.

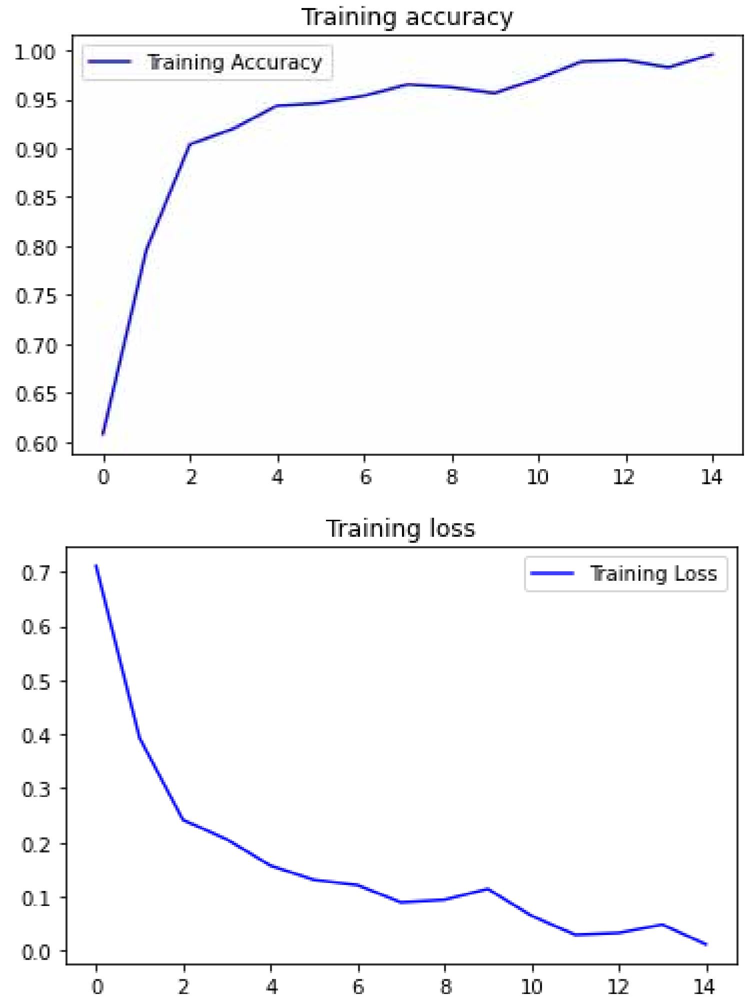

Figure 6: Loss and training accuracy during training ffss

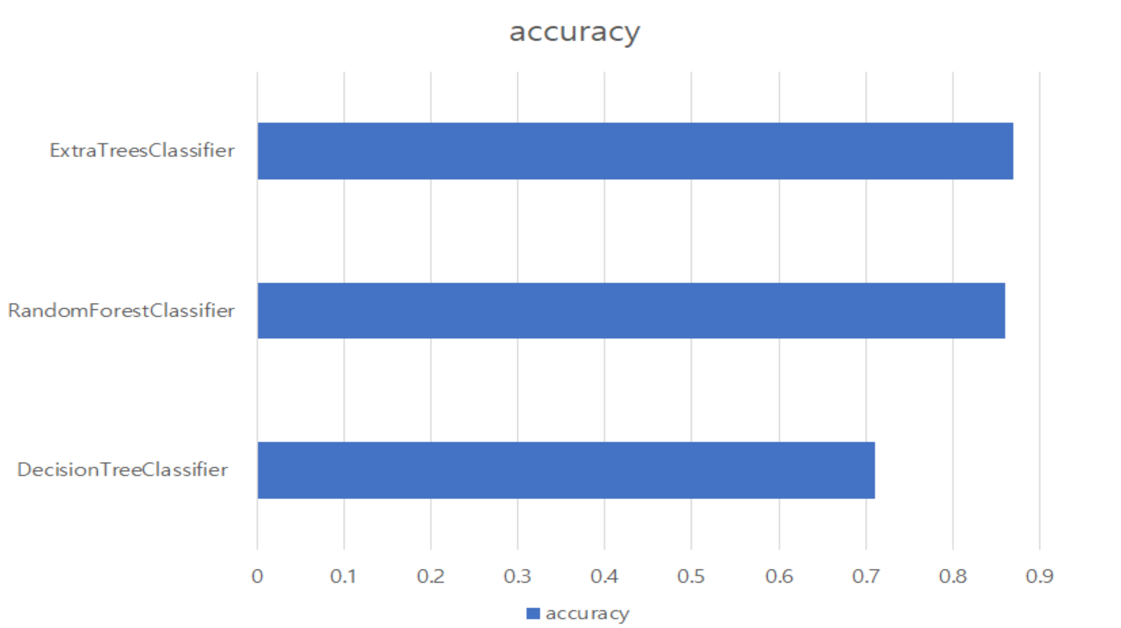

Figure 7: Accuracy comparison among CNN + machine learning classifiers

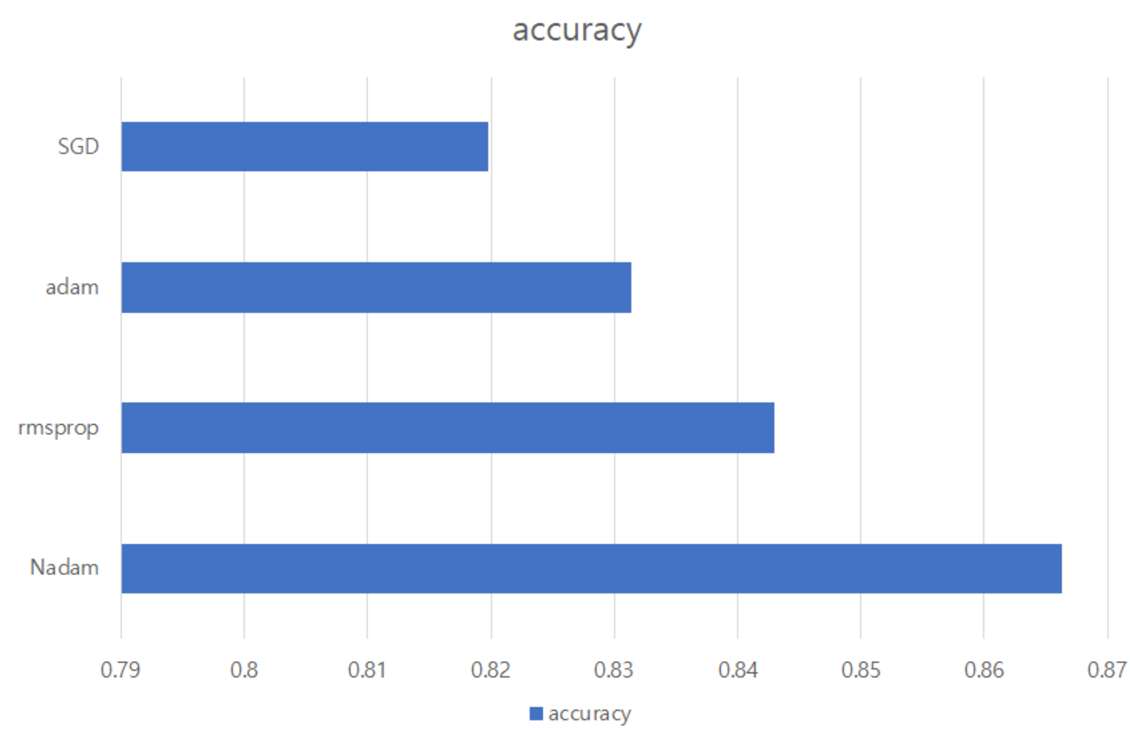

Figure 8: Accuracy comparison from vanilla CNN depending on the optimizers

b) Anomaly detection via Grad-CAM

With the aim of detecting the anomaly parts of the malware dataset, Gradient-Weighted Class Activation Map (Grad - CAM) was utilized. While the CNN models involve a fully connected layer before the classification, Grad - CAM replaced it with the global average pooling layer. Therefore, instead of calculating accuracy score, Grad - CAM exhibits the cause of the classification result through the heatmap as shown in the figure # below. The given heatmap from the Grad-Cam was blended with the target image data, then it indicates the abnormal part with the red and normal part with purple. To sum up, the figure and 10 below provides evidence why our proposed model classifies the given image into malware data (Selvaraju et al., 2017

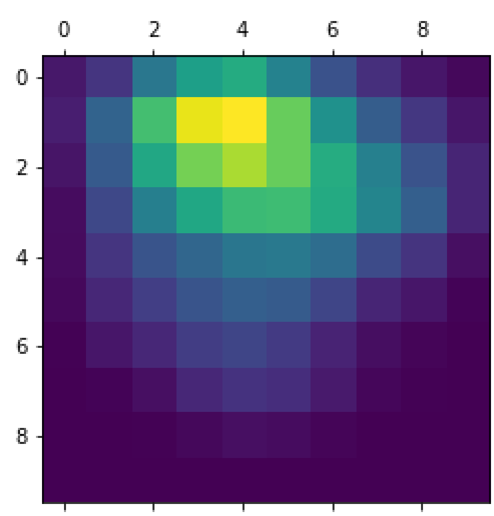

Figure 9: Heatmap extracted from the Grad-CAM

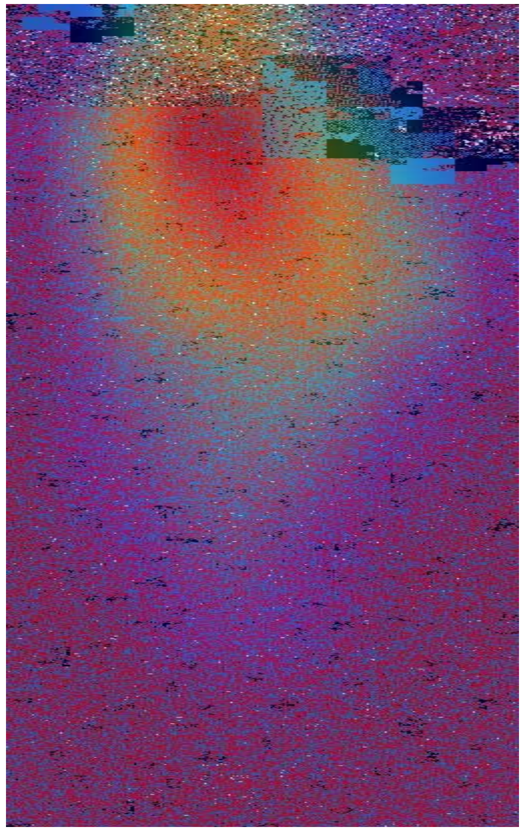

Figure 10: Anomaly parts of the malicious data detected from the Grad-CAM

V. Discussion & Limitation

Although our experiment was successful, there exist several limitations. Even though deep learning methods and machine learning methods are utilized for various approaches, only tree based machine learning models were used for the classification. Furthermore, another limitation lies on the given dataset which contains relatively fewer images for the deep learning models. For instance, other traffic dataset contains numerous samples of normal traffic data while involving less samples of malicious traffic. Therefore, previous researches conducted classification with anomaly detection algorithms such as local outlier or isolation forest. However, the dataset we used in our experiment has a restriction in that the number of samples is small for both normal and malicious dataset, which hampers us to construct the deep learning models for the anomaly detection.

Principal Finding

When it comes to detecting malicious network traffic, we suggest the Xception + Bi-GRU model since it demonstrates a higher accuracy score (95.6%) than other models. The model showed the highest accuracy score, 4% higher than Extra Tree Classifier and 5% higher than the most sophisticated CNN + Machine Learning models. This experiment conducts technical significance by successfully combining CNN based Xception and RNN based Bi-GRU. Our research revealed that hybrid deep learning models surpass the vanilla models when detecting malicious traffic. Furthermore, we detected and visualized the abnormal part of the malicious image via Grad-Cam which made our research have a considerable outcome compared to other existing research.

VI. Conclusion

Proposed hybrid model 'Xception + BI-GRU' brought out the highest accuracy score compared to any other AI models. This model showed an accuracy of about 95 percent in classifying the given dataset. With Grad -Cam, we can visualize the reason why our model classified images into specific classes. Our research achieved meaningful results but there also exist several limitations. For combining deep learning and machine learning models for hybrid approach, only tree-based machine learning models were used. In addition, our given dataset contains relatively few images for training the deep learning models, which is not sufficient condition for the adequate experiment. In addition, due to this lack of dataset, we could not apply anomaly detection algorithms which were mainly used in the previous research. Despite these limitations, our experiment reveals that the hybrid model yields a higher accuracy score than implementing a deep learning model solely. Furthermore, Grad-Cam differentiated our research from other research through visualizing the anomaly part of the malicious data. For further research,

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we would attain higher accuracy scores and also construct a CNN based anomaly detection model.

References Références Referencias

1. Ahmed, M., & Mahmood, A. N. (2014). Network traffic analysis based on collective anomaly detection. *2014 9th IEEE Conference on Industrial Electronics and Applications*. Published. https://doi.org/10.1109/iciea.2014.6931337.
2. al Khater, N., & Overill, R. E. (2015). Network traffic classification techniques and challenges. *2015 Tenth International Conference on Digital Information Management (ICDIM)*. Published. https://doi.org/10.1109/icdim.2015.7381869.
3. Cheon, M. J., Lee, D. H., Joo, H. S., & Lee, O. (2021). Deep learning based hybrid approach of detecting fraudulent transactions. Journal of Theoretical and Applied Information Technology, 99(16), 4044-4054.
4. Cho, K., Van Merriënboer, B., Gulcehre, C., Bahdanau, D., Bougares, F., Schwenk, H., & Bengio, Y. (2014). Learning phrase representations using RNN encoder-decoder for statistical machine translation. *arXiv preprint arXiv:1406.1078*.
5. Chung, J., Gulcehre, C., Cho, K., & Bengio, Y. (2014). Empirical evaluation of gated recurrent neural networks on sequence modeling. *arXiv preprint arXiv:1412.3555*.
6. Indolia, S., Goswami, A. K., Mishra, S., & Asopa, P. (2018). Conceptual Understanding of Convolutional Neural Network- A Deep Learning Approach. *Procedia Computer Science*, *132*, 679–688. https://doi.org/10.1016/j.procs.2018.05.069.
7. Layton, R. (2021, March 19). *Hackers Are Targeting U.S. Banks, And Hardware May Give Them An Open Door*. Forbes. https://www.forbes.com/sites/roslynlayton/2021/03/17/hackers-are-targeting-us-banks-and- hardware-may-give-them-an-open-door/
8. *MALICIOUS NETWORK TRAFFIC PCAPS-2021*. (2021, May 27). Kaggle. https://www.kaggle.com/sohelranaccselab/trffffffffffffffffff/metadata.
9. Radford, B. J., Apolonio, L. M., Trias, A. J., & Simpson, J. A. (2018). Network traffic anomaly detection using recurrent neural networks. *arXiv preprint arXiv:1803.10769*.
10. Rose, J. R., Swann, M., Bendiab, G., Shiaeles, S., & Kolokotronis, N. (2021). Intrusion Detection using Network Traffic Profiling and Machine Learning for IoT. *2021 IEEE 7th International Conference on Network Softwarization (NetSoft)*. Published. https://doi.org/10.1109/netsoft51509.2021.9492685.
11. Sanaei, M. R., & Sobhani, F. M. (2018). Information technology and e-business marketing strategy. *Information Technology and Management*, *19*(3)185–196. https://doi.org/10.1007/s10799-018-0289-0.
12. Selvaraju, R. R., Cogswell, M., Das, A., Vedantam, R., Parikh, D., & Batra, D. (2017). Grad-cam: Visual explanations from deep networks via gradient-based localization. In *Proceedings of the IEEE international conference on computer vision* (pp. 618-626).
13. Statista. (2021, January 25). *Leading source countries of web application attack traffic 2018*. https://www.statista.com/statistics/276425/internet-attack-traffic-by-originating-country/Wang, Z., Lu, J., Tao, C., Zhou, J., & Tian, Q. (2019). Learning Channel-Wise Interactions for Binary Convolutional Neural Networks. *2019 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*. Published. https://doi.org/10.1109/cvpr.2019.00066
14. Williams, S. (2021, September 6). *APAC top target for network DDoS attacks - report*. Security Brief. https://securitybrief.co.nz/story/apac-top-target-for-network-ddos-attacks-report.
15. Yuan, R., Li, Z., Guan, X., & Xu, L. (2008). An SVM-based machine learning method for accurate internet traffic classification. *Information Systems Frontiers*, *12*(2), 149–156. https: //doi.org/10.1007/s10796-008-9131-2.

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Towards Reducing Covid-19 Spread: A Geo-Location Based Attendance Monitoring and Navigation System for Institution

By OYEKANMI Ezekiel Olufunminiyi
Achievers University

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Keywords: *geo-location; attendance system; navigation system; COVID-19; GPS.*

GJCST-H Classification: *C.2.3*

TOWARDSREDUCINGCOVID19SPREADAGEOLOCATIONBASEDATTENDANCEMONITORINGANDNAVIGATIONSYSTEMFORINSTITUTION

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Keywords: geo-location; attendance system; navigation system; COVID-19; GPS.

I. Introduction

The act of taking attendance in the classroom has been the norm in almost every institution or school as it helps to know how regular students are and as a yardstick to measure their performance during examination. Typically, attendance systems are of two types: manual and automated. A Manual system uses sheet of papers or books in taking attendance where students fill out, and lecturers oversee for accuracy [1]. This method is prone to error because sheets could be lost or damaged. The extraction of relevant data and the manual computation might take a lot of time. A Lecturer may use extra time to complete checking the attendance of all the students that came for his/her lecture and this might delay another lecturer from entering for his/her own class period, especially when same venue has been assigned to both lecturers. This can create an overhead cost for such an organization [1]. Not only that, the pursuit of reducing the rate at which people contracted the covid-19 virus may not be realizable after resumption if attendance could continue this way. There will not be social distancing (one of the pre-cautionary measures) while taking attendance of the students, and this may increase the spread of the virus.

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An automated attendance system, however, uses electronic tags, barcode badges, magnetic stripe cards, biometrics (hand, fingerprint, or facial), and touch screens in place of paper sheets [2]. In these techniques, students touch or swipe to provide their identification, entering, and leaving time to know whether they were around for the class or not. As this is an improvement over manual, in this paper, we introduce the use of smart phones for attendance tracking purposes considering the wide popularity of smart phones which virtually all lecturers and students could afford, and is a form of an automated system. The attendance tracking system is based on the concept of web services on an Android mobile application that communicates with the database on a remote server via internet connectivity (Wi-Fi/4G). This system does not require any peripheral device other than a smart phone due to its built-in GPS. Any user can be tracked automatically via the smart phone's GPS value.

While considering attendance management, another objective of this research is to ease routing on campus for visitors. This is achieved by defining the destination place on campus, and creates a route that leads to the destination point.

The research was carried out at Achievers University Owo where a lot of captured areas were trained both for attendance management and navigation.

II. Literature Review

A desktop application for daily attendance of students was developed in [3] to store information of students in a particular class. The technology used for the application was VB.NET, and database management system used was MS-Access. On startup of the application, the name of all registered students for a particular course were displayed. Each student marks attendance by clicking the checkbox against his/her name, and click a button to submit the attendance. The application was a stand-alone compared with the proposed application.

In [4], a cost-effective computer-based embedded attendance management system was proposed, the system uses an improvised electronic card to monitor students' attendance for verification. The card after inserted in an electronic machine, shows the record of time and other information about an individual before attendance processing was done. The issue with electronic card or password based system is that it allows for imposture since cards or passwords can be shared. A better way to tackle this problem is by using a biometric recognition system which includes finger print or iris recognition.

Fingerprints had also been used to identify and calculate the attendance number of individual in [5]. The system was used to generate the reports after a fixed time duration. Smaili and kadry in [6] also solved attendance management problem by proposing a wireless system where iris of an individual was used for authentication. It was like fingerprint where no two persons can be same. Although, iris is more preserved from the external environment whereas a fingerprint is not. Both a fingerprint and iris recognition-based approach need some extra devices or scanners which can be connected to the server computation system. Also, based on the circumstance of the covid-19 pandemic, the fingerprint approach may instigate the risk of contracting the virus; hence this approach may not be fit to be used now. We proposed a geo-location-based approach for attendance management to reduce the risk of contracting covid-19.

Researchers have discovered that hardware integrated with Global Positioning System (GPS) receivers can add geospatial information to web content, photographs, audio, and video automatically [7]. Katie in [8] stated that routing on campus is easier, more accessible, and of course, be a tool to empower the next generation of outdoor advocates via a geographical coordinate approach.

Another survey of literature and the inference drawn was summarized in Table 1 as follows:

Table 1: Review and inference drawn

Author(s) with publication details	Title of the paper	Techniques used	Limitation
Mohammad and Durga Prasad [9]	Design and Implementation of Mobile Phones based Attendance Marking System	WAMP, SQ Lite,	It can be altered by other physical attacks and is prone to hacking.
Jun [10]	Attendance Management System using a Mobile Device and a Web Application	Monaca-application	No feedback from users.
Mahesh et al. [11]	A Smart Phone Integrated Smart Classroom	Face recognition, Android	Automatic switching of profile to airplane mode in Android versions 4.1 i.e. Jelly Bean and above are restricted by Android due to security reasons.
Ekta et al. [12]	Survey on Student Attendance Management System		Not automated.
Milon et al.[13]	Development of Smart phone - based Student Attendance System	Eclipse Android ADT bundle as IDE, SQLite and MySQL.	Can be used only in Android devices.
Karwan et al.[14]	Student Attendance Management System		Past attendances are not stored.

III. Research Site

This research was done at Achievers University Owo (AUO) campus area. The University has many different buildings, with most of the buildings connected; some of them had different offices and walkways. Many visitors come around to enquiry; some come for business purpose and the likes. The geographical coordinates of eleven (11) classrooms, with about thirty-four (34) locations where newly admitted students do visit were captured and tagged appropriately for easy navigation within the campus. The classrooms comprise selected lecture theatres,

Designated Students' reading Rooms (DSR) for departments, and lecture halls. Since the existence of Achievers University, no mapping system that can enable a new person on the campus to get to their destination with little or no guidance has been developed. This research focused on helping incoming visitors via their smart phone or GPS-enabled device. Figure 1 shows the Google map of Achiever University, Owo.

Figure 1: Achievers University Owo Google map

(Source: https://www.google.ro/maps/place/Achievers+University@7.198851,5.593239,15z/data=!4m5!3m4!1s0x0:0xebce36c85f04d296!8m2!3d7.198851!4d5.593239

IV. Architectural Design of the Software

In the architectural design shown in Figure 2, the users (students, lecturers, and visitors) have access to smart phones with the GPS feature enabled. The phone camera is used as the input medium to get the snapshot of the area of interest-whether for attendance or navigation purposes. The Exchangeable Image File Format (EXIF) information is stored automatically by the camera after the snapshot. Cameras with a built-in GPS receiver add the GPS data (in numerical format) to the EXIF, which comprise latitude, longitude, and elevation.

Photo GPS extract can read those numbers and visualize them on Google Maps. The coordinates point expressed in the form of latitude and longitude are the position or location of any place on Earth's surface. The combination of meridians of longitude and parallels of latitude establishes a framework using the exact positions. This can be determined using the prime meridian and Equator. For instance, a point described as 40° N, 30° W, is located at 40° of arc north of the Equator and 30° of arc west of the Greenwich meridian.

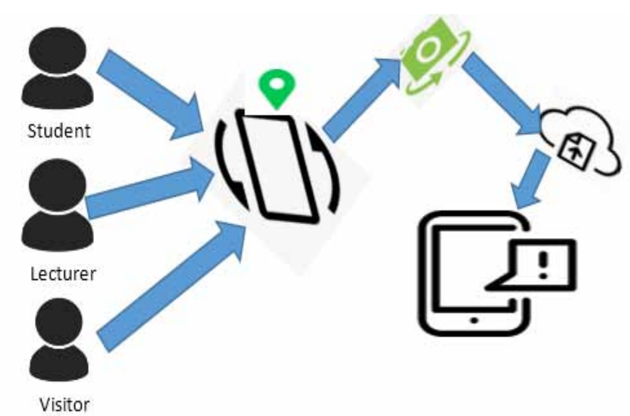

Figure 2: Architectural design of the software

V. Research Method

The approach used in the development of the system was in two stages: the training and testing stage. In the training stage, the coordinates of places of interest used were captured three times in a day, both for classroom attendance and route on-campus navigation. This will ensure a good approximate value during testing. The input, process, and output (IPO) flow of the training stage is shown in figure 3, while the flowchart is shown in Figure 4.

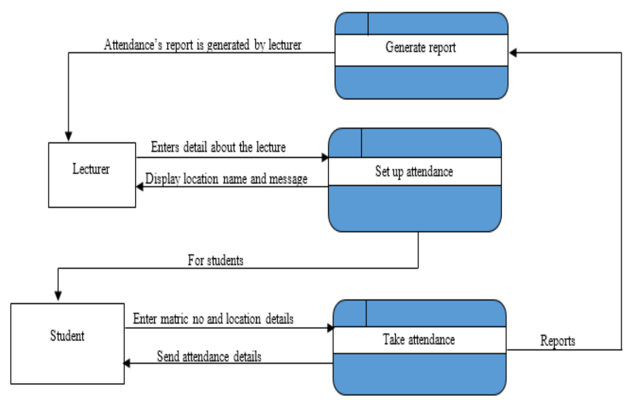

Figure 3: IPO chart for the software

In the testing stage, the approach is different. In attendance management, after the area has been captured and correctly displayed the tagged name, the lecturer then input the following parameters: staff number, current semester and session, and course code. These information are to initiate the venue of the lecture for such course. Students after that will capture the area using their respective smart phone. If the captured area name is the same with the lecturer's already captured area, the student proceeds by entering their matric number to mark the attendance register. The data flow of the attendance system is shown in Figure 5. However, in the case of navigation of routes on campus, the approach is different. Once the visitor captures the current area (source area) where they are, the tagged name is displayed, and then proceeds to input their destination place. A route is displayed from the source area to the destination area automatically. Figure 4 shows the flow chart of the navigation system.

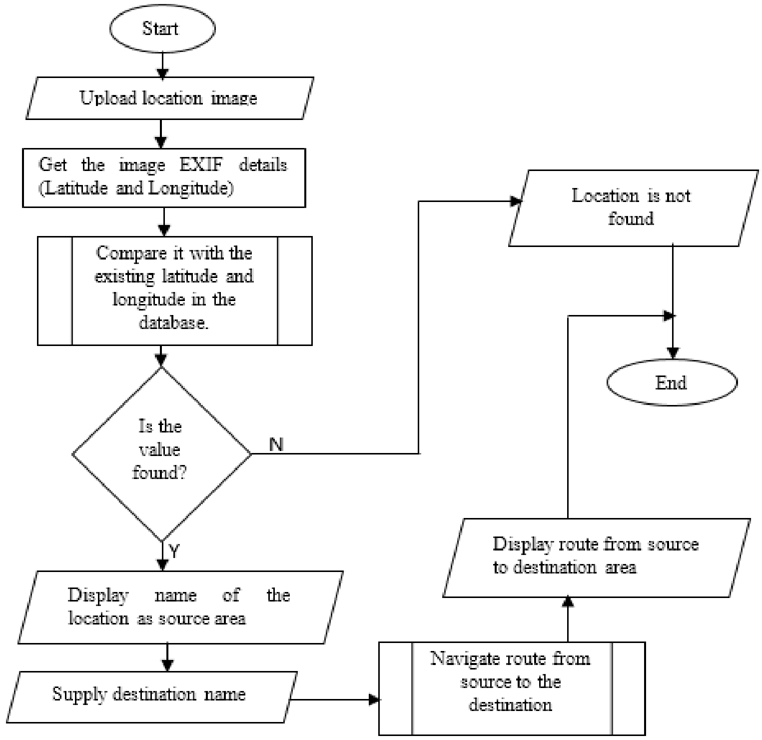

Figure 4: Flowchart for route navigation

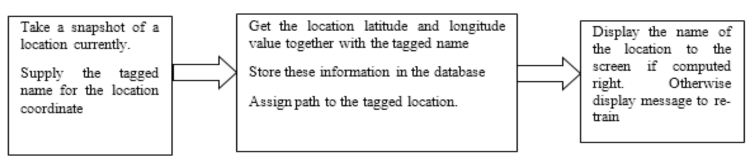

Figure 5: Data flow diagram of attendance management system

a) *Data Smoothening*

During the training section, the coordinates were captured with different decimal places. Normalization and feature selection methods were employed for data smoothening. A decimal scaling method was used to move the decimal point to a scale value range of -1 and 1 while still maintaining the original digit value. The decimal scaling is shown in equation (1) as follows:

$$w'(i) = w(i)/10^k \quad (1)$$

where $w(i)$ is the value of the feature (in this case, it is the coordinate value) w for case i and $w'(i)$ is the scaled value. k is the length of the integral part of the coordinate value which can be represented as

$$k = |int(w(i))| \quad (2)$$

The resultant value is further smoothened by rounding it to a precision value of four (4)

Furthermore, to ensure the quality of data and improve the performance of reduced data sets (scaled coordinates), a subset feature selection type was adopted. This sieves out relevant geographical coordinates of the current location has a precision value of 4. The algebra expression for getting relevant data is shown as follows:

$$\pi_{X,Y,Z}\,\sigma_{X\ LIKE\ ('x_i\%')\wedge Y\ LIKE\ ('y_i\%')}\,coordinate\_table$$

where $X, Y\ and\ Z$ are the latitude, longitude value and location name respectively. $x_i\ and\ y_i$ are the current latitude and longitude value meant for querying the database table (coordinate_table).

b) *Predicting the Location*

The problem of attendance monitoring system was a classification problem where when one or more inputs is (are) given, a classification model will try to draw some conclusion from the observed value(s). Bayes theorem is used in the classification. To compute the posterior probability for all values of c using the Bayes theorem,

$$P(c|x) = \frac{P(x|c)P(c)}{P(x)} \quad (3)$$

where $P(c|x)$ is the posterior probability of class (c, target) given predictor (x attributes). $P(x|c)$ is the likelihood which is the probability of predictor given class. $P(c)$ is the class prior probability and $P(x)$ is prior probability of the predictor.

$$P(c|X) = P(x_1|c) \times P(x_2|c) \times \ldots \times P(x_n|c) \times P(c) \quad (4)$$

The highest posterior probability class shows the predicted outcome. This is the basis of Bayes theorem.

VI. Result, Discussion and Analysis

A typical example of how the Bayes theorem works in the developed application was shown in Table 2. After the EXIF details of a snapshot of a particular location have been captured via the application using Smartphone with its GPS-enabled, the latitude and longitude readings were then retrieved from the EXIF details and used to query the coordinate table as discussed in the previous section.

Table 2: Latitude and longitude readings of some locations in Achievers University

Latitude	Longitude	Location
0.716748522	0.558483833	Admin Office
0.716748522	0.558483833	Chancery Office
0.716748522	0.558483833	Chancery Office
0.716748522	0.558483833	Mgt Staff Parking Slot
0.716748522	0.558483833	Conas
0.716748522	0.558483833	ICH Lab
0.716748522	0.558483833	Mgt Staff Parking Slot
0.716748522	0.558483833	Conas
0.716748522	0.558483833	MLS Lab
0.716748522	0.558483833	Cosmas
0.716748522	0.558483833	ICH Lab
0.716748522	0.558483833	ICH Lab
0.716748522	0.558483833	Libarian Office
0.716748522	0.558483833	Libarian Office
0.716748522	0.558483833	Library
0.716748522	0.558483833	Library
0.716748522	0.558483833	Chancery Office
0.716748522	0.558483833	Admin Office
0.716748522	0.558483833	Admin Office
0.716748522	0.558483833	Admin Office
0.716748522	0.558483833	Admin Office
0.716748522	0.558483833	Lecture Hall Area
0.716748953	0.558484406	Geology Lab
0.716749525	0.558484978	Admin Office
0.716749525	0.558484978	ICT Lab
0.716749525	0.558484978	Geology Lab
0.716749525	0.558484978	Lecture Hall Area
0.716749525	0.558484978	Histology Lab
0.716749525	0.558484978	Conas
0.716748522	0.558483833	Admin Office
0.716748522	0.558483833	Chancery Office

The attribute used with the class "location" in the computation is the latitude. The frequency of each location is calculated based on each distinct latitude value as shown in Table 3. The likelihood, which is the probability of predictor given class, is then calculated to determine the class with the highest posterior probability.

Table 3: Frequency with likelihood table of distinct latitude value

	Frequency Value				
Location	0.716748522	0.716748953	0.716749525	Likelihood Value	
Admin Office	5		1	= 6/29	0.206896552
Chancery Office	3			= 3/29	0.103448276
Mgt Staff Parking Slot	2			= 2/29	0.068965517
Conas	2		1	= 3/29	0.103448276
ICH Lab	3			= 3/29	0.103448276
MLS Lab	1			= 1/29	0.034482759
Cosmas	1			= 1/29	0.034482759
Libarian Office	2			= 2/29	0.068965517
Library	2			= 2/29	0.068965517
Lecture Hall Area	1		1	= 2/29	0.068965517
Geology Lab		1	1	= 2/29	0.068965517
ICT Lab			1	= 1/29	0.034482759
Histology Lab			1	= 1/29	0.034482759
GRAND TOTAL	22	1	6		
	= 22/29	= 1/29	= 6/29		
	0.75862069	0.034482759	0.206896552		

The outcome of this computation shows that the class (location) with the highest likelihood value is "Admin Office". With this approach, lecturers can be certain of the location name where their lecture is taking place, and students can mark their attendance in the same location. Also, visitors can know where they are and navigate to where they are going within the campus. Figure 6 shows a demonstration of a navigated place.

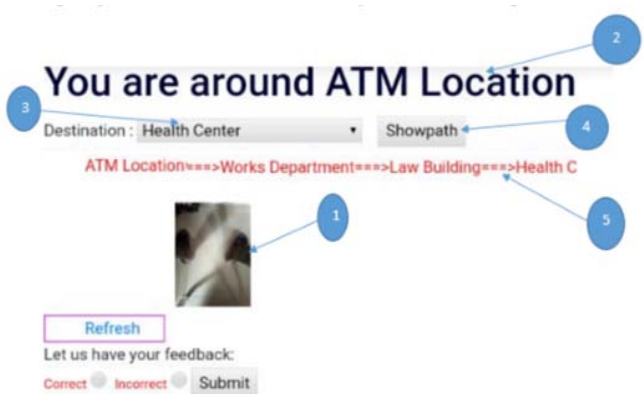

Figure 6: Route navigation page

Figure 7 shows the graph of the number of rightly-predicted locations out of 93 inputs from different smart phones

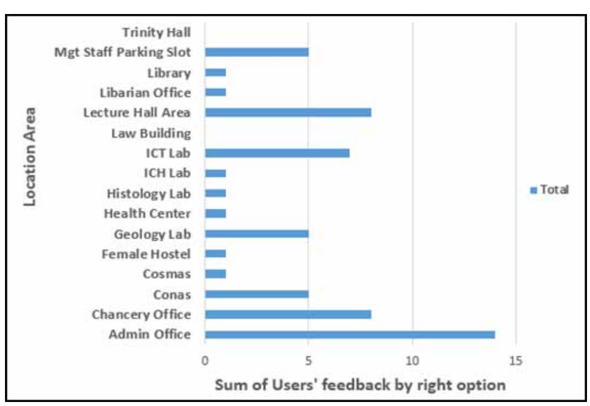

Figure 7: Count Chart of right predicted location area

The pie chart of the predicted frequency in terms of correctness is shown in Figure 8.

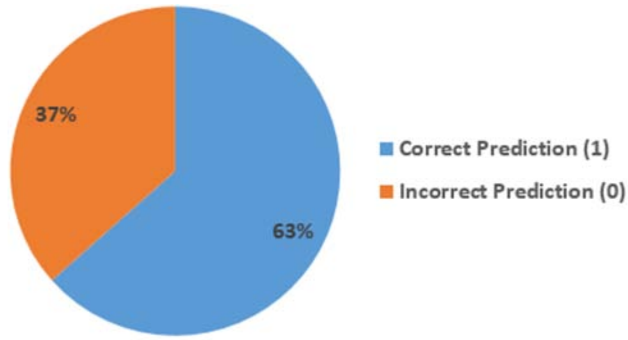

Figure 8: Pie chart representation of predicted frequency.

VI. Conclusion

The development of a geo-location-based attendance and campus navigation system is a novel system and an attempt to solve the issue of social distancing in the education system. Smartphone was the tool used to collect images at the training and testing level, due to its built-in GPS that provides an option to automatically attach geospatial information to captured media. In the attendance phase, two major modules were involved, which include the lecturer's attendance and the students' module. The lecturer module is first initialized for the student module to connect. All teachers and students within the campus can associate with the system and easily understands its way of operation. The system solves the problem of using a manual approach in taking attendance and reduces waste of time while monitoring the attendance of students. In the campus navigation phase, visitors on campus can navigate easily with little or no guidance. This research is hope to be advanced with the use of biometric.

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References Références Referencias

1. A. Kumbhar, K. Wanjara, D. Trivedi, A. Khairatkar, & D. Sharma. "Automated Attendance Monitoring System using Android Platform.", International Journal of Current Engineering and Technology, Vol. 4, No. 2, pp1096-1099, 2014.
2. S. Pankanti, S. Prabhakar, & A. Jain. "On the individuality of fingerprints". Pattern Analysis and Machine Intelligence, IEEE Transactions on, 24(8), 1010-1025, 2002.
3. S. Jain, U. Joshi and B. Sharma, "Attendance Management System," Masters Project Report, Rajasthan Technical University, Kota, accessed, 24th August, 2016.
4. O. Lawson, O. Shoewu and M. Olaniyi. "Embedded Computer-Based Lecture Attendance Management System", African Journal of Computing and ICT (Journal of IEEE Nigeria Computer Section), 4(3):27 – 36, 2011.
5. O. Shoewu and O. Idowu, "Development of Attendance Management System using Biometrics", Pacific Journal of Science and Technology, 13(1):300-307, 2012.
6. M. Smaili and S. Kadry. "Wireless attendance management system based on iris recognition", Scientific Research and essays, 5(12), 1428-1435, 2013.
7. Y. Hu & L. Ge . Chapter 11: Geo Tag Mapper: An Online Map-based Geographic Information Retrieval System for Geo-Tagged Web Content. In: M.P. Peterson, ed. International Perspectives on Maps and the Internet Lecture Notes in Geo information and Cartography. Berlin, Germany: Springer Berlin Heidelberg, pp. 153-164, 2008.
8. B. Katie (2019).Geo tagging and Social Media in Our Modern Age of Conservation, August 2nd, 2019. Accessed by 27-06-2020. Available: https://www.rei.com/blog/news/rei-presents-in-our-nature-is-photography-ruining-the-outdoors.
9. A. Mohammad, G. Durgaprasad. "Design and Implementation of Mobile Phones based Attendance Marking System", Department of Computer Science Engineering, Graphic Era University, Dehradun, Uttarakhand, India, 2015.
10. L. Jun. "Attendance Management System using a Mobile Device and a Web Application", Department of Socio-informatics, Faculty of Letters Chuo University 742-1 Higashinakano, Hachioji-shi, Tokyo 192-0393, Japan, 2016.
11. G. Mahesh, K. Jayahari, B. Kamal. "A Smart Phone Integrated Smart Classroom", Amrita e-Learning Research Lab (AERL) Amrita School of Engineering, Amritapuri, Amrita Vishwa Vidyapeetham, Amrita University, India, 2016.

12. C. Ekta, C. Heeral, G. Shubham, M. Sompurna, J. Nikhil. "Survey on Student Attendance Management System", S.B. Jain Institute of Technology, Management and Research, Nagpur, 2016.
13. I. Milon, H. Kamrul, B. Masum, U. Manik. "Development of Smartphone-based Student Attendance System", Department of Computer Science and Engineering Khulna University of Engineering & Technology, Khulna-9203, Bangladesh, 2017.
14. J. Karwan, I. Falah, A. Shahab. "Student Attendance Management System", University of Zakho, Iraq, 2018.

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Multi - Target Detection Capability of Linear Fusion Approach under Different Swerling Models of Target Fluctuation

By Mohamed Bakry El_Mashade

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Abstract- In evolving radar systems, detection is regarded as a fundamental stage in their receiving end. Consequently, detection performance enhancement of a CFAR variant represents the basic requirement of these systems, since the CFAR strategy plays a key role in automatic detection process. Most existing CFAR variants need to estimate the background level before constructing the detection threshold. In a multi-target state, the existence of spurious targets could cause inaccurate estimation of background level. The occurrence of this effect will result in severely degrading the performance of the CFAR algorithm. Lots of research in the CFAR design have been achieved. However, the gap in the previous works is that there is no CFAR technique that can operate in all or most environmental varieties. To overcome this challenge, the linear fusion (LF) architecture, which can operate with the most environmental and target situations, has been presented.

Keywords: adaptive detection, non-coherent integration, fluctuating targets, swerling models, target multiplicity environments.

GJCST-H Classification: I.5.1

MULTITARGETDETECTIONCAPABILITYOFLINEARFUSIONAPPROACHUNDERDIFFERENTSWERLINGMODELSOFTARGETFLUCTUATION

Strictly as per the compliance and regulations of:

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Abstract- In evolving radar systems, detection is regarded as a fundamental stage in their receiving end. Consequently, detection performance enhancement of a CFAR variant represents the basic requirement of these systems, since the CFAR strategy plays a key role in automatic detection process. Most existing CFAR variants need to estimate the background level before constructing the detection threshold. In a multi-target state, the existence of spurious targets could cause inaccurate estimation of background level. The occurrence of this effect will result in severely degrading the performance of the CFAR algorithm. Lots of research in the CFAR design have been achieved. However, the gap in the previous works is that there is no CFAR technique that can operate in all or most environmental varieties. To overcome this challenge, the linear fusion (LF) architecture, which can operate with the most environmental and target situations, has been presented. This processor is a combination of the properties of three different CFAR algorithms (CA, OS, and TM), and forms two different processes: statistical ordering and averaging. This paper is devoted to analyze LF structure when the primary and the secondary targets are considered to be fluctuating in terms of four Swerling models. Closed-form expression is derived for the processor performance. Superiority of the LF algorithm over the conventional ones in multi-target scenarios is verified by numerical simulation. Additionally, the LF ideal performance outperforms that of Neyman-Pearson (N-P) detector, which is the basic reference in the CFAR world. Moreover, the LF detector mitigates the impact of outlying targets and has the capability of holding the rate of false alarm stationary en face of outliers.

Keywords: adaptive detection, non-coherent integration, fluctuating targets, swerling models, target multiplicity environments.

I. Introduction

Radar systems are widely used for safety purposes. For case in point, they are utilized at airports to safely regulate the air traffic and in a military context, they are employed to defend against hostile missiles. The mission of the radar is to detect targets of interest and to discard those that don't concern a particular application.

Depending on the type of radar application, the system might be concerned with estimating the target radar cross section (RCS), measuring and tracking its position or velocity, imaging it, or providing fire control data to direct weapons to the target. In all of these practical applications, one of the most fundamental tasks of a radar is the detection; the process of examining the radar data and determining if it represents interference only, or interference plus echoes from a target of interest (ToI) [1-5].

The detection capability is one of the most significant factors in the behavior of such type of vital systems. Normally, the purpose of detection is to distinguish genuine target reflections from noise and clutter. More specifically, target detection can be regarded as a style of classification, which distinguishes whether the tested signal contains an echo from a target or just corresponds to the noise. This process relies on the thresholding criteria. This criteria has two philosophies: fixed and adaptive. Although the fixed threshold is simple in design, it has a misdetection and this procedure deprives the system from its ability to control the false alarm rate. This strategy of detection is useful for non-fluctuating targets of identical reflection models but fails when a mixture of different targets exists in radar's field of view (FoV). Therefore, variable threshold will be needed to cover such scenarios. For this reason, adaptive detection thresholds have been the subject of research for a long time. In other words, there is a demand for a detection process that is based on dynamic, instead of static, threshold to cope with those situations of inhomogeneous or changing clutter environment all over the search space. This is the objective of the second philosophy. Constant false alarm rate (CFAR) technology is the most popular target detection framework to address the issues associated with fixed threshold. This technology is crucial as a desired property for automatic target detection in an unknown and non-stationary background. In other words, CFAR is a property that is assigned to the processor in which the threshold, or gain control devices, guarantees an approximately constant rate of false target detection when the noise/clutter level temporally varies. The feature of CFAR activates the threshold in such a way that it becomes adaptive to the local clutter environment. Thus, the CFAR mechanism maintains the amount of false alarm under supervision in a diverse background of interference. It should be taken into account that this approach doesn't come at no cost.

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In radar applications which necessitate precision strikes for reduced risk and cost efficient operation with minimum possible guarantee damage, besides radar size, computation cost is major issue. The increased performance of the detection algorithm demands an increase in computation speed and device memory for every scan. Therefore, a trade-off between performance and cost has to be made [6-10].

A robust detector should not only find targets but also eliminate false alarms. Therefore, the general objective of all radar detection schemes is to ensure that false alarms don't fluctuate randomly. During the detection process, each cell is evaluated for the presence/absence of a target using a threshold. It is beneficial to be able to detect both high- and low-fidelity targets while maintaining constant false alarm rate. This is actually the function of the adaptive thresholding algorithm which most modern radar systems apply it in their detection process. Although there exists a large number of versions of CFAR circuits, cell-averaging (CA), order-statistics (OS), and trimmed-mean (TM) scenarios remain the most popular and well-understood techniques. In many cases, a single CFAR processor can hardly meet the complex radar operation environment. Thus, the concept of composite CFAR designing was introduced, to account for both homogeneous and heterogeneous situations. Based on this concept, fusion of particular decisions of the single CFAR detectors by appropriate fusion rules provides a better final detection. In this regard, the linear fusion (LF) approach is based on the parallel operation of the CA, OS, and TM types of CFAR techniques. However, the computational complexity may prevent the use of these more robust algorithms in favor of simple thresholding techniques, especially in automotive applications. Nevertheless, with the increasing prospect of reduction in hardware cost and availability of high-speed processors, the drift to high-performance algorithms is inevitable [11-15].

The behavior of the target detection processor can be significantly enhanced with the availability of the statistical characteristics of a target's radar cross-section (RCS). To achieve such interesting objective, Swerling proposed five models (SWI-SWV), to describe the RCS statistical properties, for practical objects, based on χ^2-distribution with varying degrees of freedom. In SWI model, the target reflections in a single scan have a constant RCS magnitude (perfectly correlated), but it varies from scan-to-scan obeying χ^2-probability density function (PDF) with two-degrees of freedom. For SWII model, the PDF of RCS is the same as in SWI with the exception that it is independent from pulse-to-pulse instead of scan-to-scan. Because some objects have a dominant scatterer, SWIII mod uses a fourth-degree χ^2-statistics to model the returned pulses. This model has the same characteristics as SWI style which has constant magnitude from pulse-to-pulse, but different from scan-to-scan. The RCS, in SWIII template, has the same description as SWI form with the difference that its PDF follows χ^2-statistics with four-degrees of freedom. The RCS, in SWIV pattern, varies from pulse-to-pulse, instead of scan-to-scan, with the same PDF of SWIII model. Finally, SWV mode is characterized by constant and perfectly correlated, from pulse-to-pulse and from scan-to-scan, echo pulses which corresponds to infinite degrees of freedom [10, 13].

Our goal in this paper is to analyze LF-CFAR structure when this strategy uses non-coherent integration of M pulses to carry out its decision. The primary and the secondary outlying targets are assumed to be fluctuating in terms of four Swerling models s (SWI-SWIV). Closed-form expression is derived for its performance in the absence as well as in the presence of interferers. A comparison of the tested scheme with its basic variants along with Neyman-Pearson (N-P) detector is also portrayed. The paper proceeds as follows. Section II formulates the problem of interest. The detection performance of the tested methodology along with its fundamental variants is analyzed in section III. Section IV portrays our numerical results to evaluate the accuracy of the theoretical derivation and substantiate the effectiveness of the proposed schemes. Finally, our useful conclusions are drawn in section V.

II. Statistical Background and Model Description

The basic demands of the limited warfare of the present era necessitate precision strikes of reduced risk and cost efficient operation with minimum possible guarantee damage. In order to reply such exact challenges, the capability of automatic detection is increasingly becoming more important to the defense community. Automatic detection can be achieved by setting a fixed threshold based on the interference power level. This construction operates with predictable performance if the interference belongs only to thermal noise. However, the ideality of operating environment of radar systems is scarcely verified. Therefore, technology of adaptation is of primary concern in the design of their future scenarios [15-16].

The ability of a weak echo detection by the radar receiver is limited by the noise energy that occupies the same spectrum as the signal. From this point of view, the process of detection is based on establishing a threshold level at the output of the receiver. This threshold must be adjusted in such a way that weak signals are detected, but not so low that allows noise peaks to cross it and give a false target. Thus, the proper threshold selection is dependent upon how important it is if a mistake is occurred because of failing to recognize a signal (miss probability) or falsely indicating the presence of a signal (false alarm probability). On the other hand, to cope with a changing clutter environment, there is a persistent need of dynamic and adaptive threshold. This threshold must be varied, up and down, in accordance with the background level for the false alarm rate to be maintained at its pre-set value. A detector with this characteristic is designated as constant CFAR. Thus, the CFAR strategy is the main goal of the radar system designer.

For the CFAR circuit to be efficient, it must realize some characteristics. The more motivating features include rigorous fitting of the detection threshold to the clutter background, masking avoidance of closely spaced targets, low CFAR loss, and constructing a threshold that gives point as well as extended targets the chance to pass. Whatever the structure of the CFAR model is, the framework of sliding window is regarded as its basic arrangement. As Fig.(1) depicts, this window moves throughout the coverage area, and contains a set of reference cells (RC's) around the central cell, which is termed as cell under test (CUT). To alleviate self-interference in a real target echo, some guard cells (GCs) embrace CUT. These cells are used as buffer between CUT and the training cells. They are excluded from the background computation to insure that the CUT doesn't affect the threshold calculation. The declaration of the presence of a target is carried out if the power of CUT is greater than the power of both GCs and the estimated level. Each resolution cell has the chance to occupy the position of CUT. In this regard, the RC's that have been already processed constitute the leading subset, whilst those that have not yet occupied the center organize the lagging subset. The size selection of the sliding window is dependent upon rugged knowledge of the typical clutter background. Generally, the window length *N* should be as large as possible for the estimation process to be of good modality. Meanwhile, *N* is preferred to be compatible with the typical range extension of homogeneous clutter zones for the demand of identically distributed random variables to be statistically satisfied. Normally, the typical value of *N* lies in the 16-32 range.

The detection threshold is established as the product of the estimated noise power *Z* by a scaling factor *T*, which is imposed to verify the desired rate of false alarm, as Fig.(1) portrays. By comparing the content of CUT with the resulting threshold, the procedure will recommend that the signal is belonging to a target, if the magnitude of the CUT surpasses the calculated threshold. Otherwise, the signal is coming from interference and no target is present.

Most modern radar systems are of coherent type. This means that they receive the returned signal in a polar (amplitude and phase) form. In the radar receiver, the synchronous detector generates an in-phase (I) and a quadrature (Q) components from the received signal. Whilst the in-phase component denotes the real part, the quadrature component represents the imaginary part of the received signal. Under the null hypothesis (H_0), the received noise for both I and Q channels is modeled as an independent and identically distributed (IID) Gaussian random process with zero mean and of variance ψ/2. In addition, I and Q channels are statistically independent. Thus, the received noise is a complex Gaussian signal ($\mathbb{N}=I+iQ$) with $\mu=0$ and $\sigma_n^2=\psi$.

After pulse compression, the signal passes through a rectifier, which converts the complex signal into an amplitude and phase. In this vein, there are two familiar types of rectifiers: linear and square-law detectors. The linear detector measures only the magnitude $(I^2+Q^2)^{½}$ of the complex received signal, which follows the Rayleigh distribution. The square-law detector, on the other hand, measures only the power (I^2+Q^2) of the linear detector, the distribution of which is exponential. For both types, the phase is uniformly distributed in the interval $[-\pi, \pi]$ [17].

a) Neymann - Pearson Detector

The Neyman-Pearson (N-P) processor operates with a detection threshold which is imposed in such a way that for a desired rate of false alarm, the level of detection will be maximized. This threshold is fixed and is derived from a known interference PDF. Practically, the using of N-P detector necessitates: 1) the background interference is IID over all resolution cells, to which the fixed threshold is to be applied, 2) the interference is of statistical distribution the parameters of which are known, 3) the interference environment is homogenous.

Generally, the detection process is achieved at the output of the rectifier and yields one of three possible outcomes: correct decision, missed detection, or false alarm. A correct decision is one in which the detector correctly declares the presence/absence of a target. A missed detection is one in which the detector declares the absence of a target when in truth the measurement contains a target return. A false alarm occurs when the detector declares the presence of a target and in reality a target's return is not present in the measured data. Whilst the first outcome is specified by P_d, the second one represents its complement (1 - P_d). Therefore, P_d plays an important role in determining the first two outcomes. The last outcome is characterized by P_{fa}. Thus, once P_d and P_{fa} are calculated, the processor performance is completely evaluated.

Here, we are concerned with square-law type of signal rectifiers. Thus, as we have noted above, the square-law detected output for any range cell (v_0) has an exponential distribution, the general formulation of which is:

$$p_{v_0}(\nu) = \frac{1}{\eta} \exp\left(-\frac{\nu}{\eta}\right) U(\nu) \tag{1}$$

In the above expression, U(.) stands for the unit-step function. The value of η depends on the situation of operation and can take one of the following values:

$$\eta \triangleq \begin{cases} \psi & for & Clear\ Background \\ \psi(1+\gamma) & for & Object\ Under\ Test \\ \psi(1+\vartheta) & for & Spurious\ Background \end{cases} \tag{2}$$

In the preceding formula, "γ" denotes the signal-to-noise ratio (SNR) of the ToI return, whereas "θ" symbolizes the interference-to-noise ratio (INR) of the interfering target return, and "ψ" represents the background noise power.

Since the target returns and interference are of the stochastic nature, the performance of a signal's detector is characterized in terms of probabilities. For N-P procedure, these probabilities take the form [9]:

$$P_s = \int_{Tr}^{\infty} \frac{1}{\eta} \exp\left(-\frac{\nu}{\eta}\right) d\nu = 1 - F_{v_0}(Tr) = \begin{cases} P_{fa} & if & \eta = \psi \\ P_d & if & \eta = \psi(1+\gamma) \end{cases} \tag{3}$$

It may be rarely that a decision is made on the basis of a single transmitted pulse. More often, a lot of pulses are transmitted, and the resulting received signal is integrated or processed in some way to enhance, relative to the mono-pulse case, the SNR. In this regard, to detect the target signal with some reasonable probability and to reject noise, the signal must be more strengthened than the noise. For M-pulses, the range cell (v_0) has a PDF given by [.]:

$$p_{v_0}(\nu) = \left(\frac{1}{\eta}\right)^M \frac{\nu^{M-1}}{(M-1)!} \exp\left(-\frac{\nu}{\eta}\right) U(\nu) \tag{4}$$

The cumulative distribution function (CDF) corresponding to the PDF of Eq.(4) has a form given by:

$$F_{v_0}(\nu) = 1 - \sum_{\ell=0}^{M-1} \frac{(\nu/\eta)^{\ell}}{\ell!} \exp\left(-\frac{\nu}{\eta}\right) U(\nu) \tag{5}$$

In radar systems, detection performance is always related to target models and background environments. Thus, the availability of the statistical characteristics of a target's radar cross-section (RCS) can significantly ameliorate the performance of the detection algorithm. For this purpose, Swerling introduced five models (SWI-SWV), to describsse the RCS statistical properties of the objects based on χ^2-distributionss of varying degrees of freedom. For κ^{th} degree of freedom χ^2 fluctuating target, the PDF of the target return is given by [9]:

$$p_{v_0}(\nu/\bar{\gamma}) = \left(\frac{\kappa}{\bar{\gamma}+\kappa}\right)^{\kappa} {}_1F_1\left(\kappa; M; \frac{\bar{\gamma}}{\bar{\gamma}+\kappa}\nu\right) \frac{\nu^{M-1}}{(M-1)!} e^{-\nu} U(\nu) \tag{6}$$

${}_1F_1(.)$ stands for the confluent hyper-geometric function and $\bar{\gamma}$ denotes the average M-pulse SNR. The calculation of the CDF associated with this PDF yields:

$$F_{v_0}(\nu) = \zeta^{\kappa} \sum_{j=0}^{\infty} \frac{(\kappa)_j}{j!} (1-\zeta)^j \left\{1 - \sum_{\ell=0}^{M+j-1} \frac{\nu^{\ell}}{\ell!} e^{-\nu}\right\} \quad \& \quad \zeta \triangleq \frac{\kappa}{\bar{\gamma}+\kappa} \tag{7}$$

with

$$\kappa = \begin{cases} 1 & for & SWI \\ M & for & SWII \\ 2 & for & SWIII \\ 2M & for & SWIV \\ \infty & for & SWV \end{cases} \tag{8}$$

and

$$(\kappa)_j \triangleq \frac{\Gamma(\kappa + j)}{\Gamma(\kappa)} = \begin{cases} 1 & if \quad j=0 \\ \kappa(\kappa+1)(\kappa+1)\ldots\ldots\ldots(\kappa+j-1) & if \quad j>0 \end{cases} \tag{9}$$

The substitution of Eq.(7) into Eq.(3) and using the values indicated in Eq.(8), the N-P performance can be easily obtained for fluctuating targets of different Swerling's models.

b) Constant False Alarm Rate (CFAR) Detector

CFAR detectors are designed to track changes in the interference and to adjust the detection threshold to maintain a constant probability of false alarm. Since the performance of a detection scheme is measured by evaluating the probability of detection and the probability of false alarm, our strategy in analyzing a CFAR variant is to calculate its detection probability which is given by:

$$P_d \triangleq \Pr\left(Z\langle \frac{\nu_0}{T} \Big/ H_1\right) = \int_0^\infty p_{\nu_0}(x) \int_0^{\nu_0/T} p_Z(y)\; dy\; dx = T \int_0^\infty p_{\nu_0}(T\nu)\; F_Z(\nu)\; d\nu \tag{10}$$

$F_Z(.)$ denotes the CDF of the noise power level estimate and *T* is a thresholding constant required to guarantee the designed rate of false alarm. In terms of the Laplace transformation, Eq.(10) takes the form:

$$P_d = T\; \Phi_g(\Omega)\Big|_{\Omega=0} \quad with \quad \Phi_g(\Omega) \triangleq \int_0^\infty p_{\nu_0}(T\nu)\; F_Z(\nu)\; \exp(-\Omega\nu)\; d\nu \tag{11}$$

With the aid of convolution theorem, Eq.(11) can be put in another form as:

$$\Phi_g(\Omega) = \frac{1}{T}\; M_{\nu_0}(\Omega/T) * \Theta_Z(\Omega) \tag{12}$$

In the above formula, $M_x(.)$ represents the moment generating function (MGF) of the random variable (RV) x, $\Theta_Z(.)$ denotes the Laplace transformation of the CDF of the RV Z, and the symbol "*" stands for the convolution process. By using Eq.(12), Eq.(10) can be written as:

$$P_d = \frac{1}{2\pi j} \oint_{C^-} M_{\nu_0}(\omega/T)\; \Theta_Z(\Omega-\omega)\; d\omega\Big|_{\Omega=0} \tag{13}$$

The contour of integration C^- consists of a vertical path in the complex ω-plane crossing the negative real axis at the rightmost negative real axis singularity of $M_{\nu 0}(.)$ and closed in an infinite semicircle in the left half plane.

Eq.(13) demonstrates that the MGF of ν_0, the content of the CUT, plays an important role in determining the processor detection performance. Let's go to calculate this interesting parameter for the Swerling's models of fluctuating targets.

For mono-pulse application and when a non-fluctuating target return-plus-noise represents the content of the CUT, the output of this cell has a PDF given by [11]:

$$p_{\nu_0}(\nu) = \frac{1}{\psi} \exp\left(-\frac{\nu+\delta}{\psi}\right)\; I_0\left(2\frac{\sqrt{\delta\nu}}{\psi}\right)\; U(\nu) \tag{14}$$

δ denotes the signal power, ψ is the noise power, δ/ψ represents the SNR at the square-law detector input and $I_0(.)$ stands for the modified Bessel function of type 1 and of order 0. Since the single pulse case is infrequently used, the M-pulses form of Eq.(14) is preferable. After integrating M pulses, the new form of Eq.(14) becomes [9]:

$$p_{\nu_0}(\nu) = \frac{1}{\psi} \left(\frac{\nu}{\delta}\right)^{\frac{M-1}{2}} \exp\left(-\frac{\nu+\delta}{\psi}\right)\; I_{M-1}\left(2\frac{\sqrt{\delta\nu}}{\psi}\right)\; U(\nu) \tag{15}$$

The MGF associated with the PDF of Eq.(15) can be easily evaluated and the result yields:

$$M_{v_0}(\Omega/\delta) = \left(\frac{1}{\psi\,\Omega+1}\right)^{M} \exp\left(-\frac{\delta\,\Omega}{\psi\,\Omega+1}\right) \tag{16}$$

The unconditional MGF can be obtained by averaging the above formula over the target fluctuation distribution of δ. For χ^2 family of target fluctuation models, the RV δ is characterized by a PDF given by [18]

$$p_{\delta}(\delta/\bar{\delta}) = \frac{1}{\Gamma(\kappa)} \left(\frac{\kappa}{\bar{\delta}}\right)^{\kappa} \delta^{\kappa-1} \exp\left(-\kappa\frac{\delta}{\bar{\delta}}\right) U(\delta) \tag{17}$$

The unconditional MGF is then extracted by calculating the average value of Eq.(16) given the PDF of Eq.(17). Thus, we have

$$M_{v_0}(\Omega) = \int_0^{\infty} M_{v_0}(\Omega/\delta)\, p_{\delta}(\delta/\bar{\delta})\; d\delta = \left(\frac{1}{\psi\,\Omega+1}\right)^{M-\kappa} \left(\frac{1}{\alpha\,\Omega+1}\right)^{\kappa} \;\&\; \alpha \triangleq \psi\left(1+\frac{\bar{\delta}/\psi}{\kappa}\right) \tag{18}$$

Eq.(18) is the fundamental formula from the Swerling's models can be derived as special cases.

Swerling I Model (SWI)

As Eq.(8) indicates, this model is characterized by κ=1. Replacing κ by 1 in Eq.(18) yields:

$$M_{v_0}(\Omega) = \left(\frac{1/\psi}{\Omega+1/\psi}\right)^{M-1} \left(\frac{1/\alpha}{\Omega+1/\alpha}\right) \;\&\; \alpha \triangleq \psi\left(1+\bar{\delta}/\psi\right) = \psi\,(1+\gamma) \tag{19}$$

In the above expression, γ denotes the average per pulse SNR. The substitution of this MGF into Eq.(13) results:

$$P_d = \frac{T}{\alpha}\left(\frac{1/\psi}{1/\psi-1/\alpha}\right)^{M-1} \Theta_Z\left(\frac{T}{\alpha}\right) + \left(\frac{T}{\psi}\right)^{M-1} \left\{ \frac{T/\alpha}{\Gamma(M-1)} \frac{d^{M-2}}{d\,\Omega^{M-2}}\left[\left(\frac{1}{\Omega+T/\alpha}\right)\Theta_Z(-\Omega)\right]\Bigg|_{\Omega=-\frac{T}{\psi}} \right\} \tag{20}$$

Swerling II Model (SWII)

This model of target fluctuation has an M[th] degree of freedom. Setting κ=M in Eq.(18) leads to:

$$M_{v_0}(\Omega) = \left(\frac{1/\alpha}{\Omega+1/\alpha}\right)^{M} \;\&\; \alpha \triangleq \psi\left(1+\frac{\bar{\delta}/\psi}{M}\right) = \psi\,(1+\gamma) \tag{21}$$

γ denotes the average, over M pulses, SNR. In this case, the processor detection performance is given by:

$$P_d = \frac{(T/\alpha)^M}{\Gamma(M)} \frac{d^{M-1}}{d\,\Omega^{M-1}}\Theta_Z(-\Omega)\Bigg|_{\Omega=-\frac{T}{\alpha}} \tag{22}$$

Swerling III Model (SWIII)

This model of target fluctuation is characterized by κ=2 in the MGF of the CUT. In this situation, the MGF of the concerned cell becomes:

$$M_{v_0}(\Omega) = \left(\frac{1/\psi}{\Omega+1/\psi}\right)^{M-2} \left(\frac{1/\alpha}{\Omega+1/\alpha}\right)^{2} \;\&\; \alpha \triangleq \psi\left(1+\frac{\bar{\delta}/\psi}{2}\right) = \psi\,(1+\gamma) \tag{23}$$

The probability of detection of SWIII target fluctuation model will be:

$$P_d = \left(\frac{T}{\alpha}\right)^2 \left(\frac{T}{\psi}\right)^{M-2} \left\{ \frac{d}{d\Omega}\left[\left(\frac{1}{\Omega + T/\psi}\right)^{M-2} \Theta_Z(-\Omega)\right]\Bigg|_{\Omega=-T/\alpha} + \frac{1}{\Gamma(M-2)}\frac{d^{M-3}}{d\Omega^{M-3}}\left[\left(\frac{1}{\Omega + T/\alpha}\right)^2 \Theta_Z(-\Omega)\right]\Bigg|_{\Omega=-T/\psi} \right\} \tag{24}$$

Swerling IV Model (SWIV)

This case of target fluctuation has $(2M)^{th}$ degrees of freedom. Thus, the substitution of κ=2M in Eq.(18) yields:

$$M_{\nu_0}(\Omega) = \left(\frac{1/\psi}{\Omega + 1/\psi}\right)^{-M} \left(\frac{1/\alpha}{\Omega + 1/\alpha}\right)^{2M} \quad \& \quad \alpha \triangleq \psi\left(1 + \frac{\bar{\delta}/\psi}{2M}\right) = \psi(1+\gamma) \tag{25}$$

Eq.(25), as a MGF, in the definition of P_d gives the processor detection performance which has a mathematical form given by:

$$P_d = \left(\frac{T}{\alpha}\right)^{2M} \left(\frac{T}{\psi}\right)^{-M} \frac{1}{\Gamma(2M)} \frac{d^{2M-1}}{d\Omega^{2M-1}}\left\{\left(\frac{1}{\Omega + T/\psi}\right)^{-M} \Theta_Z(-\Omega)\right\}\Bigg|_{\Omega=-T/\alpha} \tag{26}$$

In all cases, the false alarm probability takes a unified form; the mathematical version of which is:

$$P_{fa} = \left(\frac{T}{\psi}\right)^{M} \frac{1}{\Gamma(M)} \frac{d^{M-1}}{d\Omega^{M-1}}\left\{\Theta_Z(-\Omega)\right\}\Big|_{\Omega=-T/\psi} \tag{27}$$

Since enhancing detection performance of a CFAR variant is a basic requirement in evolving radar systems, we choose the recent version of CFAR detectors to fulfill this objective. It is intuitive that as P_d increases, the missed detection decreases and consequently, the processor performance will be enhanced. The upcoming section is devoted to evaluate the performance of the linear fusion (LF) strategy to have a knowledge about its reaction against fluctuating targets of Swerling models.

By careful examining the previous derived formulas, it is evident that they rely on the Laplace transformation of the CDF of the noise power level estimate Z and its mathematical differentiation. Therefore, we are focused on formulating this transformation when the detection scheme operates in an environment that has several outlying targets along with the main one (ToI).

III. Processor Performance Analysis

Specifically, the efficiency of a CFAR scheme is measured in the perfect case of operating conditions or in the presence of some of fallacious targets beside the ToI. Since the ideal situation is a special case of non-ideal operation, it is preferable to analyze the processor performance in heterogeneous background. This is actually the case that we are going to follow in the upcoming subsections.

a) *Single Adaptive Processors*

i. *Ordered-Statistics (OS)*

This procedure of CFAR technology performs robustly in both inhomogeneous clutter and target multiplicity situations. It extracts the K^{th} largest sample from the candidates of the reference window to represent the estimate of the unknown noise power. To carry out such extraction, it ranks the reference cells in an ascending order, in such a way that:

$$y_{(\ell)} \le y_{(\ell+1)} \quad \& \quad \ell = 1,2,\ldots\ldots\ldots, N-1 \tag{28}$$

In this ranked samples, $y_{(1)}$ denotes the lowest noise level whilsst $y_{(N)}$ represents the highest one. After the rank order, we plan to pick the sample of K^{th} level to constitute the unknown noise level in the reference window. Thus, the OS test-statistic takes the form:

$$Z_{OS} \triangleq y_{(K)} \quad \& \quad 1 \le K \le N \tag{29}$$

Aiming at evaluating the performance of the OS algorithm, this necessitates the PDF calculation of the K[th] ordered sample in the case where the samples are independent, but not identically distributed. To accomplish such objective, let us consider that the reference window has "R" cells that contain outlying target returns each with power level $\psi(1+\vartheta)$ and the remaining, "N – R" ones having thermal noise only with power level ψ. In both cases, the observations are governed by the exponential PDF and are statistically independent quantities. Taking these assumptions into account, the cumulative distribution function (CDF) of the K[th] ordered cell is given by [19]:

$$F_K^{NH}(t;N,R) = \sum_{i=K}^{N} \sum_{j=Max(0,i-R)}^{Min(i,N-R)} \binom{N-R}{j} \binom{R}{i-j} \sum_{n=0}^{j} \binom{j}{n} (-1)^n \sum_{m=0}^{i-j} \binom{i-j}{m} (-1)^m \{1-F_C(t)\}^{N-R-n} \{1-F_I(t)\}^{R-m} \quad (30)$$

In the above expression, $F_C(.)$ represents the CDF of the cell that contains clutter background whilst $F_I(.)$ denotes the same thing for the cell that has interfering target return. The random variable (RV's) representing the returns from clutter background has MGF of the same form as that given in Eq.(18) after nullifying α. By using the resulting form of that equation, the Laplace transformation of $F_c(.)$ becomes:

$$\Psi_C(\Omega) = (\Omega+1)^{-M} / \Omega \quad (31)$$

The Laplace inverse of the above formula yields:

$$F_C(t) = 1 - \sum_{\ell=0}^{M-1} \frac{t^{\ell}}{\Gamma(\ell+1)} e^{-t} U(t) \quad (32)$$

For the interference case, there are two situations:

a. χ^2 fluctuation with 4-degrees of freedom: if the interfering target fluctuates following this statistical type, $F_I(.)$ has a form given by [12]:

$$F_I(t) = L^{-1}\left\{ \frac{1}{\Omega} \prod_{i=1}^{M} \varepsilon_i^2 \frac{\Omega+1}{(\Omega+\varepsilon_i)^2} \right\} = 1 - \sum_{\ell=1}^{M} (\zeta_\ell + t\,\xi_\ell) e^{-\varepsilon_\ell t} U(t) \quad , \quad \varepsilon_\ell \triangleq \frac{1}{1+\vartheta\lambda_\ell/2} \quad (33)$$

Where

$$\zeta_j \triangleq \varepsilon_j (1-\varepsilon_j)^M \prod_{\substack{i=1 \\ i\neq j}}^{M} \left(\frac{\varepsilon_i}{\varepsilon_i - \varepsilon_j} \right)^2 \left\{ \frac{M}{1-\varepsilon_j} + \frac{1}{\varepsilon_j} - \sum_{\substack{\ell=1 \\ \ell\neq j}}^{M} \frac{2}{\varepsilon_\ell - \varepsilon_j} \right\} \quad (34)$$

and

$$\xi_j \triangleq \varepsilon_j (1-\varepsilon_j) \prod_{\substack{k=1 \\ k\neq j}}^{M} \varepsilon_k^2 \frac{1-\varepsilon_j}{(\varepsilon_k - \varepsilon_j)^2} \quad (35)$$

The substitution of Eqs.(32 & 33) into Eq.(30) leads to:

$$F_K^{NH}(t;N,R) = \sum_{i=K}^{N} \sum_{j=\max(0,i-R)}^{\min(i,N-R)} \binom{N-R}{j} \binom{R}{i-j} \sum_{k=0}^{j} \sum_{\ell=0}^{i-j} \binom{j}{k} \binom{i-j}{\ell} (-1)^{i-k-\ell} \left\{ \sum_{m=0}^{M-1} \frac{t^m}{\Gamma(m+1)} e^{-t} \right\}^{N-R-k} \left\{ \sum_{n=1}^{M} (\zeta_n + t\,\xi_n) e^{-\varepsilon_n t} \right\}^{R-\ell} \quad (36)$$

By using binomial theorem, we can expand the bracketed quantities as a binomial of t. This expansion results in reformatting Eq. (36) as:

$$F_K^{NH}(t;N,R) = \sum_{i=K}^{N} \sum_{j=\max(0,i-R)}^{\min(i,N-R)} \binom{N-R}{j} \binom{R}{i-j} \sum_{\kappa=0}^{j} \sum_{\ell=0}^{i-j} \binom{j}{\kappa} \binom{i-j}{\ell} (-1)^{i-\kappa-\ell} \sum_{\alpha_0=0}^{N-R-\kappa} \sum_{\alpha_1=0}^{N-R-\kappa} \cdots\cdots \sum_{\alpha_{M-1}=0}^{N-R-\kappa}$$
$$\frac{\Psi(N-R-\kappa;\alpha_0,\ldots,\alpha_{M-1})}{\prod_{\nu=0}^{M-1}[\Gamma(\nu+1)]^{\alpha_\nu}} \sum_{\mu=0}^{R-\ell} \binom{R-\ell}{\mu} \sum_{\sigma_1=0}^{\mu} \sum_{\sigma_2=0}^{\mu} \cdots\cdots \sum_{\sigma_M=0}^{\mu} \Psi(\mu,\sigma_1,\sigma_2,\ldots,\sigma_M) \sum_{\eta_1=0}^{R-\ell-\mu} \sum_{\eta_2=0}^{R-\ell-\mu} \cdots\cdots \sum_{\eta_M=0}^{R-\ell-\mu} \tag{37}$$
$$\Psi(R-\ell-\mu,\eta_1,\eta_2,\ldots,\eta_M) \prod_{\lambda=1}^{M} \left(\zeta_\lambda^{\sigma_\lambda} \xi_\lambda^{\eta_\lambda}\right) t^{\left(R-\ell-\mu+\sum_{\beta=0}^{M-1}\beta\alpha_\beta\right)} \exp\left(-\left(N-R-\kappa+\sum_{n=1}^{M}(\sigma_n+\eta_n)\varepsilon_n\right)t\right)$$

The Laplace transformation of Eq. (37) gives:

$$\Theta_K^{NH}(\Omega;N,R) = \sum_{i=K}^{N} \sum_{j=\max(0,i-R)}^{\min(i,N-R)} \binom{N-R}{j} \binom{R}{i-j} \sum_{\kappa=0}^{j} \sum_{\ell=0}^{i-j} \binom{j}{\kappa} \binom{i-j}{\ell} (-1)^{i-\kappa-\ell} \sum_{\alpha_0=0}^{N-R-\kappa} \sum_{\alpha_1=0}^{N-R-\kappa} \cdots\cdots \sum_{\alpha_{M-1}=0}^{N-R-\kappa}$$
$$\frac{\Psi(N-R-\kappa;\alpha_0,\ldots,\alpha_{M-1})}{\prod_{\nu=0}^{M-1}[\Gamma(\nu+1)]^{\alpha_\nu}} \sum_{\mu=0}^{R-\ell} \binom{R-\ell}{\mu} \sum_{\sigma_1=0}^{\mu} \sum_{\sigma_2=0}^{\mu} \cdots\cdots \sum_{\sigma_M=0}^{\mu} \Psi(\mu,\sigma_1,\sigma_2,\ldots,\sigma_M) \sum_{\eta_1=0}^{R-\ell-\mu} \sum_{\eta_2=0}^{R-\ell-\mu} \cdots\cdots \sum_{\eta_M=0}^{R-\ell-\mu} \tag{38}$$
$$\Psi(R-\ell-\mu,\eta_1,\eta_2,\ldots,\eta_M) \prod_{\lambda=1}^{M} \left(\zeta_\lambda^{\sigma_\lambda} \xi_\lambda^{\eta_\lambda}\right) \frac{\Gamma\left(R-\ell-\mu+\sum_{\beta=0}^{M-1}\beta\alpha_\beta+1\right)}{\left(\Omega+N-R-\kappa+\sum_{n=1}^{M}(\sigma_n+\eta_n)\varepsilon_n\right)^{\left(R-\ell-\mu+\sum_{\beta=0}^{M-1}\beta\alpha_\beta+1\right)}}$$

In the previous formulas, the term $\Psi(J; j_1, j_2, \ldots, j_M)$ is defined as [20]:s

$$\Psi(J; j_1, j_2, \ldots, j_M) \triangleq \begin{cases} \dfrac{\Gamma(J+1)}{\prod_{i=1}^{M}\Gamma(j_i+1)} & \text{if} \quad \sum_{\lambda=1}^{M} j_\lambda = J \\ 0 & \text{if} \quad \sum_{\lambda=1}^{M} j_\lambda \neq J \end{cases} \tag{39}$$

b. χ^2_fluctuation with 2-degrees of freedom: Let us now return to the fluctuating target obeying χ^2_distribution with 2-degrees of freedom in its fluctuation. In this case, $F_I(.)$ is given by [19]:

$$F_I(t) = L^{-1}\left\{\frac{1}{\Omega}\prod_{\ell=1}^{M}\frac{\theta_\ell}{\Omega+\theta_\ell}\right\} \quad \& \quad \theta_\ell \triangleq \frac{1}{1+\vartheta\lambda_\ell} \tag{40}$$

y evaluating the Laplace inverse processing of the above formula, one obtains:

$$F_I(t) = 1 - \sum_{j=1}^{M} \varphi_j \exp(-\theta_j t)\, U(t) \quad \& \quad \varphi_j \triangleq \prod_{\substack{i=1 \\ i\neq j}}^{M} \frac{\theta_i}{\theta_i-\theta_j} \tag{41}$$

The substitution of Eqs.(32 & 41) into Eq.(30) yields:

$$F_K^{NH}(t;N,R) = \sum_{i=K}^{N} \sum_{j=\max(0,i-R)}^{\min(i,N-R)} \binom{N-R}{j} \binom{R}{i-j} \sum_{\lambda=0}^{j} \sum_{\ell=0}^{i-j} \binom{j}{\lambda} \binom{i-j}{\ell} (-1)^{i-\lambda-\ell} \left\{\sum_{m=0}^{M-1} \frac{t^m}{\Gamma(m+1)} e^{-t}\right\}^{N-R-\lambda} \left\{\sum_{n=1}^{M} \varphi_n e^{-\theta_n t}\right\}^{R-\ell} \tag{42}$$

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With the aid of binomial theorem, the bracketed quantities can be expanded as a binomial of t. Following this procedure of expansion, Eq.(42) can be rewritten as:

$$F_K^{NH}(t;N,R) = \sum_{i=K}^{N} \sum_{j=\max(0,i-R)}^{\min(i,N-R)} \binom{N-R}{j} \binom{R}{i-j} \sum_{\lambda=0}^{j} \binom{j}{\lambda} \sum_{\ell=0}^{i-j} \binom{i-j}{\ell} (-1)^{i-\lambda-\ell} \sum_{u_0=0}^{N-R-\lambda} \sum_{u_1=0}^{N-R-\lambda} \cdots\cdots \sum_{u_{M-1}=0}^{N-R-\lambda}$$
$$\frac{\Psi(N-R-\lambda;u_0,u_1,u_2,\ldots\ldots,u_{M-1})}{\prod_{\sigma=0}^{M-1}[\Gamma(\sigma+1)]^{u_\sigma}} \sum_{v_1=0}^{R-\ell} \sum_{v_2=0}^{R-\ell} \cdots\cdots \sum_{v_M=0}^{R-\ell} \Psi(R-\ell;v_1,v_2,\ldots\ldots,v_M) \prod_{\eta=1}^{M} (\varphi_\eta)^{v_\eta} \tag{43}$$
$$t^{\sum_{\tau=0}^{M-1}\tau u_\tau} \exp\left(-(N-R-\lambda+\sum_{n=1}^{M} v_n\theta_n)\, t\right)$$

The Laplace transformation of Eq.(43) results:

$$\Theta_K^{NH}(\Omega;N,R) = \sum_{i=K}^{N} \sum_{j=\max(0,i-R)}^{\min(i,N-R)} \binom{N-R}{j} \binom{R}{i-j} \sum_{\lambda=0}^{j} \binom{j}{\lambda} \sum_{\ell=0}^{i-j} \binom{i-j}{\ell} (-1)^{i-\lambda-\ell} \sum_{u_0=0}^{N-R-\lambda} \sum_{u_1=0}^{N-R-\lambda} \cdots\cdots \sum_{u_{M-1}=0}^{N-R-\lambda}$$
$$\frac{\Psi(N-R-\lambda;u_0,u_1,u_2,\ldots\ldots,u_{M-1})}{\prod_{\sigma=0}^{M-1}[\Gamma(\sigma+1)]^{u_\sigma}} \sum_{v_1=0}^{R-\ell} \sum_{v_2=0}^{R-\ell} \cdots\cdots \sum_{v_M=0}^{R-\ell} \Psi(R-\ell;v_1,v_2,\ldots\ldots,v_M) \prod_{\eta=1}^{M} (\varphi_\eta)^{v_\eta} \tag{44}$$
$$\frac{\Gamma\left(\sum_{\tau=0}^{M-1}\tau u_\tau+1\right)}{\left(\Omega+N-R-\lambda+\sum_{n=1}^{M} v_n\theta_n\right)^{\left(\sum_{\tau=0}^{M-1}\tau u_\tau+1\right)}}$$

Once Eqs. (38 & 44) are obtained, the false alarm and detection performances are completely evaluated, as Eqs.(20, 22, 24, 26, 27) demonstrate. The major drawback of this scheme is the high processing time that is taken in performing the sorting mechanism.

ii. *Trimmed-Mean (TM)*

The trimmed-mean (TM) algorithm is the more generalized version of the OS scheme. It may be considered as an amended version of the OS scenario. The motivation of using this algorithm is to combine the benefits of averaging and ordering along with censoring. In this scheme, the noise power is estimated by a linear combination of some selected ordered range samples. The linear combination may be anticipated to give better results because averaging estimates the noise power more efficiently as in the case of the CA processor and thus loss of detection in uniform background is more tolerable. In the TM-CFAR detector, the lowest L_1 ordered range samples and the highest L_2 ordered ones are excised before summing the remaining cells to formulate the statistic Z_{TM}. Thus,

$$Z_{TM}(L_1,L_2) \triangleq \sum_{\ell=L_1+1}^{N-L_2} y_{(\ell)} \tag{45}$$

Clearly, the ordered samples $y_{(i)}$'s are neither independent nor identically distributed, so the performance evaluation of TM scheme becomes cumbersome. To handle this evaluation, a new linear transformation is needed. In other words, the following transformation can be used to make the ordered samples $y_{(i)}$'s satisfy the IID property [18]. Mathematically, this transformation takes the form:

$$Y_\ell \triangleq y_{(L_1+\ell)} - y_{(L_1+\ell-1)}U(\ell-2) \tag{46}$$

As a function of these new variables Y_i's, Eq.(45) can be rewritten as:

$$Z_{TM}(L_1,L_2) = \sum_{j=1}^{L_T} (L_T - j + 1)\, Y_j \quad \& \quad L_T \triangleq N - L_1 - L_2 \tag{47}$$

In terms of the Ω-domain representation of the CDF of the ordered samples $y_{(i)}$'s, the MGF of the random variables Y_j's can be easily calculated as [12]:

$$M_{Y_j}(\Omega) = \begin{cases} \Omega\, \Theta_{L_1+1}^{NH}(\Omega;N,R) & \text{for} \quad j = 1 \\ \dfrac{\Theta_{L_1+j}^{NH}(\Omega;N,R)}{\Theta_{L_1+j-1}^{NH}(\Omega;N,R)} & \text{for} \quad 1 < j \le L_T \end{cases} \tag{48}$$

After obtaining the formula (48), the computation of the MGF of the noise level estimate Z_{TM} becomes an easy task owing to the independency of its samples. Thus,

$$M_{Z_{TM}}(\Omega;L_1,L_2) = \prod_{\ell=1}^{L_T} M_{Y_\ell}(\Omega)\Big|_{\Omega=(L_T-\ell+1)\Omega} \tag{49}$$

Though the TM-CFAR scheme offers good performance, the large processing time, which is taken in ordering the candidates of the reference window, limits its practical applications. This problem can be overcome by partitioning the reference window into Q, symmetrical or nonsymmetrical, smaller sub-windows. The samples in the each sub-window are processed and its statistic Z may be estimated according to a specified rule and the final statistic is chosen by further processing the Q sub-window outputs. Here, we apply this idea by symmetrically partitioned the reference window into preceding and succeeding sub-windows (*Q*=2). In this situation, suppose that the preceding subset has R_1 cells from outlying target returns, N/2-R_1 ones from thermal background, the lowest P_1 cells and the highest P_2 ones are censored from its ordered-statistic before adding the remaining cells to establish the background level of the preceding sub-window. Similarly, assume that the succeeding sub-window has R_2 cells of fallacious target returns, N/2-R_2 samples containing clutter, its associated ordered-statistic is trimmed from its ends, where the lowest S_1 ordered cells are excised and S_2 highest ranked cells are nullified. Under these circumstances, the MGF's of their noise power level estimates, Z_1 and Z_2, have the same form as that given by Eq.(49) after replacing its common parameters with their corresponding values for the preceding and succeeding subsets. Since the mean-level (ML) operation represents the simplest way that uses arithmetic averaging to extract the unknown noise power level, the two noise level estimates are combined through the ML operation to formulate the final noise power estimate. Mathematically, this can be expressed as:

$$Z_f = Mean(Z_1, Z_2) \tag{50}$$

Since the two noise level estimates are statistically independent, the final noise level estimate has a MGF given by:

$$M_{Z_f}(\Omega) = M_{Z_{TM}}(\Omega;P_1,P_2)\, M_{Z_{TM}}(\Omega;S_1,S_2) \tag{51}$$

As Eqs.(20, 22, 24, 26, 27) indicate that the probabilities of detection and false alarm are functions of the Laplace transformation of the CDF of the noise level estimate Z_f, it is necessary to compute such important parameter. As a function of the MGF of Z_f, its CDF has a Laplace transformation given by [21]:

$$\Theta_{Z_f}(\Omega) = M_{Z_f}(\Omega)\big/\Omega \tag{52}$$

Once the Ω-domain representation of the PDF of the resultant noise level estimate is formulated, the processor false alarm and detection performances can be completely evaluated, as we have proved in the previous section. It is of importance to note that the TM scenario reduces to the conventional CA and OS algorithms for specific trimming values. In other words, TM (0, 0) and TM (K-1, N-K) tend to the well-known CA and OS (K) processors, respectively; each handles N reference cells to estimate the unknown noise power level. Thus, for the conventional CA and OS (K) schemes, we have:

$$M_{Z_{CA}}(\Omega) = M_{Z_{TM}}(\Omega;0,0)\, M_{Z_{TM}}(\Omega;0,0) \tag{53}$$

and

$$M_{Z_{OS}}(\Omega) = M_{Z_{TM}}\left(\Omega;K_1-1,\frac{N}{2}-K_1\right) M_{Z_{TM}}\left(\Omega;K_2-1,\frac{N}{2}-K_2\right) \tag{54}$$

In Eq.(53), the noise levels extracted from the preceding and succeeding sub-windows of the OS scheme are:

$$Z_1 \triangleq y_{(K_1)} \;\&\; Z_2 \triangleq y_{(K_2)} \;,\; K_1, K_2 \in \left(1,2,......,\frac{N}{2}\right) \tag{55}$$

iii. *Cell-Averaging (CA)*

The CA is the king of the CFAR schemes that has the highest homogeneous performance, given that the clutter is exponentially distributed and the contents of the reference window are IID. It uses the maximum likelihood estimate of the noise power to set the adaptive threshold. The CA performs the traditional averaging technique by dividing the summing of the contents of the reference cells by their number. Commonly, it is regarded as the reference model against which new implementations are compared. Nevertheless, it exhibits a weak behavior against heterogeneous background which are frequently created by clutter edges and the appearance of multiple target situations. If one or more spurious targets fall within the reference window, the probability of losing the targets will be increased owing to the severe phenomenon of target masking.

Since CA is a special case of TM scheme, we can exploit the analysis of the TM variant to evaluate the performance of the CA detector, where all of its ordered samples are activated. Thus, under the same conditions of the double-window TM scenario, the MGF of the double-window CA processor is given by Eq.(53).

b) *Combined CFAR Schemes*

i. *Linear Fusion (LF) Emerged Strategy*

A robust detector should not only pick out targets but also diminish false alarms. For target detection in complex background, it is difficult to realize high level of detection simultaneously with holding low rate of false alarm. Therefore, an effective detector dictates an incorporation of different features in such a way that each aspect resolves one of the challenges that enface the detection characteristics. In other words, an architecture involving decentralized processing at multiple sensor locations provides the proper choice of optimum results in heterogeneous situation. From this point of view, the fusion strategy has rapidly become a methodology of choice for detecting fluctuating targets. Such establishment involves higher reliability and survivability, along with improved system performance at low latency. In this scenario of CFAR technology, a Fig.(1) portrays the detailed architecture of such developed model. In this layout, there are three individual arms in accordance with the standard detectors. Depending on the required rate of false alarm, the detection threshold along with the signal strength of the CUT of each local scheme is used to reach the final decision about the presence/absence of the target under research. According to the appropriate fusion rule, the three local decisions are simultaneously mixed in the fusion center to establish the final decision. As the circuit of Fig.(1) depicts, the potential outputs of fusion CA_OS_TM strategy are summarized in Table I. Since the CA scheme provides a low false alarm rate and a high level of detection, its output is taken as a baseline for the fusion center. When the CA output is positive (presence of target), there is a possibility of occurrence of false alarm, caused by clutter transition or target multiplicity. To eliminate this eventuality, the AND fusion Rule(I), indicated in Eq.(56), can be applied. This rule necessitates the application of an AND logic between the CA output and that obtained by applying an OR logic between the outputs of OS and TM schemes. On the other hand, when the CA output is negative (absence of target), there exists the possibility of a target lost caused by clutter interference. To avoid such occurrence, an AND fusion Rule(II), exhibited in Eq.(56) is utilized. This involves the application of an AND logic between the outputs of OS and TM variants.

$$Rule = \begin{cases} I & CA \wedge (OS \vee TM) \\ II & OS \wedge TM \end{cases} \quad (56)$$

In the previous expression, "∨" stands for the algebraic Boolean of OR gate whilst "∧" represents the same thing of AND gate.

Table 1: Possible Outcomes of Linear Fusion Strategy

CA Scenario	OS Procedure	TM Strategy	FUSION RULE
Absence	Absence	Absence	Absence
Absence	Absence	Presence	Absence
Absence	Presence	Absence	Absence
Absence	Presence	Presence	Presence
Presence	Absence	Absence	Absence
Presence	Absence	Presence	Presence
Presence	Presence	Absence	Presence
Presence	Presence	Presence	Presence

As Table I indicates, the appearance of ToI is demonstrated by the outcomes of rows 4, 6, 7, and 8. Since the occurrence of one of them excludes the occurrence of the others, they are mutually exclusive. Taking into account that the decisions of CA, OS, and TM approaches are independent events, the global detection probability "P_{LF}" of the new implementation can be obtained by summing the outcomes of these rows. Thus, P_{LF} has a mathematical form given by:

$$\begin{aligned} P_{LF} &= P_{miss_{CA}} P_{d_{OS}} P_{d_{TM}} + P_{d_{CA}} P_{miss_{OS}} P_{d_{TM}} + P_{d_{CA}} P_{d_{OS}} P_{miss_{TM}} + P_{d_{CA}} P_{d_{OS}} P_{d_{TM}} \\ &= P_{d_{CA}} (P_{d_{OS}} - 2 P_{d_{OS}} P_{d_{TM}} + P_{d_{TM}}) + P_{d_{OS}} P_{d_{TM}} \end{aligned} \quad (57)$$

Here, P_{miss} denotes the probability of missed detection. All the parameters of Eq.(57) are previously calculated. So, the detection performance of the LF-CFAR strategy is completely analyzed.

Our scope in the upcoming section is to numerically simulate the derived formulas through a PC device using C++ programming language to see the new contribution of the LF style in the CFAR world.

IV. Simulation Results and Discussion

It is of importance to numerically evaluate the performance of the examined model. This section introduces the simulation results in order to confirm the performance superiority of the proposed algorithm. How well the model reacts against the presence of inhomogeneous background, can be assessed by several parameters. The most dominant and common ones include detection performance, CFAR loss, and actual probability of false alarm which measures the model's capability of holding the rate of false alarm stationary en face of outliers. Thus, we go to compute the detection performance, in the absence as well as in the presence of fallacious targets, for two and four (M=2 & 4) post-detection integrated pulses to see to what extent the pulse integration can ameliorate the reaction of the CFAR scheme against fluctuating targets. In our simulated results, it is assumed that the reference window has a size (N) of 24 cells, the designed P_{fa} is 10^{-6}. For OS scenario, the 10^{th} ordered sample, OS(10), is chosen to represent its noise level estimate of each reference sub-window, whilst for TM scheme, the two smallest cells along with the two highest ones, TM(2, 2), are excised from the ordered set of each sub-window before adding the remaining ordered samples to extract its background power. Since the double-windows and mean-level operation are common for all the CFAR processors under test, it is of preferable to omit these features from nominating them. Instead, it is sufficient to designate each one of them with the CFAR rule used in estimating the unknown noise level of each sub-window as CA, OS(10) and TM(2, 2).

Fig.(2) shows the level of detection as a function of primary target signal strength (SNR) of the new methodology in homogeneous environment for the four Swerling models when the CFAR circuit based its decision on integrating two (M=2) consecutive sweeps. For the sake of comparison, the single sweep (M=1) case is attached for χ^2 fluctuating target with two (κ=1) and four (κ=2) degrees of freedom. Additionally, the same results of the optimum (N-P) detector are included among the curves of Fig.(2). In the case of single pulse operation, the displayed results illustrate that there is a turnover point; below which the N-P scheme surpasses, in detection performance, the LF strategy whilst upper this point the reverse is occurred. In other words, when the target signal is strengthened, the detection performance of the new variant outweighs that of the N-P detector and the gap between the two curves

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increases as the signal becomes more strengthened. Moreover, the processor performance for fluctuating targets with κ=2 is higher than that obtained for κ=1and this behavior is noticed for LF and N-P processors given that the turnover point is exceeded. Furthermore, the performance of SWI model coincides with that of SWII model and the performances of SWIII and SWIV models are the same.

For M=2, on the other hand, it is noted that the turnover point is shifted towards lower signal strength. At the preceding of this point, SWI has the top performance whereas SWIV gives the worst detection level. As this point is surpassed, the reverse is observed; where SWIV model has the highest performance whilst the SWI model exhibits the lowest probability of detection. It is of importance to note that the detector performance against SWII fluctuation model coincides with that corresponds to SWIII model in the case where the radar receiver has a non-coherent integration of two successive pulses (M=2) as Eq.(8) demonstrates. As we have noticed for M=1, the N-P detector has a detection performance which is meagerly superior, at lower SNR, than that of LF scheme, when the turnover point is not reached. When the SNR is greater than that corresponding to the turnover point, the new methodology has the top performance whatever the fluctuation model is. The gap between the two curves (LF & N-P) corresponding to SWI model is the widest whereas this gap is narrow for SWIV model, taking into account that the LF strategy has always the top performance against any fluctuation model.

Fig.(3) illustrates the same thing as that presented in Fig.(2) on the exception that the operating environment is contaminated with some interfering targets instead of being free of them. The results of this scene are obtained on the assumption that one of each reference sub-window cells contains interfering target return ($R_1=R_2=1$); the signal strength of which equals to that of the primary target (INR=SNR) and follows the same Swerling model, as the target of interest, in its fluctuation. A big insight on the variation of the curves of this plot indicates that the turnover points of LF and N-P are different, instead of coincide as in homogeneous case in Fig.(2), and this occurs either the pulse integration is absent (M=1) or present (M=2). In addition, the N-P detector has the top performance especially when the signal strength is modest. As the target echo becomes strengthened, the detection performance of the new processor approaches that of the N-P and may surpass it if the CFAR circuit is provided by pulse integration, as Fig.(3) demonstrates. Moreover, the point of exceeding for SWI fluctuation model takes place at a SNR which is lower than that occurs for SWII model which in turn precedes, in its location, that associated with SWIV model. It is of importance to note that this behavior doesn't appear if pulse integration doesn't achieve. The single sweep performance confirms this knowledge.

Fig.(4) repeats the behavior of LF and N-P, against fluctuating targets, when the operating environment is ideal (homogeneous) as that displayed in Fig.(2) with the exception that the radar receiver builds its decision on integrating four (M=4), instead of two (M=2), successive pulses. The portrayed results of this figure prove that the candidates of this figure have the same variation as those corresponding in Fig.(2) within some gain. Additionally, the gap between the performance of novel scheme and that of N-P becomes evident; with LF detector always on the top given that the signal strength exceeds the turnover point.

Similarly, Fig.(5) redraws the results of Fig.(3) for M=4 under the same circumstances. In comparison with the results of Fig.(3), the current results exhibit some noticeable remarks as: the gap between the LF performance and optimum (N-P) is narrower, the point of exceeding is shifted towards lower SNR with the same sequence of Swerling models as that outlined during our comments on the curves of Fig.(3), and there is an evident gain in the performance of the examined and standard detectors.

Now, Let us go to evaluate another figure of merit which is known as CFAR loss. Fig.(6) shows how the signal strength must be to satisfy a detection level of 90% ($P_d=0.9$) as a function of the correlation strength among the primary target returns when this target obeys χ^2-statistics, with two (κ=1) degrees of freedom, in its fluctuation. As a reference of comparison, the traditional CFAR and N-P schemes are incorporated among the results of the LF style. The displayed results are acquired on the assumption that the environment of operation is ideal and two (M=2) consecutive sweeps are non-coherently integrated. A big insight on the behavior of the curves of this figure demonstrates that as the correlation among the target returns increases, the echo signal must be more strengthened to reply the required level of detection. Additionally, the conventional OS scenario needs the highest, relative to the other ones stated here, signal power to attain 90% level of detection, the standard TM mechanism comes next, the traditional CA procedure reserves the third position, the optimum (N-P) occupies the fourth location, whilst the new methodology (LF) needs the minimum signal strength in order to accomplish the requested probability of detection. The results of this scene reveals the superiority of the underlined detector over its original ones as well as the N-P which is taken as a reference of any new variant added to the CFAR world. Fig.(7) depicts the same behavior for the concerned processors when the primary target fluctuates in accordance with χ^2-statistics, with four (κ=2) degrees of freedom. The tested variants follow the same sequence, as indicated in Fig.(6), in demanding the signal strength to reply a detection level of 90%. Moreover, for any one of the examined schemes, the signal power required in this situation is weaker than that needed in Fig.(6) to satisfy the same probability of detection.

In multiple target situations, Figs.(8-11) illustrate the needed signal strength to satisfy a given level of detection when the primary and the secondary targets follow SWI, SWII, SWIII, and SWIV models, respectively, in their fluctuation for the underlined detectors given that the decision is carried out based on integrating two (M=2) successive pulses and the outlying target returns have the same signal strength as those of primary target ($\vartheta=\gamma$).

As a reference of comparison, the results of the N-P scheme are included among the curves of these figures under the same target fluctuation model. Fig.(8) portrays the required signal power versus the pre-assigned level of detection for the standard as well as the derived versions when one cell among the contents of each reference sub-window is contaminated with extraneous target returns ($R_1=R_2=1$). The displayed results illustrate that the CA technique can reply the request probability of detection till a specified level beyond which it hasn't the capability to satisfy the needed level of detection whatever the signal strength is. In this regard, we define the dynamic range as the range belong to which, the CFAR processor can reply any given level of detection. Based on this definition, the CA scheme has a limited dynamic range which is very narrow. All the other under-examination processors are able to reply any level of detection with different signal powers. For lower values of detection probability, there is a gap between the signal strengths needed by LF strategy and N-P detector with LF needs the highest. However, as the pre-assigned detection level increases, this gap becomes narrower till the two curves coincide and may LF requests the lowest signal strength to verify the high levels of detection. The OS(10), TM(2, 2), and LF scenarios have full dynamic range, with OS(10) demands the highest whilst LF needs the lowest signal power to give the pre-assigned level of detection. In addition, the length of the dynamic range of CA detector varies as a function of the target fluctuation model in such a way that SWI model gives smallest whilst SWIV model results in relatively the largest extend of the dynamic range. The remaining schemes have always the full length for their dynamic range irrespective the fluctuation model is. However, the required signal strength varies depending on the model of fluctuation in such a way that the SWI model requires the highest whereas the SWIV model needs the lowest signal power to reply the same level of detection.

Finally, we are going to test the capability of the new methodology of holding the rate of false alarm unchanged en face of fallacious target returns that may exist among the contents of the reference sub-windows. This category of plots includes Figs.(12 & 13). While Fig.(12) is devoted to measure the actual false alarm rate, as a function of the correlation strength among the interferer's returns, in the case where the outliers fluctuate following χ^2-distribution with two-degrees ($\kappa=1$) of freedom, Fig.(13) depicts the same thing for χ^2-distribution with four-degrees ($\kappa=2$) of freedom for the fluctuation of the interferers. In these two figures, it is assumed that each reference sub-window has only one contaminated cell ($R_1=R_2=1$) and the interference strength has a power of 10dB ($\vartheta=10$dB). In addition, the data of these figures is established taking into account that the CFAR circuit non-coherently integrates two successive pulses (M=2). The displayed results of Figs.(12 & 13) demonstrate that the LF derived version has the ability of maintaining the false alarm rate, as the standard OS(10) and TM(2, 2) procedures, whatever the strength of correlation among interferer's returns is. As predicted, the conventional CA detector is incapable of fixing the rate of false alarm against the existence of outlier's returns.

V. Conclusions

According to the analysis outlined above, the current investigation is aimed at comparing the performance of several CFAR alternatives regarding the maintaining of the false alarm probability and the reaching of the top of detection probability with the goal of selecting the most promising CFARs. For the Swerling target models, embedded in white Gaussian noise of unknown level, we derive an analytical expression for the overall probability of detection while the overall probability of false alarm is retained at the desired level for the given fusion rules. Through extensive simulations, the superiority and robustness of the linear fusion mechanism are clearly demonstrated by outperforming the conventional processors of CA, OS, TM and N-P in scenarios with different target fluctuation models, different correlation strengths among the target's returns, different numbers of integrated pulses, and varied operating circumstances. This ability to obtain improved performance compared to existing models is the major contribution of this work. In other words, performance analysis, conducted on both analytical and simulated results, highlights that the new architecture operating in multi-target background guarantees the constant false alarm rate property with respect to the correlation strength variations and a limited detection loss with respect to the other detectors, whose detection thresholds nevertheless are very sensitive to the interference power. The cost is that LF-CFAR suffers from more computational burden and elapsed time than other processors. We conclude from our simulation results that the fusion detector has higher quality detection interactions in heterogeneous environments. In other words, the linear fusion enjoy significant advantages in both the false alarm regulation property and detection performance, as the displayed results of this research demonstrated. Thus, the LF strategy has the proficiency of choice en face of heterogeneous situations.

References Références Referencias

1. W. Q. Wang, "Radar Systems: Technology, Principals and Applications", Nova Science Publishers, Inc, 2013.
2. El Mashade, M. B., "Monopulse detection analysis of the trimmed mean CFAR processor in nonhomogeneous situations", IEE Proc. Radar, Sonar Navig., Vol. 143, No. 2 , pp.87-94, April 1996.
3. El Mashade, M. B., "Partially correlated sweeps detection analysis of mean-level detector with and without censoring in non ideal background conditions", Int. J. Electron. Commun. (AEŰ), Vol.53, No.1, (Feb. 1999), pp. 33-44.
4. A. Farrouki and M. Barkat, "Automatic censoring CFAR detector based on ordered data variability for nonhomogeneous environments", IEE Proc.-Radar Sonar Navig., Vol. 152, No. 1, pp.43-51, February 2005.
5. El Mashade, M. B., "Analysis of Cell-Averaging Based Detectors for χ^2 Fluctuating Targets in Multitarget Environments", Journal of Electronics (China), Vol.23, No.6, (November 2006), pp. 853-863.
6. L. Zhao, W. Liu, X. Wu and J.S. Fu, "A novel approach for CFAR processors design", *Proc. of the IEEE International Conference on Radar*, Atlanta, GA, 1-3 May 2001, pp. 284–288.
7. Santos Lopez-Estrada, René Cumplido, "Fusion center with neural network for target detection in background clutter", *Proc. of the Sixth Mexican International Conference on Computer Science (ENC'05)*, 2005.
8. Toufik Laroussi, Mourad Barkat and Nassim Benadjina, "A Performance Comparison of two time Diversity Systems using TM-CFAR Detection for Partially Correlated Chi-Square Targets in Nonuniform Clutter and Multiple Target Situations", 2007 IEEE International Conference on Signal Processing and Communications (ICSPC 2007), 24-27 November 2007, Dubai, United Arab Emirates.
9. El Mashade, M. B., "Analytical Performance Evaluation of Optimum Detection of χ^2 Fluctuating Targets with M-Integrated Pulses", Electrical and Electronic Engineering, Vol. 1, No. 2, pp. 93-111, 2011.
10. Anatolii A. Kononov, Jin-Ha Kim, Jin-Ki Kim, and Gyoungju Kim, "A New Class of Adaptive CFAR Methods for Nonhomogeneous Environments", Progress In Electromagnetics Research B, Vol. 64, 145-170, 2015.
11. Md. Maynul Islam, Mohammed Hossam-E-Haider, "Detection Capability and CFAR Loss Under Fluctuating Targets of Different Swerling Model for Various Gamma Parameters in radar", (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 9, No. 2, pp.90-93, 2018
12. El Mashade, M. B., "Performance superiority of CA_TM model over N-P algorithm in detecting χ^2 fluctuating targets with four-degrees of freedom", Int. J. Systems, Control and Communications, Vol. 11, No. 1, pp. 92-118, 2020.
13. D. Ivkovč, B. Zrnić and M. Andrić, "Fusion CFAR detector in receiver of the software defined radar", *Proc. of the International Radar Symposium IRS-2013*, Dresden, Germany, 19-21 June 2013.
14. El Mashade, M. B., "Performance Analysis of OS Structure of CFAR Detectors in Fluctuating Target Environments", Progress In Electro magnetics Research C, Vol.2, pp. 127-158, 2008.
15. El Mashade, M. B., "Partially-Correlated χ^2 Targets Detection Analysis of GTM-Adaptive Processor in the Presence of Outliers", I.J. Image, Graphics and Signal Processing, Vol. 7, No. 12, pp. 70-90, Dec. 2014.
16. El Mashade, M. B., "Adaptive Detection Enhancement of Partially-Correlated $\chi 2$ Targets in an Environment of Saturated Interference", Recent Advances in Electrical & Electronic Engineering, Vol. 9, No. 2, pp.1-21, 2016.
17. J. R. Machado-Fernández, N. Mojena-Hernández, J. Bacallao-Vidal, "Evaluation of CFAR detectors performance", ITECKNE Vol. 14, No. 2, December 2017, pp.170 – 178.
18. El Mashade, M. B., "Heterogeneous Performance Analysis of the New Model of CFAR Detectors for Partially-Correlated χ^2-Targets", Journal of Systems Engineering and Electronics, Vol. 29, No. 1, February 2018, pp.1 – 9.
19. El Mashade, M. B., "M-Sweeps multi-target analysis of new category of adaptive schemes for detecting χ^2-fluctuating targets", Journal of Information and Telecommunication, Vol. 4, No. 3, 314–345, 2020.
20. El Mashade, M. B., "Inhomogeneous Performance Evaluation of a New Methodology for Fluctuating Target Adaptive Detection", Progress In Electro-magnetics Research C, Vol. 107, 273–286, 2021.
21. El Mashade, M. B., "Inhomogeneous Analysis of Novel Model of CFAR Approaches to Detect Two-Degrees of Freedom Partially-Correlated χ^2-Targets", WSEAS Transactions on Communications, Vol. 20, pp.28-43, 2021.

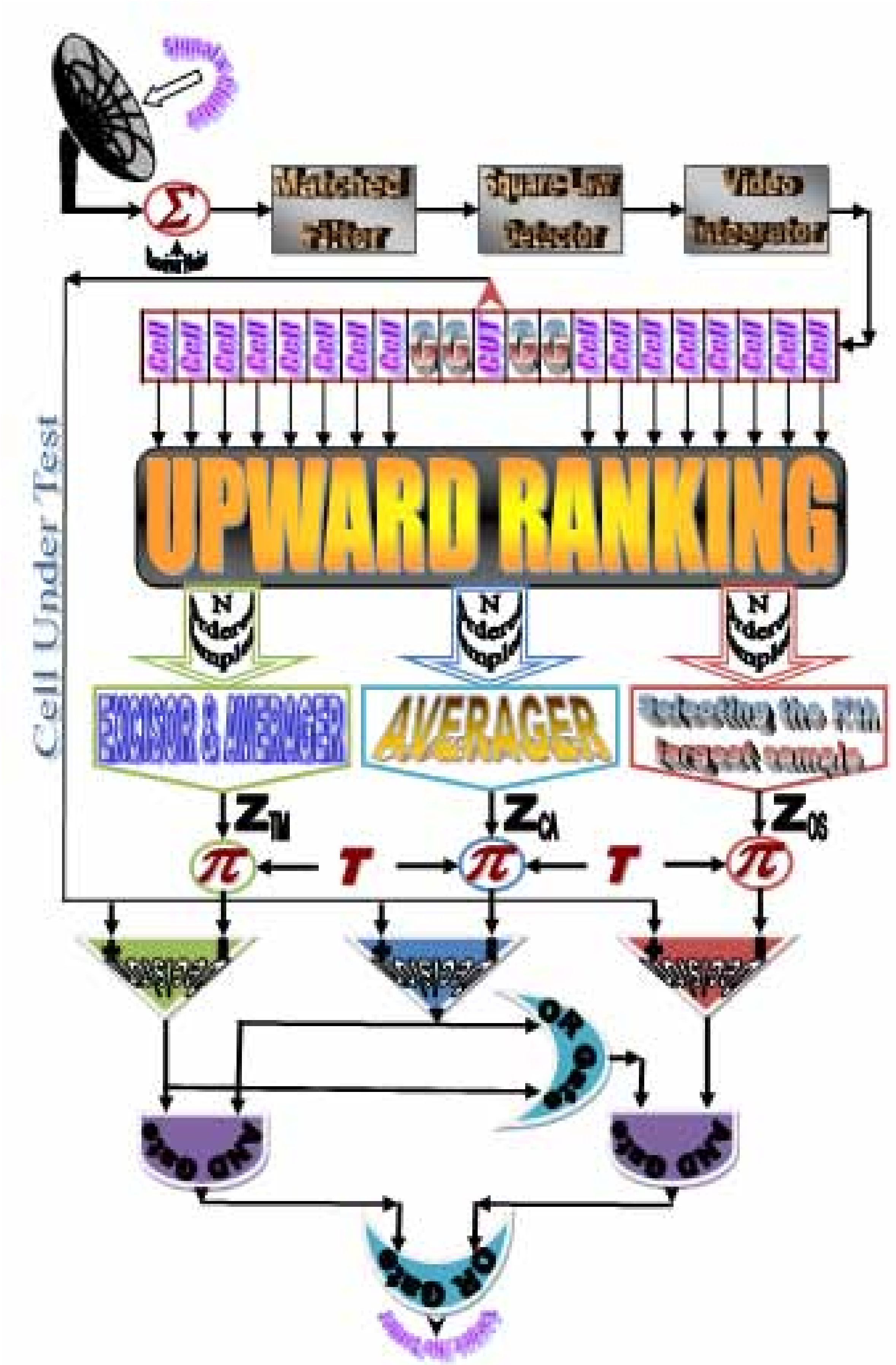


Fig. (1): Architecture of linear fusion (LF) adaptive detector with postdetection intregation

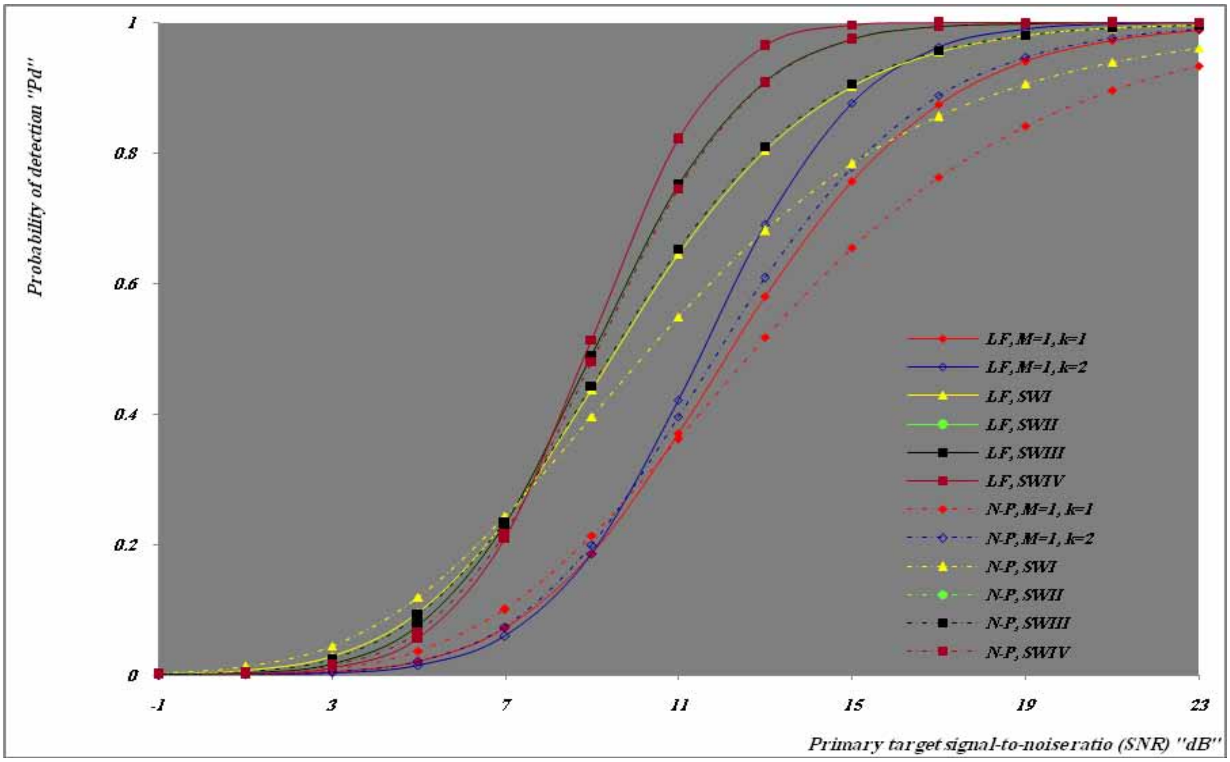


Fig. (2): M-sweeps homogeneous detection performance of LF and N-P schemes for Swerling models of χ^2-fluctuating targets when N=24, M=2, and $P_{fa}=10^{-6}$

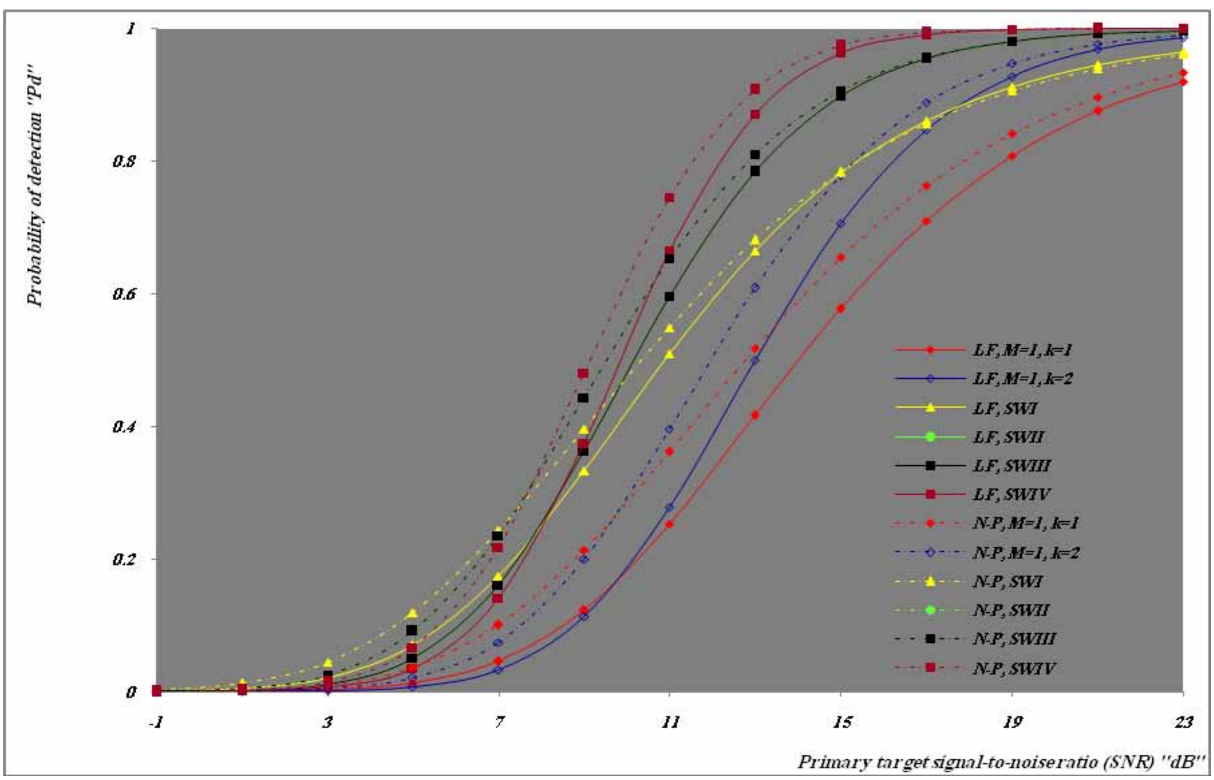


Fig. (3): M-sweeps multi-target detection performance of LF and N-P schemes for Swerling models of χ^2-fluctuating targets when N=24, M=2, $R_1=R_2=1$, $\vartheta=\gamma$, $\rho_s=\rho_p$, and $P_{fa}=10^{-6}$

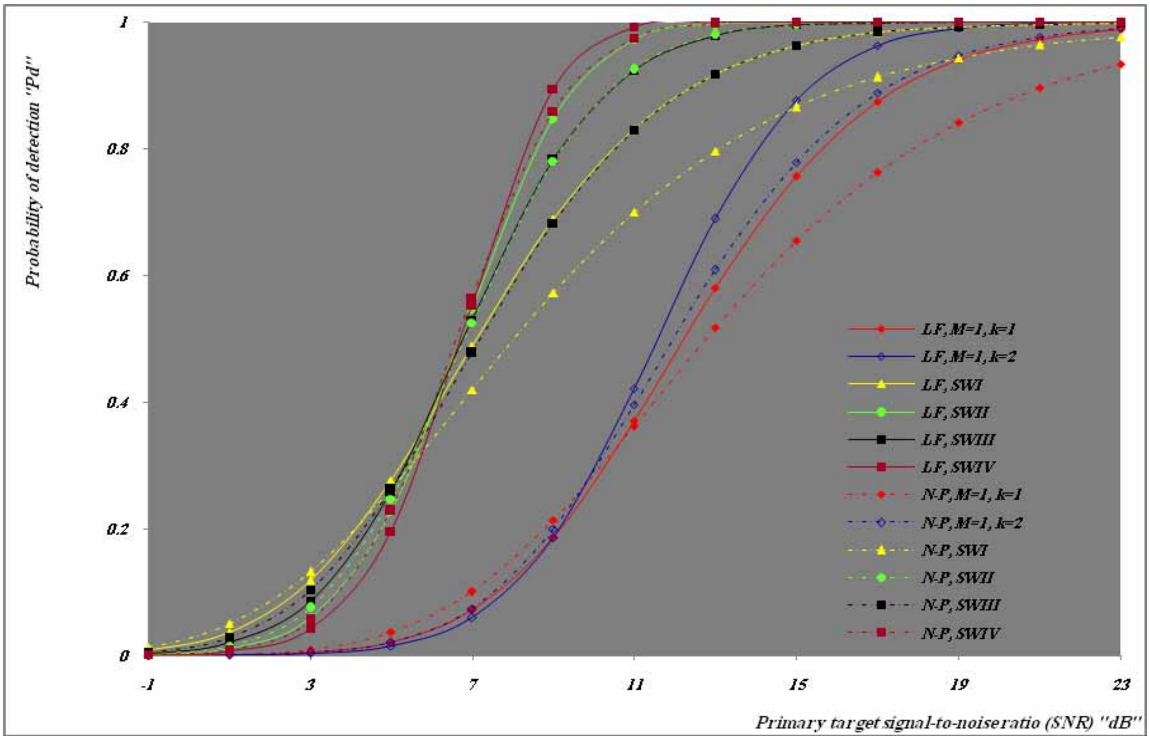


Fig. (4): M-sweeps homogeneous detection performance of LF and N-P schemes for Swerling models of χ^2-fluctuating targets when N=24, M=4, and $P_{fa}=10^{-6}$

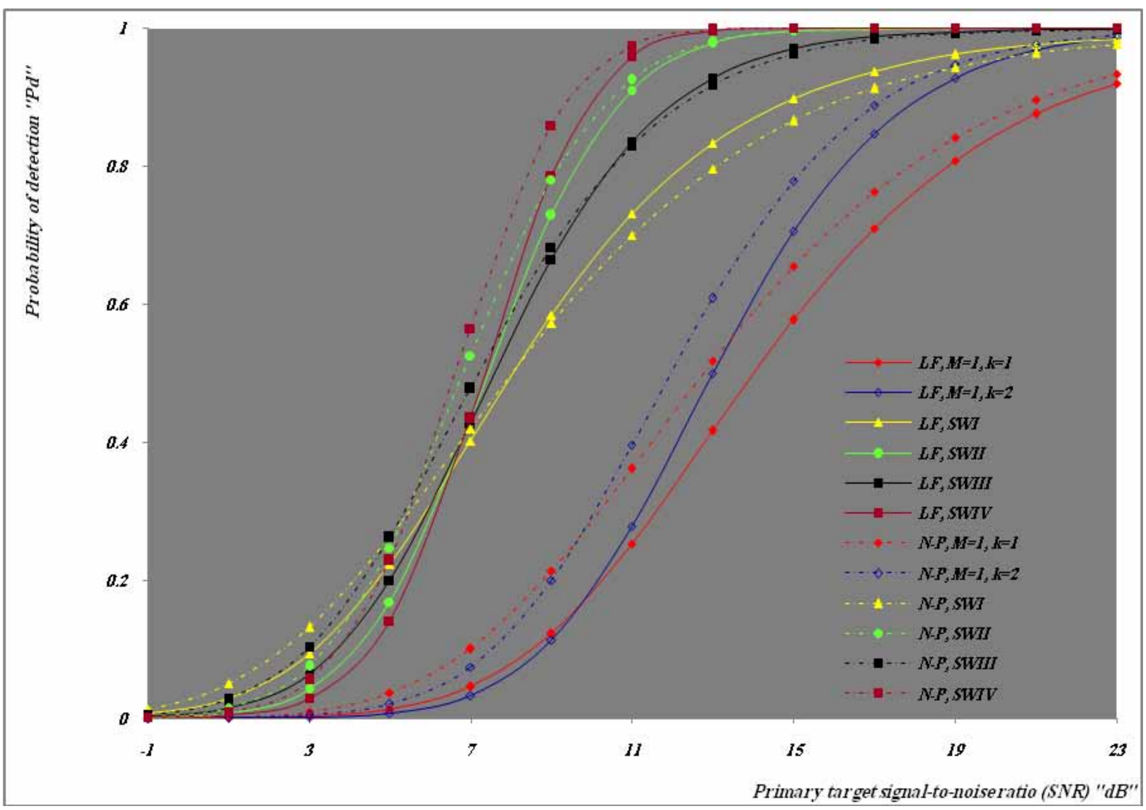


Fig. (5): M-sweeps multi-target detection performance of LF and N-P schemes for Swerling models of χ^2-fluctuating targets when N=24, M=4, $R_1=R_2=1$, $\vartheta=\gamma$, $\rho_s=\rho_p$, and $P_{fa}=10^{-6}$

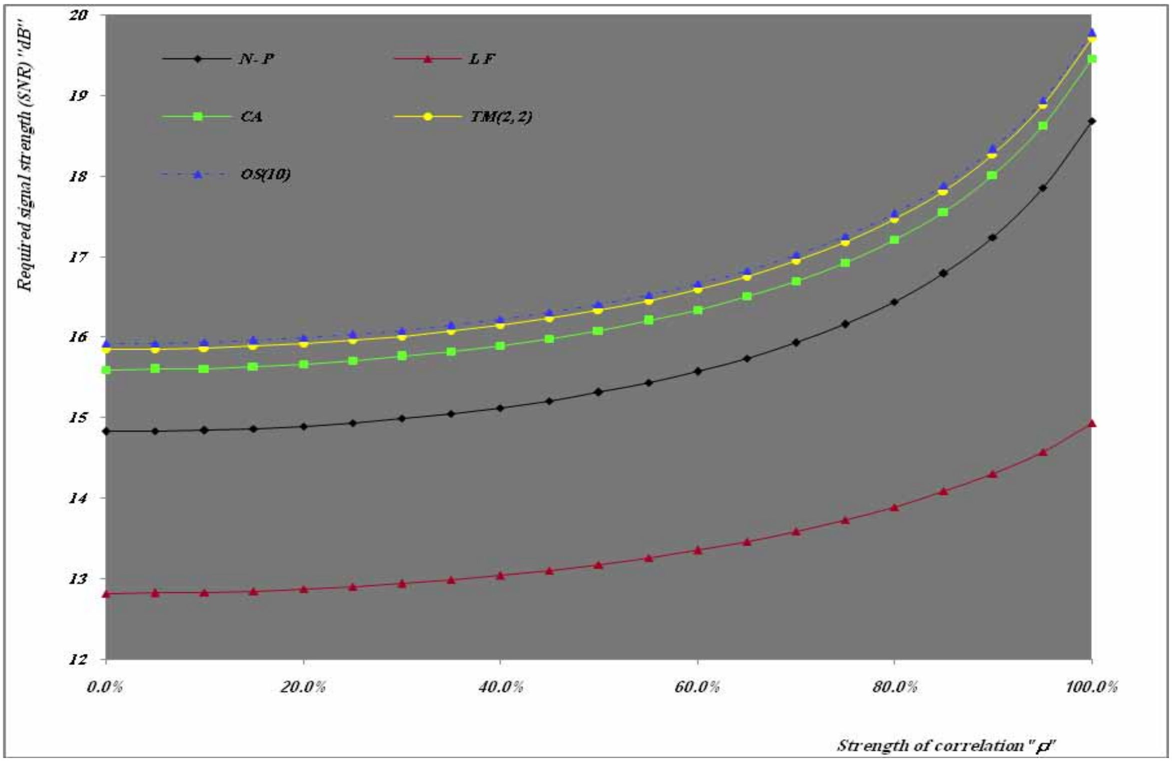


Fig. (6): M sweeps homogeneous signal strength requested to achieve a detection level of 90% of CFAR schemes for second-degree of freedom χ^2-fluctuating targets when N=24, M=2, and $P_{fa}=10^{-6}$

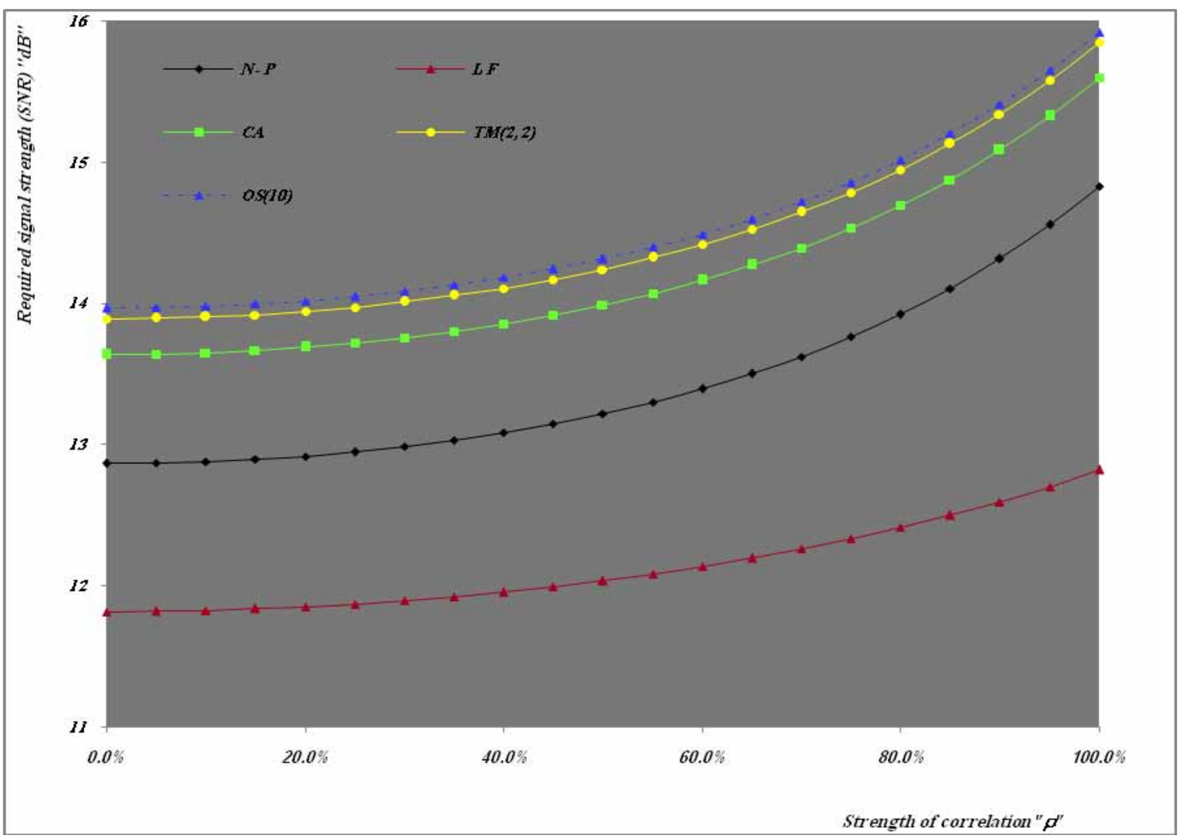


Fig. (7): M-sweeps homogeneous signal strength requested to achieve a detection level of 90% of CFAR schemes for fourth-degree of freedom χ^2-fluctuating targets when N=24, M=2, and $P_{fa}=10^{-6}$

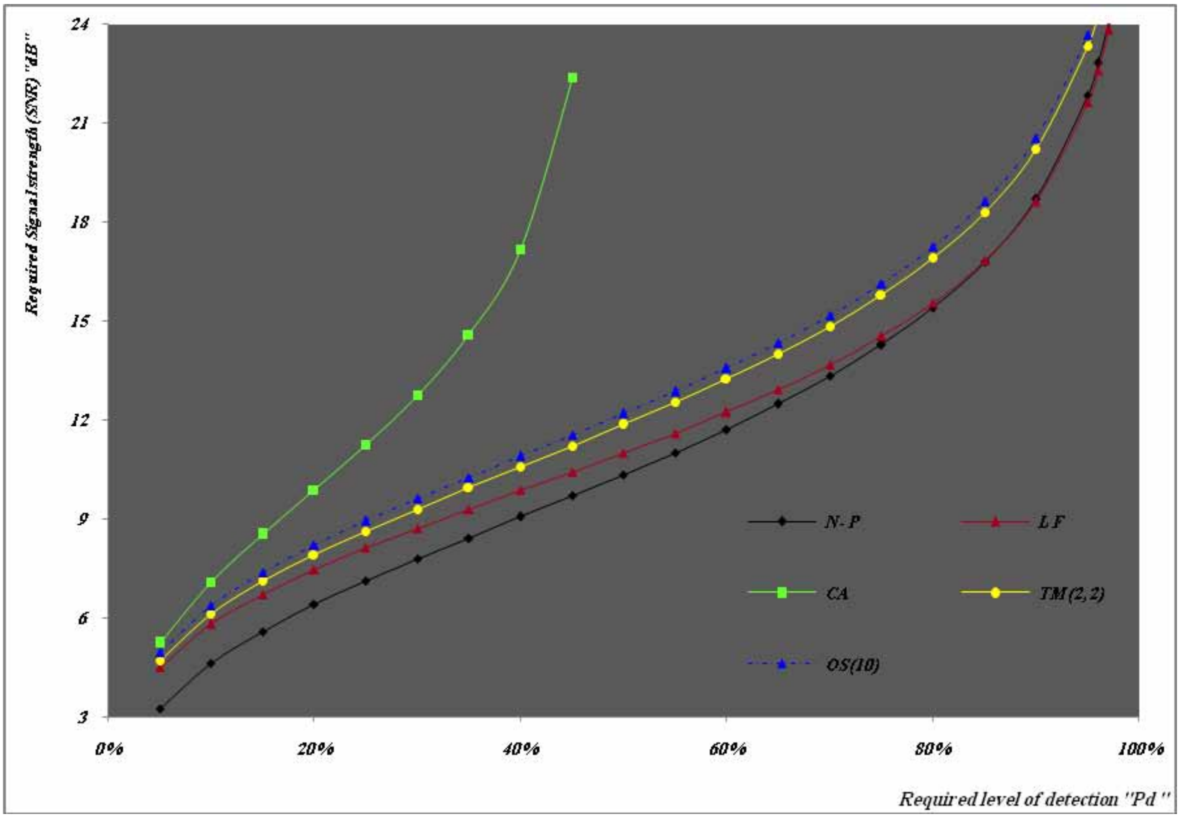


Fig. (8): M-sweeps multi-target signal strength requested to achieve a given level of detection of CFAR schemes for SWI target fluctuation model when N=24, M=2, R =R =1, $\vartheta=\gamma$, $\rho_s=\rho_p$, and P =10 ^{6}

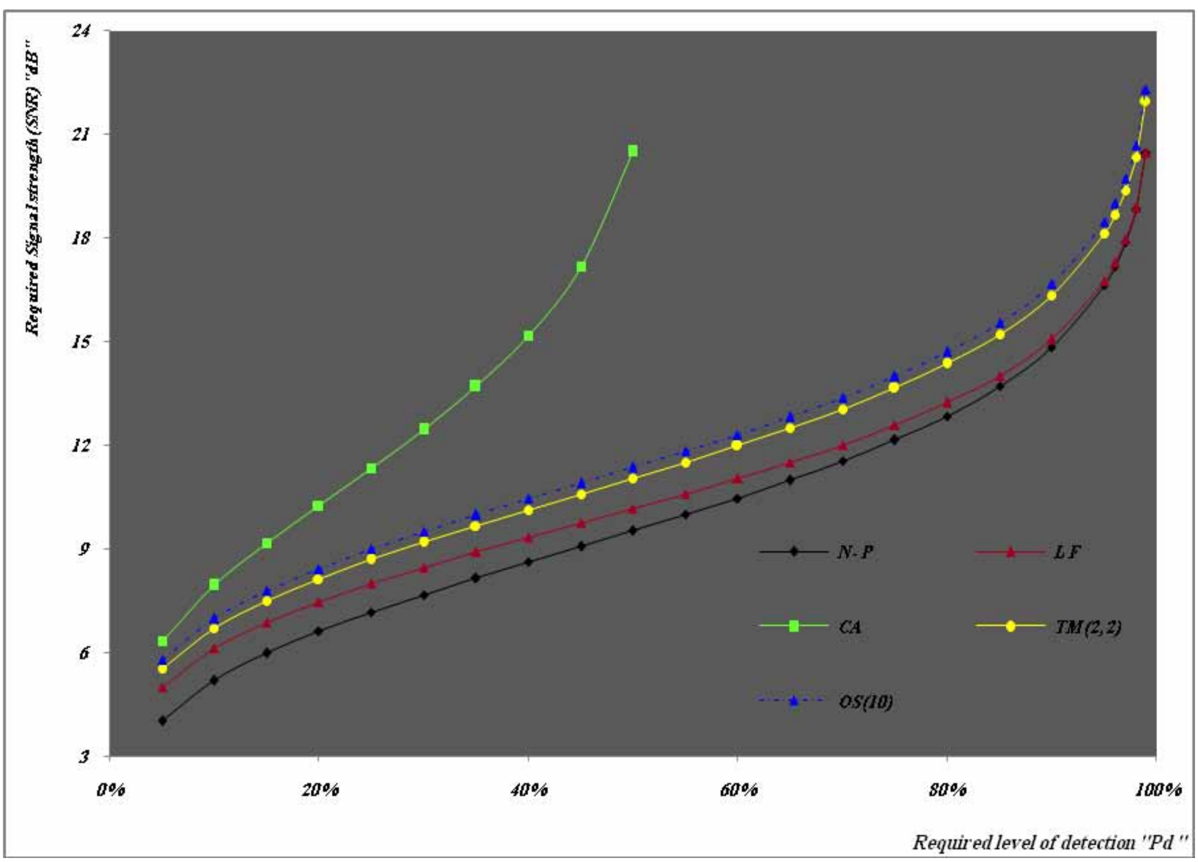


Fig. (9): M-sweeps multi-target signal strength requested to achieve a given level of detection of CFAR schemes for SWII target fluctuation model when N=24, M=2, $R_1=R_2=1$, $\vartheta=\gamma$, $\rho_s=\rho_p$, and $P_{fa}=10^{-6}$

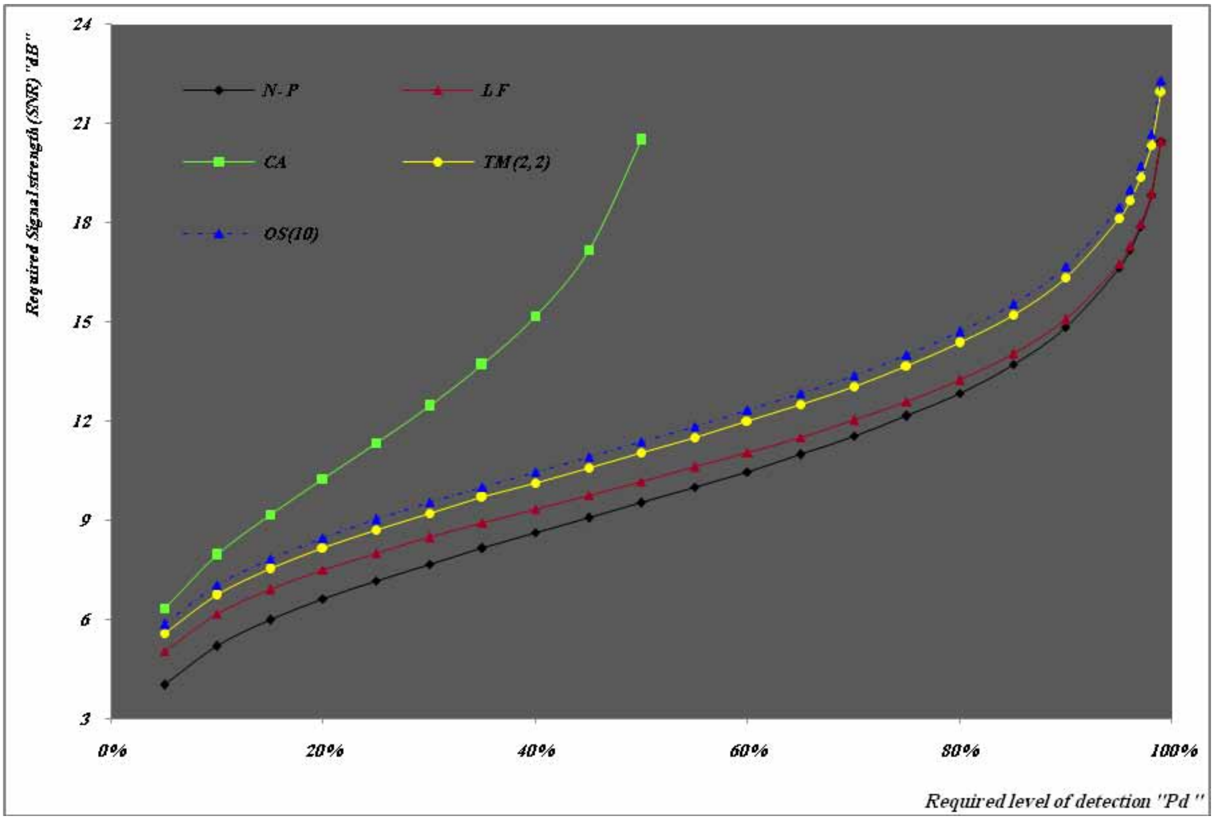


Fig. (10): M-sweeps multi-target signal strength requested to achieve a given level of detection of CFAR schemes for SWIII target fluctuation model when N=24, M=2, R =R =1, $\vartheta=\gamma$, $\rho_s=\rho_p$, and $P_{fa}=10^{-6}$

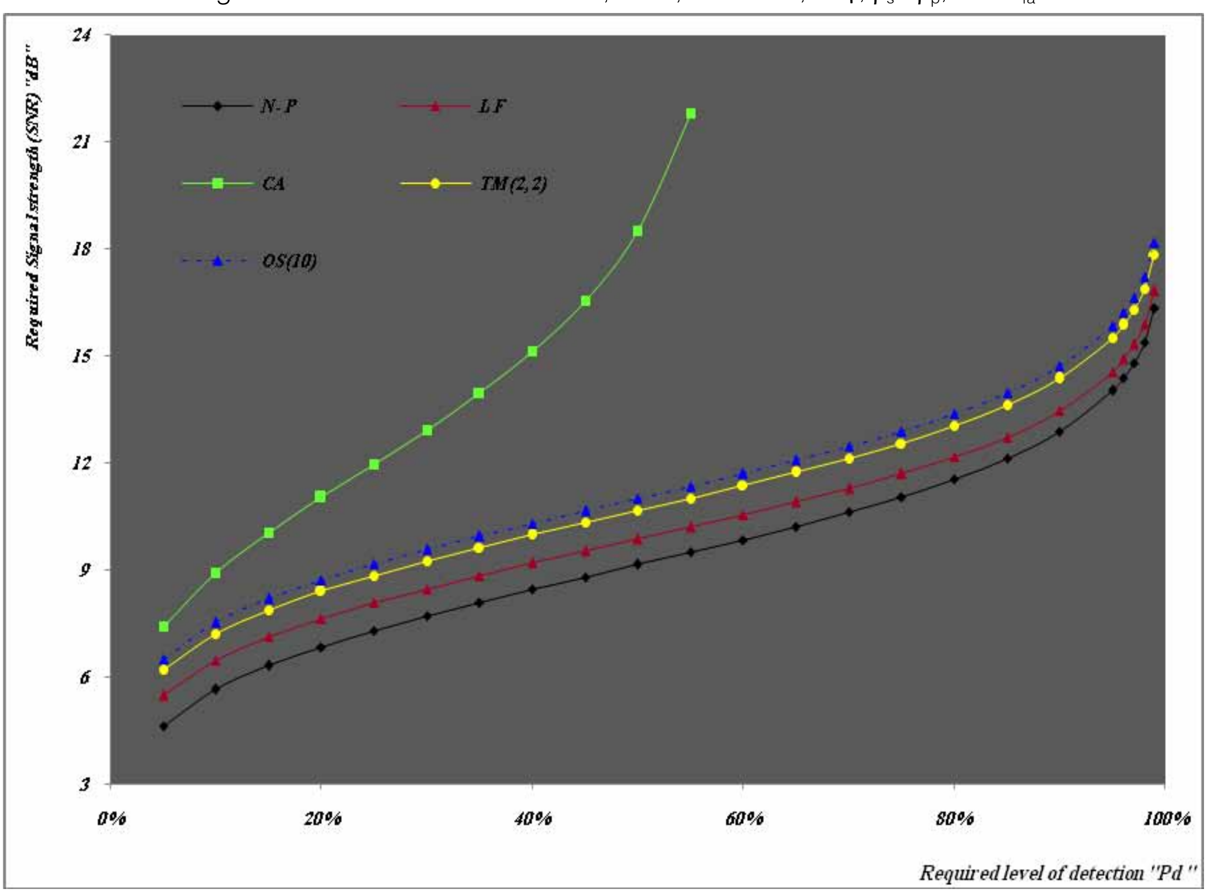


Fig. (11): M-sweeps multi-target signal strength requested to achieve a given level of detection of CFAR schemes for SWIV target fluctuation model when N=24, M=2, $R_1=R_2=1$, $\vartheta=\gamma$, $\rho_s=\rho_p$, and $P_{fa}=10^{-6}$

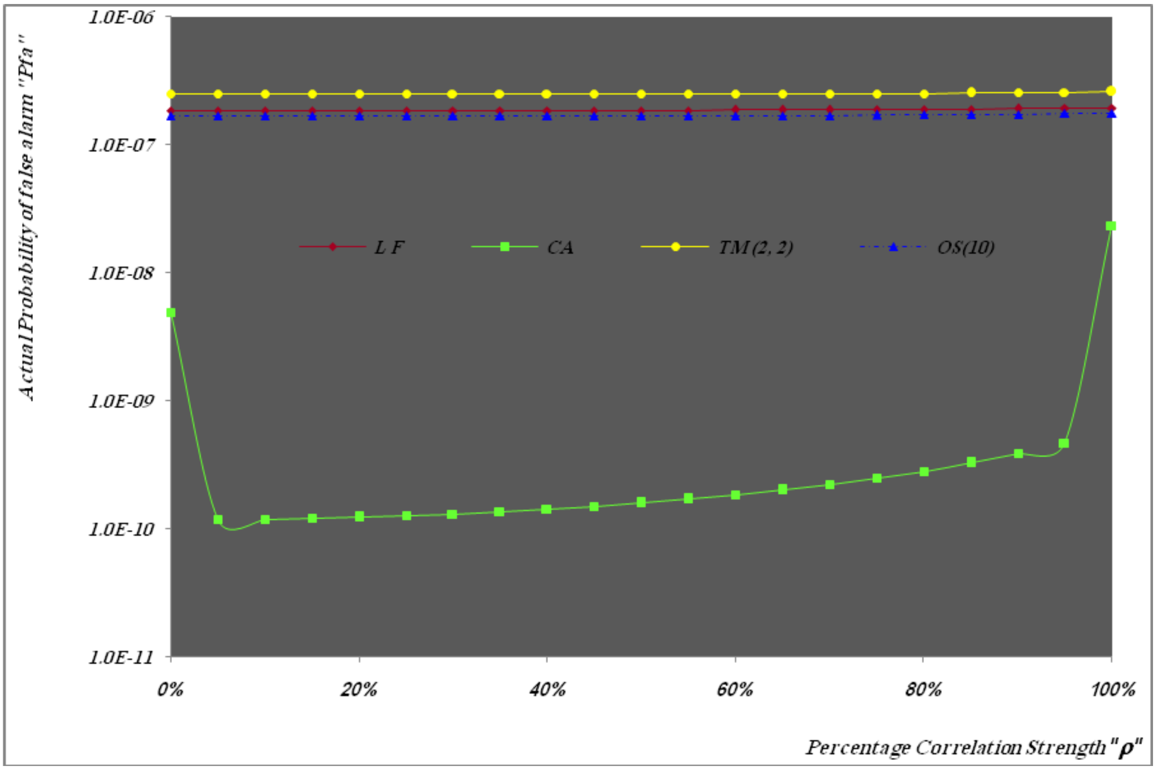
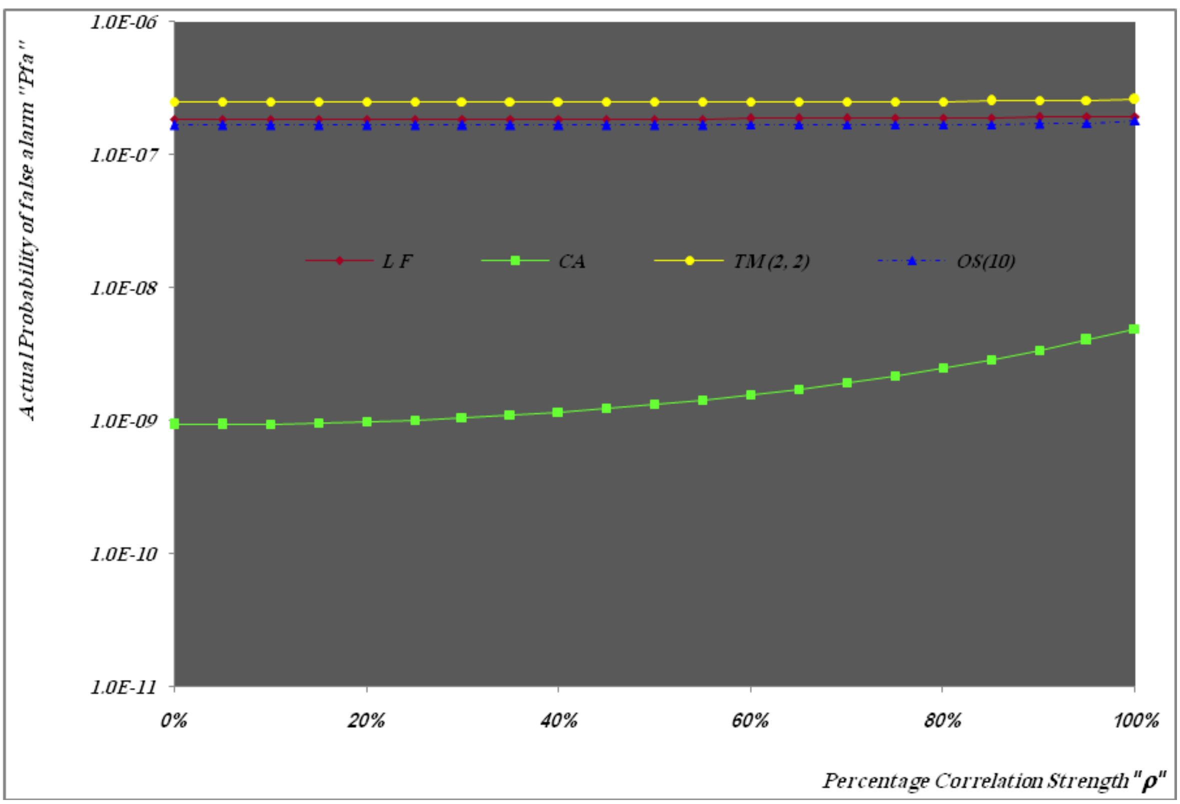


Fig. (12): M-sweeps multi-target actual false alarm performance of M-sweeps operation of CFAR detectors for two-degrees of freedom χ^2-fluctuating targets when N=24, M=2, $R_1=R_2=1$, ϑ=10dB, and design $P_{fa}=10^{-6}$



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Sentiment Analysis of Public Expressions in Hindi Language on Media Platform

By Suraj Prasad Keshri & Neelam Sahu

Dr. C.V.Raman University

Abstract- Nowadays people are actively involved in commenting and reviewing on social networking websites and other website like shopping website, news website etc. large number of people share everyday a large number of user data is collected, their opinion on the web. Users also find it trivial to read all the reviews and then arrived at the decision. It would be better if there were reviews some are categorized into categories so that the user has ease of reading. Sentence analysis is a natural language processing (NLP) function that measures information from various textual forms such as blogs and news are classified as positive, negative, or neutral based on their polarity But for the past few years, user content in Hindi language is also growing rapidly on the web. Therefore mining in Hindi language is also very important. A Hindi language sentence system is proposed in this research paper. The system classifies reviews as positive, negative and Neutral to Hindi language. Negativity is also control in this research system. Experimental results by experiment the review of films shows the effectiveness of the system.

Keywords: sentiment analysis, hindisentiwordnet (hswn), sentiment analysis, hindi language.

GJCST-H Classification: I.1.1

SENTIMENTANALYSISOFPUBLICEXPRESSIONSINHINDILANGUAGEONMEDIAPLATFORM

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Suraj Prasad Keshri α & Neelam Sahu σ

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I. Introduction

With the recent development of Web 2.0 and natural language processing, regional is used for communication. As the Internet is reaching more and more people in the world, there is a tremendous growth in web content of other languages. Most of the research work is done in the mining of textual content in the English language; very little work is done for other languages. In our view we are categorizing the Hindi document into several classes and then extracting the emotions from the respective classes as positive, negative and neutral. The Classification is the technique in which we identify which set of categories is based on a new observation and it is based on a training data set that includes observations whose category membership is already known.

II. Existing Research Work

Minimum amount of work has been done in mining for Hindi language which is as follows. The research was conducted in Hindi and Bengali. Most prominent job done by Amitav Das and K. M. Anil Kumar [1], they have developed SentiwordNet for Bengali language. To obtain a Bengali SentiwordNet, the word level is a lexical-transfer technique. For every entry in the English Sentiwordnet applied using the English-Bengali dictionary. Rs 25,715 Bengali entries have been returned by their use.

Four strategies were devised by Das and Band Mohsen Farhadloo [3] to estimate the emotion of a word. In point of view, he proposed an interactive game in which words were annotated with their polarity. In the second approach, to determine the polarity of a bi-lingual word the dictionary was used for English and Indian languages. The third approach used WordNet and polarity was determined using synonyms and antonym relations.

The efficient approached was developed by Namita Mittal et. al. [6] based on negation and Relation of identifying emotions with Hindi content. Annotated corpus for The Hindi language was developed and reformed by the existing Hindi SentiWordNet (HSWN) including more opinionated words in it. He also formulated rules to deal with negation and Discourses that affect the feelings expressed in the review 80% accuracy was achieve by their research algorithm for classification of review.

A fall back strategy was research by Joshi et. al., for the Hindi words language. The Approached using three: Sentence Analysis in Language, Sentence Analysis in Hindi, a textual resource developed by him in this strategy based on sentence analysis. The Hindi SentiWordNet (HSWN) is based on English format. The HSWN was By using two textual resources (English SentiWordNet, WordNet Linking using WordNet Linking) to achieve H-SWN, the 78.14 accuracy achieved.

The Lexicon was created by Bakaliwal et al., using a graph based method. They determine how subject matter can be interpreted using synonyms and antonym relations. Using a simple graph traversal approach, 79% accuracy on classification was achieved. Review by their proposed algorithm. This includes creating a new scoring function to classify Hindi reviews as positive and test on two different methods.

III. Proposed Work

The system is divided into the following steps.

a) Created Dataset for Hindi language

In order to perform Opinion Mining in Hindi word language, firstly the data set has to be prepared.

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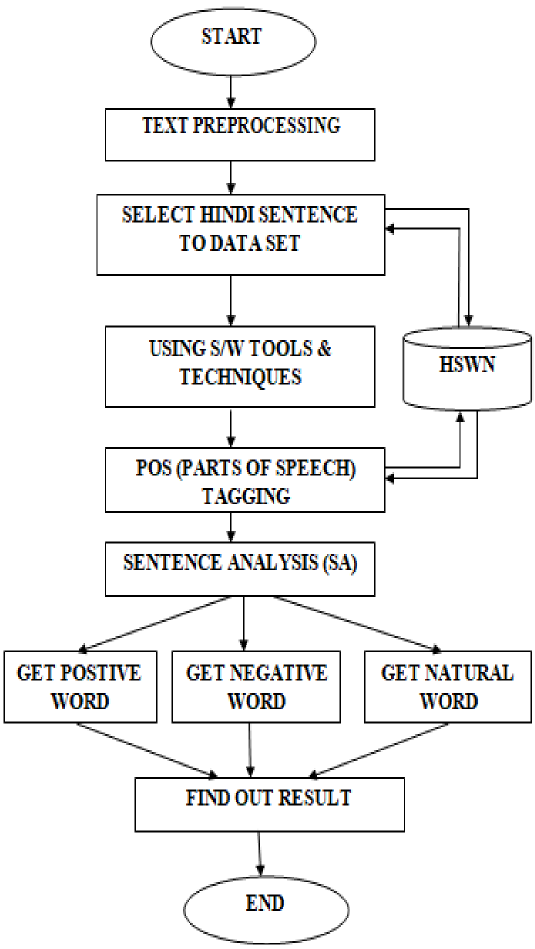
The Data generation a large collection of Hindi sentences on social media. There are many websites that have Hindi content. Here, Hindi Movie Review News papers website But the data collected is already unproven before applying as input. The reviews were implemented as an input in the form of premeditation.

b) Flowchart



c) POS Hindi Language Tagging

POS tagging is very important for opinion mining. POS tagging is used to determine opinion Words and Features in Review. POS tagging can be done manually or with the help of POS tagger.POS tags all the words in the tagger tag to the appropriate part of their tag. The guide POS tagging of reviews takes a lot of time. Here, the online POS tagger of Hindi is used to tag all words in review.

d) Detecting polarity of Hindi sentence

He has determined the polarity of the collected reviews with the help of a main instruction and a Hindi dictionary. The polarity of the review is determined by the basis of majority. If the positive words are higher than the polarity of the review, then the opinion words Is positive otherwise it is negative. If the positive and negative words in the review are the same, polarity is neutral. Since negativity is also controlled in this approach, if the word opinion is after that the polarity of the review is not reversed.

Example of Negative Sentences

अपने विवादित बयानों के लिए मशहूर पाकिस्तान क्रिकेट टीम के पूर्व कप्तान और ऑलराउंडर शाहिद अफरीदी ने हाल ही में पाकिस्तान के कब्जे वाले कश्मीर का दौरा किया था। इन दिनों, पूर्व कप्तान दुनिया भर में महामारी कोरोना वायरस के बीच अपने एनजीओ शाहिद अफरीदी फाउंडेशन के माध्यम से पाकिस्तान भर के जरूरतमंदों के बीच भोजन और जरूरतमंद बनाने की कोशिश में व्यस्त है। वह इसी सूची में पीओके तक भी पहुंचे थे, हालांकि वहां के लोगों की मदद करने के बजाय, वह अपने राजनीतिकउल्लू की खोज में भारतीय प्रधानमंत्री नरेंद्र मोदी और कश्मीर पर कुछ और कर रहे थे और जहर उगल रहे थे।

Here, the opinion word is '**उल्लू**' which is followed by '**जहर**' shows negative polarity.

Example of positive Sentences

हमारा देश अद्भुत युवा शक्ति से भरा है। हम जो भी भविष्य की इच्छा रखते हैं, हमें युवाओं को केंद्र में रखना होगा। यदि हम ऐसा कर सकते हैं, तो हम अद्भुत गति के साथ एक लहर की तरह आगे बढ़ सकते हैं।

Here, the opinion word is '**भविष्य**' which is followed by '**आगे बढ़**' shows positive polarity.

गुजरात ने हमेशा देश को एक नई राह दिखाई है। महात्मा गांधी और सरदार पटेल ने स्वतंत्रता के लिए देश का नेतृत्व किया और अब गुजरात कृषि, शिक्षा और पेट्रोकेमिकल जैसे कई क्षेत्रों में अग्रणी है।

Here, the opinion word is '**नेतृत्व**' which is followed by '**अग्रणी**' shows positive polarity.

Example of natural Sentences

प्रधानमंत्री मोदी विभिन्न सोशल मीडिया अकाउंट पर सबसे अधिक फॉलो किए जाने वाले नेता हैं। वह अक्सर सोशल मीडिया के माध्यम से दुनिया भर के लोगों के संपर्क में रहते हैं। ट्विटर पर उनके 5 करोड़ 33 लाख 70 हजार से ज्यादा फॉलोअर्स हैं। जबकि वह खुद 2373 लोगों को फॉलो करता है।

Here, the opinion word is '**दुनियाभर**' which is followed by '**ज्यादा**' shows Natural polarity.

IV. Experimental Result

The websites have Hindi reviews. Reviews were implemented as input to the system that categorized these reviews and determined the polarity of these reviews and presented the summary as positive and negative results that are helpful to users. Input reviews were also categorized for us to determine how well the system has classified reviews compared to humans. Three evaluation measures are used depending on which system performance Calculated, these are:

- Precision
- Scrap
- Accuracy

Table 1: Stew Matrix

Prototype	Proximate Positives	Proximate Negatives
Positive Prototype	Positive True Prototype(Ptp)	Negative False Prototype(nf)
Negative Prototype	Negative False Prototype(Nfp)	Negative True Prototype(nt)

Precision: All correct prediction against the example is part of the examples 90% reading means that the example of the prediction is exactly the same as the real *Examples.*

Precision = ptp + nf / Ptp+nt+nfp+nf

Scrap: Scrap is part of the real positive example examples against all positive predictions.

Scrap = ptp / ptp+nf

Accuracy: Accuracy part of true positive prediction examples against all real positives Examples.

Accuracy = ptp / ptp+nf

V. Conclusion

Sentiment analysis is an emerging research area and this work is very important because people spent most of his time on the web. This paper proposes to determine an attitude orientation which means polarity of Hindi reviews. Opinion must be mined Due to the increase in Hindi data on the web, the Hindi language performed. The Various positive, negative and natural Hindi word sentence summary results are generated which are helpful for the algorithm in decision making. The Experimental results show that the proposed approach is performing well in this domain and work can be extended to feature base performance in the future. Remove opinion from these reviews and review opinion mining in Hindi to perform Opinion mining in other Hindi domains.

References Références Referencias

1. K. M. Anil Kumar, N. Rajasimha, M Reddy, A. Rajanarayana, K. Nadgir, “Analysis of Users' Sentiments from Kannada Web Documents”, Eleventh International Conference Communication Networks, vol. 54, pp. 247-256, August 2015.
2. Kishorjit, Sivaji et al., "Verb Based Manipuri Aanalysis”, International Journal on Natural Language Computing (IJNLC) Vol. 3, No.3, pp. 113-119, June2014.
3. Mohsen Farhadloo, Erik Rolland,” Multi-Class Sentiment Analysis with Clustering and Score Representation”, IEEE 13 th International Conference on Data Mining Workshops, pp. 904-912, December 2013.
4. Richa Sharma1, Shweta Nigam2 and Rekha Jain (2014b) “Opinion Mining in Hindi Language: A Survey” International Journal in Foundations of Computer Science & Technology (IJFCST), Vol.4, No.2, March 2014.
5. Dilip kumar et al., "Verb Based Manipuri Aanalysis”, International Journal on Natural Language Computing (IJNLC) Vol. 3, No.3, pp. 113-119, June 2014.
6. Basant Agarwal and Namita Mittal, “Optimal Feature Selection Methods for Sentiment Analysis”, In 14th International Conference on Intelligent Text Processing and Computational Linguistics (CICLing 2013),Vol-1 , 7817, pages-13-24, 2013.
7. Subhabrata Mukherjee and Pushpak Bhattacharyya, “Sentiment Analysis in Twitter with Lightweight Discourse Analysis”, In Proceedings of the 24th International Conference on Computational Linguistics (COLING 2012), 2012.
8. A. Joshi, B. A. R, and P. Bhattacharyya,” A fall-back strategy for sentiment analysis in Hindi: a case study” In International Conference on Natural Language Processing (ICON), 2010.

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All the Fellow members of FCSRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.

Career | Credibility | Reputation

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Get discounts on the future publications

Fellows receive discounts on future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career Financial

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Unlimited forward of Emails

Fellows get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

Career Credibility Reputation

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To take future researches to the zenith, fellows receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

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Organize seminar/conference

Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career Credibility Financial

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Early invitations to all the symposiums, seminars, conferences

All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

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Fellows can publish articles (limited) without any fees. Also, they can earn up to 70% of sales proceeds from the sale of reference/review books/literature/publishing of research paper. The FCSRC member can decide its price and we can help in making the right decision.

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Get a remuneration of 15% of author fees

Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

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Become a member of the Editorial Board

Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

Career Credibility Exclusive Reputation

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All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.

ACSRC

ASSOCIATE OF COMPUTER SCIENCE RESEARCH COUNCIL

ASSOCIATE OF COMPUTER SCIENCE RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

> The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.

Benefit

To the Institution

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Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

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Certificate, LoR and Laser-Momento

Associates receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Associates can use the honored title of membership. The "ACSRC" is an honored title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., ACSRC or William Walldroff, M.S., ACSRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

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Career | Credibility | Reputation

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Career Credibility Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

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Exclusive

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Earn 30-40% of sales proceeds

Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Exclusive | Financial

Reviewers

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Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

And Much More

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Associate	Fellow	Research Group	Basic
$4800 **lifetime designation**	$6800 **lifetime designation**	$12500.00 **organizational**	APC **per article**
Certificate, LoR and Momento 2 discounted publishing/year **Gradation** of Research 10 research contacts/day 1 **GB** Cloud Storage **GJ** Community Access	**Certificate,** LoR and Momento **Unlimited** discounted publishing/year **Gradation** of Research **Unlimited** research contacts/day 5 **GB** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**Certificates,** LoRs and Momentos **Unlimited** free publishing/year **Gradation** of Research **Unlimited** research contacts/day **Unlimited** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**GJ** Community Access

Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
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- Findings
- Writings
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- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

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1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

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Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Computer Science Research Paper

Techniques for writing a good quality computer science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10.Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- o Single section and succinct.
- o An outline of the job done is always written in past tense.
- o Concentrate on shortening results—limit background information to a verdict or two.
- o Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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