

A BIG DATA ENABLED CHANNEL MODEL FOR 5G WIRELESS COMMUNICATION SYSTEMS

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ABSTRACT

The normalization movement of the fifth era (5G) remote interchanges has of late been quickened and the main business 5G administrations would be given. The developing of huge PDAs, inventive multipart situation, cumbersome recurrence groups, enormous reception apparatus components, and thick little cells will manufacture huge datasets and pass on 5G interchanges to the age of huge information. This contradiction examines a scope of solicitation of huge information investigation, particularly AI calculations in remote correspondences and channel displaying. We recommend a major information and AI empowered remote channel model structure. The proposed channel model depends on fake neural organizations (ANNs), along with feed-forward neural organization (FNN) and spiral premise work neural organization (RBF-NN). The commitment imperative are transmitter (Tx) and beneficiary (Rx) organizes, Tx-Rx separation, and transporter recurrence, while the yield boundaries are channel measurable properties, tallying they got power, root mean square defer spread, and RMS point spreads. Datasets used to prepare and examination the ANNs are gathered from together genuine channel estimations and calculation based stochastic model (GBSM). Reproduction grades show excellent execution and pick that AI calculations can be compelling insightful instruments for future estimation based remote channel displaying.

Keywords: Big data, wireless communications, machine learning, channel modelling, artificial neural network

INTRODUCTION

Remote correspondence frameworks are the Eureka comparing of our event indicated the fast mechanical developments in the earlier many years and consistency advances for the Internet of Things. Until this point, five age of portable remote cell interchanges frameworks exist, with the new age being the fifth era (5G) remote organization. It is the interest for rapid solid correspondences with essentially improved client experience that drives the advancement of the Fifth Generation (5G) remote correspondence organizations. It has been generally acknowledged that the limit of 5G remote correspondence frameworks ought to accomplish multiple times bigger than the Fourth Generation (4G) Long Term Evolution (LTE)/LTE-Advanced (LTE-A) remote correspondence framework. Likewise, ghastly effectiveness is needed to arrive at multiple times regarding current 4G LTE-A, which is comparable to 10 Gbps top information rate for low portability clients and 1 Gbps top information rate for

high versatility clients. The Mobile and remote correspondences Enablers for Twenty-twenty Information Society (METIS) venture even anticipates that 10 should multiple times higher information rates for commonplace clients

5G organizations will convey a broad assortment of administrations containing upgraded versatile broadband (eMBB), super dependable and low-idleness correspondences (uRLLC), and enormous machine type interchanges (mMTC); for point by point data about the vision, prerequisites, and center highlights of 5G remote cell portable correspondence organizations. In any case, remote information traffic volume and the greatness of associated things are relied upon to jump to hundredfold of hardware in a given cubic meter. Also, information hungry applications, for example, sending holographic recordings needs a range transfer speed that is right now inaccessible in the mm-wave range. The present circumstance presents troublesome difficulties on a region or a spatial otherworldly proficiency and the

required recurrence range groups for availability. Consequently, a more extensive radio recurrence range data transfer capacity has become a need and must be found at the sub-terahertz (THz) and THz groups. Moreover, the effective increment of differentiated versatile applications, particularly those upheld by Artificial Intelligence (AI) innovation, is prodding warmed conversations on the future development of remote interchanges

Notwithstanding the customary phantom effectiveness necessities, other Key Performance Indicators (KPIs) have been considered in the plan of 5G remote correspondence organizations. To empower longer battery lifetime for gadgets, energy proficiency, which gauges the communicated bit per Joule, should be improved by multiple times. The Traffic Volume Density (TVD) portrays information throughput per unit zone. It was accounted for that the objective for 5G is to build the TVD by a factor of 1000. The capacity to handle countless gadgets will be mandatory as there will be billions of associated gadgets in the 5G remote correspondence network by 2020. The multiple times decreased End-to-End (E2E) inactivity will assume a significant part in improving client experience. It is additionally foreseen that concurrence of different Radio Access Technologies (multi-RATs) is unavoidable in 5G remote correspondence organizations. For this situation, the utilization of unlicensed range will be more effective. Besides, extra situations, for example, High Speed Train correspondences, Machine to-Machine interchanges, and short power huge machine correspondence will be keep up in 5G. To persuade the previously mentioned prerequisites, prevalent advances, for example, progressed various access plans, more range, denser little cells, and high-effectiveness different radio wire methods will be key parts of 5G remote correspondence organizations

RELATED WORKS

In [1] Cheng-Xiang Wang, Fourat Haider, Xiqi Gao and Xiao-Hu You, Yang et al presents The fourth era remote correspondence frameworks have been conveyed or are destined to be sent in numerous nations. In any case, with an explosion of remote cell phones and powers, there are stationary different questions that can't be obliged consistent by 4G, for

example, the range emergency and high energy utilization. Remote framework stylish have been in facade of the relentlessly increasing demand for high information rates and portability needed by novel remote applications and hence have begun research on fifth era remote frameworks that are relied upon to sort out past 2020. In this uncover, we suggest a potential cell underlying model that isolates indoor and open air circumstance, and impart a scope of capable innovation for 5G remote correspondence frameworks, for example, tremendous MIMO, energy-effective foundation, psychological radio affiliation, and noticeable light interchanges. Future debate confronting these potential innovations is likewise consider. One of the by and large unequivocal difficulties is the corporal shortage of radio recurrence spectra owed for cell interchanges

In [2] Zhong Fan, Woon Hau Chin, And Russell Haines et al presents As the receive of Long Term Evolution (LTE)/4G cell quickens, there is expanding interest in information that will depict the consequently age media transmission standard. This editorial recognizes a few arising innovations which will change and characterize the people in the future of media transmission standards. A portion of these innovations are already creation their strategies into principles, for example, 3GPP LTE, while others are as yet in advancement. Furthermore, we will show up at a few of the exploration issues that these novel advances present. In this editorial, we order a few advances, rank in apparent result, which will be urgent in possibility remote guidelines. These might improve limit, revealing, or energy proficiency. We have secret a few of these innovations as indicated by the thing they are attempting to achieve in Table. Table shows scientific classification of these advances as far as their functionalities in the organization. It likewise there the status of a few of the remote normalization bodies, tallying 3GPP, IEEE 802.11, and OneM2M and perceive a tad bit of the analyst face that these advancements will move. This shows expanding interests to amalgamate different innovations to support prospect network and information rates

In [3] KUN YANG, QIN YU, SUPENG LENG et al presents another kind of correspondence network called information and energy coordinated correspondence networks which incorporates the generally detach two

movement, i.e., remote in grouping transport and remote energy migrate, satisfying co-transmission of information and energy. In careful, the energy transmission utilizing radio recurrence is for the rule of energy gathering relatively than data disentangling. One driving intensity of the appearance of DEINs is remote enormous information, which comes from remote sensors that produce a huge amount of little bit of information. These sensors are normally controlled by progression that channels at some point or another and should be locked in out and afterward supplanted or energized. EH has arisen as an innovation to remotely charge batteries in a contactless strategy. Late examination work has endeavored to consolidate WET with WIT, traditionally under the brand of synchronous remote data and force move. Such work in the story generally centers around the correspondence surface of the entire remote organizations with specific significance on impact allotment. The DEIN correspondence network arranged in this broadsheet respects the intersection of WIT and WET as an involved association that thinks about the actual layer as well as the more noteworthy layers, for example, media permission control and data steering.

In [4] Dongxuan He, Chenxi Liu, Tony Q. S. Quek, and Hua Wang et al presents To expand the likely advantages of AI in alluring actual layer asylum in multi-input multi-yield multi-recv wire snoop wiretap channels. To this end we center around the situation where the source receives send receiving wire determination (TAS) as the transmission technique. We guess that the channel state data of the real beneficiary is open to the establishment, while the CSI of the snoop can be additionally known or not perceived at the source. By demonstrating the issue of TAS as a multi-class order issue, we propose two AI based plans, to be specific, the help vector machine-based plan and the credulous Bayes-based plan, to pick the best likely radio wire that misuse the mystery execution of the thought about course of action. Assess to the traditionalist TAS design, we show that our expected plans can achieve around the indistinguishable mystery execution with respectably humble input overhead. The work accessible here offer bits of knowledge into the plan of novel AI based ensured transmission plans. We accept that the source receives TAS as the transmission technique. We initially portray the issue of TAS as a multi-class arrangement issue.

In [5] Xiang Cheng, Luoyang Fang, Xuemin Hong, and Liuqing Yang et al presents The overall pack of 4G LTE portable correspondence networks has quicken the multiplication of the versatile Internet and energize a novel thrive of portable solicitation on PDAs. This creative wave has given portable administrators a gigantic occasion to accumulate a tremendous measure of information to screen the mechanical and conditional parts of their organizations. Contemporary analyze on portable enormous information evacuation have revealed its gigantic potential for grouped rule assortment from recovering traffic the executives, empowering individual and relevant military, to observing city elements, etc. The versatile enormous information research has multi-disciplinary landscape that requests unmistakable data from portable correspondences, signal handling, and information mining. The exploration field of versatile large information has arisen rapidly as of late, however is somewhat divided. This analysis means to offer a coordinated image of this arising field to connect various controls and ideally to energize desires research. On one hand, it has been clear that portable Internet not just offers customary administrations running on the fixed Internet, yet empowers a wide scope of new applications that permits the Internet to be associated with pretty much every part of present day life.

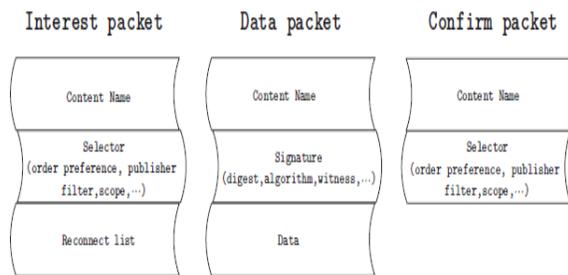
PROPOSED SYSTEM

The proposed channel model has a decent compromise among precision, intricacy, and adaptability. Existing channel models depend on numerous suspicions, while ANN based channel model structure is straightforwardly gained from the datasets and can be more exact. For various organization design arrangements (transporter recurrence, Tx/Rx position, and so forth), the current channel models should be run each time, which is convoluted and tedious. On opposite, the channel measurable properties can be straightforwardly gotten in a basic manner by the educated machine/work progressively. Also, various conditions should be built in beam following model and distinctive boundary sets should be acquired in WINNER-like model each time, while love general ANN based channel model structure can be gained from datasets gathered from different situations. The exhibition of the proposed ANN based channel model is

completely explored through broad reenactments dependent on genuine channel estimation information and calculation based stochastic model (GBSM) produced information.

Caching Mechanism

In light of the attributes of 5G cell engineering and NDN design, we have speculative that while the acknowledged substance are reserved in the SBS (or Macro) and the client demand for the indistinguishable substance, the SBS can straightforwardly ship the substance to the client without asking the worker. For example, as uncovered in Figure when UE1 demands for content insights D1, UE1 would straight be able to get D1 structure SBS1 or Macro with no need to send the interest to the worker.



Since each base SBS are capable of with a blemished stockpiling opportunity to reserve agreeable information, how to improve the store hit rate gainfully elaborate our consideration

Big Data Analytics in Wireless Communications

By and large, huge information insightful instruments incorporate stochastic demonstrating, information mining, and AI. Stochastic demonstrating utilizes probabilistic models to catch the express highlights and elements of the information traffic. Information mining centres on misusing the understood structures in the portable dataset. AI can build up a utilitarian connection between input information and yield activities, along these lines accomplishing auto preparing ability for inconspicuous examples of information inputs. In particular, AI calculations have grown significantly in the course of recent years and have been applied to different territories. We focus on researching the utilizations of AI calculations in remote correspondences and channel displaying

Machine Learning Algorithms

As a rule, AI calculations can be basically sorted as managed learning, unaided learning, and fortification learning. Administered learning intends to take in the planning from the info information to the yield information. For solo learning, the objective is to demonstrate the basic structure of the info information. For support learning, basic prize criticism is needed to consequently decide the ideal conduct inside a particular setting to amplify its exhibition. A few kinds of well known AI calculations incorporate choice tree, Bayesian, bunching, arrangement, relapse, dimensionality decrease, ANN, profound learning calculations, and so forth

Machine Learning in Wireless Communications

As of late, there have been different advancements in applying enormous information examination to remote correspondences. The center to utilize AI calculations in remote interchanges is that numerous issues in remote correspondences can be changed over to bunching, characterization, and relapse issues. By learning and preparing the large datasets in remote interchanges, the organization can be more keen to accomplish better execution and adjust to different applications.

A famous utilization of AI in remote interchanges is indoor and outside confinement/situating. In highlights that speak to engendering conditions were extricated from super wideband (UWB) estimation information, at that point grouping and relapse calculations were created dependent on SVM. SVM can be utilized for non-probabilistic paired order. The created calculations were fit for non-view (NLOS) recognizable proof and alleviation to lessen restriction blunders. In the RVM based restriction calculation was applied for NLOS recognizable proof and relief. Contrasted with SVM, RVM has an indistinguishable useful structure however gives probabilistic order dependent on Bayesian measurements. In two ELMS based calculations were created for indoor situating. ELM is a FNN for characterization or relapse with a solitary layer of concealed hubs, where the loads associating contributions to shrouded hubs are haphazardly allotted and never refreshed. The loads between shrouded hubs and yields are found out in a solitary advance, which

basically sums to learning a straight model. In FNN based limitation calculation was proposed utilizing channel unique mark vectors as sources of info. In the SVM was utilized for range detecting. In the SVM was utilized for receiving wire determination, while in both the SVM and Naive Bayesian were used for reception apparatus choice.

Machine Learning in Wireless Channel Modelling

There has been another pattern to apply enormous information investigation to remote channel demonstrating. As new complex situations, huge recurrence groups, and huge reception apparatuses will be utilized for 5G remote correspondence frameworks, huge channel drive reaction (CIR) datasets will be produced from channel estimation crusades. In the interim, numerous new channel attributes should be estimated and displayed, including three-dimensional (3-D) twofold directional points, non-stationarity in spatial-fleeting recurrence spaces, round wave front, high way misfortune, and high defer goal.

In the RBF-NN was utilized to anticipate the way misfortune. The Tx and Rx statures, Tx–Rx distance, transporter recurrence, and intervene range were the sources of info, and the yield was the way misfortune. In the meager Bayesian learning of RVM was applied to course of appearance (DoA) assessment. It previously acquired coarse sign areas with the sparsity-instigating RVM on a predefined spatial lattice, and afterward accomplished refined course assessment by means of looking. In the RVM was utilized to channel the MPCs of estimated power defer profiles (PDPs) in indoor conditions, empowering the assurance of the postponements and complex amplitudes. The RVM utilized not many piece capacities to produce the sparsity idea, and it permitted the assessment of channel boundaries just as the quantity of MPCs. In the FNN and RBF-NN were joined with beam dispatching in complex indoor conditions. The neural organization was utilized to foresee the halfway focuses in beam dispatching calculation to diminish the calculation multifaceted nature. In large information was utilized to demonstrate remote channels, and a group cores based channel model was proposed. To begin with, the estimation information was prepared by utilizing high goal assessment calculations to acquire MPC boundaries and afterward grouped. Then, the picture

preparing calculations were applied to reproduce the estimation climate and discover primary dispersing objects. The bunches and scatterers were coordinated dependent on the group attributes and article properties, and afterward a set number of group cores were shaped. With the bunch cores, the CIR was delivered by AI calculations, for example, ANN.

Machine Learning Enabled Channel Model

Channel displaying is significant for framework plan and execution assessment. From channel demonstrating, some significant channel factual properties including huge scope and little scope boundaries can be acquired. By and large, channel estimations will be irreplaceable to approve channel models. For the coming 5G remote interchanges, the situations become more confounded, for example, mm Wave, gigantic MIMO, fast trains, and so on Channel estimations should be led to concentrate new direct proliferation attributes in these difficult situations. The enormous transfer speeds, huge radio wires, quick speed, and different situations will produce huge datasets which are tedious for information present preparing and required on be taken care of by AI. By gaining from channel estimation datasets, significant channel factual properties can be acquired and communicated as a non-straight capacity of subjective known information sources, in this manner diminishing the tedious channel estimations and confounded information post-preparing works. Nonetheless, a channel sounder which can fulfill all the 5G new organizations is extravagant and testing, and channel estimation crusades are additionally very tedious. It is difficult to accomplish enormous datasets from channel estimation crusades, which ought to contain different setups, for example, various situations, Tx and Rx radio wire arranges, Tx–Rx distances, and transporter frequencies. We option in contrast to together certifiable channel measurement datasets and GBSM recreation datasets. Estimation datasets are acquired at some fixed areas, while reenactment datasets are gotten in an irregular way.

GBSM modelling approach

GBSM is a mainstream channel demonstrating approach. It speaks to scatterers with normal or sporadic math shapes. The MPC boundaries including force, deferral, and flight and appearance points are then determined from the calculation connections. The

GBSM utilized here is a 3-D wide band mm Wave MIMO channel model. Groups in the 3-D space are created with a homogeneous Poisson point measure (PPP) to catch impacts of the climate. The Tx and Rx reception apparatuses are encircled by two circles to impersonate the grouping property of MPCs in both postponement and precise areas. The scatterers are connected with beams in each group which are restricted by surfaces of a round cone and a circular section. After the age, all things considered, and scatterers, courses from the Tx receiving wire to the Rx radio wire are framed, each relates to a MPC with boundaries of got force, deferral, and flight and appearance points. The got power is determined from way misfortune model, the postponement is gotten from the length of each MPC, while the flight and appearance points are determined from the calculation connections. The channel model is approved by contrasting and diverts estimations in a similar office climate and used to create enormous channel datasets.

From the MPC restriction, unassuming critical channel arithmetical things can be procured. The total got power is resolved as

$$P = \sum_{l=1}^L p_l.$$

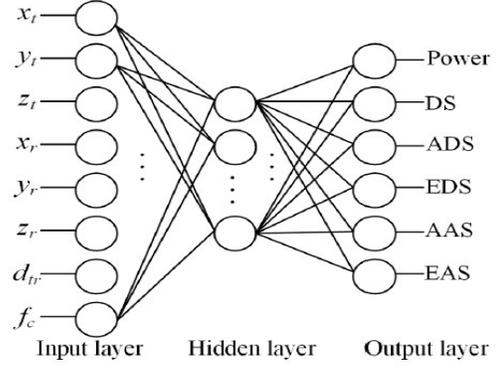
The RMS DS is a significant second-request measurement to depict divert scattering in defer space and can be determined as

$$DS = \sqrt{\frac{\sum_1^L p_l \tau_l^2}{\sum_1^L p_l} - \left(\frac{\sum_1^L p_l \tau_l}{\sum_1^L p_l}\right)^2}.$$

The RMS AS is a significant second-request measurement to portray direct scattering in point area and can be determined as

$$AS = \sqrt{\frac{\sum_1^L p_l \psi_l^2}{\sum_1^L p_l} - \left(\frac{\sum_1^L p_l \psi_l}{\sum_1^L p_l}\right)^2}$$

ANN Based Channel Model



ANN depends on a huge assortment of basic neural units. Each neural unit is associated with numerous others. Edges of the hubs and loads of the associations are prepared to get familiar with the non-straight connection between the data sources and yields. The datasets are normally separated as preparing and testing datasets. For multi-dimensional displaying, FNN and RBF-NN are the broadly utilized ANN calculations. FNN expands the quantity of non-straight divisions utilizing two layers containing enactment capacities to accomplish high non-linearity. FNN contains one info layer, one concealed layer, and one yield layer. RBF-NN utilizes a solitary layer with a high number of neurons with a similar objective of accomplishing higher number of non-direct division. Since neurons are added as learning proceeds and just one layer of loads is to be changed for RBF-NN, its computational expense of learning is not as much as that for FNN

For GBSM recreation information, a sum of 500 gatherings of datasets are created from multiple times Monte-Carlo reproductions, in which 400 gatherings are utilized for preparing and the left 100 gatherings are utilized for testing. The Tx and Rx arranges are changing arbitrarily in the kept climate, the Tx–Rx distance is determined by Tx and Rx facilitates, and the transporter recurrence is differing haphazardly in the scope of 10 GHz to 60 GHz. The eight boundaries are utilized as contributions of the ANN. The creation are the six channel measurable properties, tallying got power P , RMS DS σ_{ds} , AAoD spread (ADS) σ_{ads} , EAoD spread (EDS) σ_{eds} , AAoA spread (AAS) σ_{aas} , and EAoA spread (EAS) σ_{eas} . The relationship among the information sources and yields is

$$y(P, \sigma_{ds}, \sigma_{ads}, \sigma_{eds}, \sigma_{aas}, \sigma_{eas}) = f(x_t, y_t, z_t, x_r, y_r, z_r, d_{tr}, f_c).$$

As the data sources have clear actual implications, their qualities are fluctuating in various reaches and at various levels with various units, the information boundaries should be standardized and planned to be in the scope of -1 to 1 . The yields likewise have comparable reverse change tasks to get genuine anticipated qualities. In our recreations, both the FNN and RBF-NN are utilized to foresee channel measurable properties. The forecast exhibitions of the two ANN calculations are likewise looked at

RESULT AND DISCUSSION

In the simulations, for both FNN and RBF-NN, the Levenberg-Marquardt optimization algorithm is used to train the neural network, the mean square error (MSE) is selected to evaluate the prediction performance, and the number of iterations was set as 1000. Compared with RBFNN, the goal of convergence for FNN is larger to avoid local optimization and over-fitting. The detailed parameters and values for FNN and RBF-NN are summarized

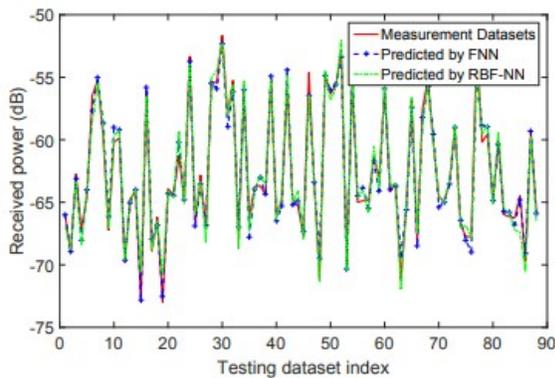


Fig. 3. Measurement and predicted received power.

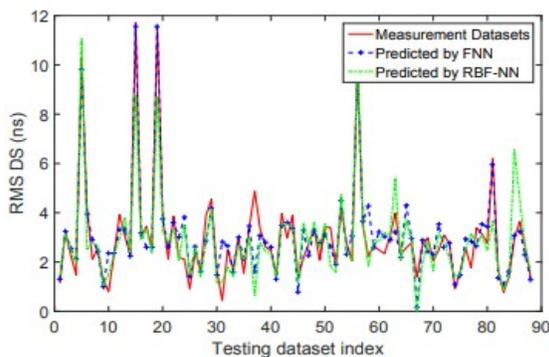


Fig. 4. Measurement and predicted RMS DS.

Once the ANN is trained to achieve the goal of convergence error, the neural network is well learned for the training datasets, and it can predict the outputs for testing input parameters. The predicted outputs can then be compared with measured and simulated outputs to evaluate the performance of the learned neural network.

CONCLUSION

The outstanding increment of portable information has carried 5G remote organization to the period of enormous information. In this paper, we have researched different AI calculations and late improvements in applying huge information examination to remote interchanges and channel demonstrating. An ANN based channel model structure has been proposed. Datasets have been created from authentic channel limit and GBSM reenactment. Both the FNN and RBF-NN have been applied and looked at. Significant channel measurable properties including the got power, RMS DS, and RMS ASs have been anticipated. Recreation outcomes have been dissect and verify, which have indicated that AI calculations can be compelling analytical instruments for prospect estimation based remote channel model.

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