IJITCE

ISSN 2347- 3657

International Journal of Information Technology & Computer Engineering

Email : ijitce.editor@gmail.com or editor@ijitce.com

International Journal of Information Technology & Computer Engineering

ISSN 2347–3657
Volume 8,Issue 4, oct 2020

Optimization Algorithm Inspired by Artificial Bee Colonies to Improve Wireless Network Routing

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Abstract:

Using an AI algorithm, the capacity of wireless multi-channel networks may be increased. It's possible that network performance may increase if interference was reduced. This method has three stages: first, a model of the wireless environment is created; second, performance is optimised using the appropriate tools; and third, routing is improved by carefully picking performance metrics. The communication in wireless networks is improved by the use of an artificial bee colony optimization method with evaluation characteristics. This technique uses the straightforward actions of bee agents to make synchronised and distributed routing choices. The MATLAB simulations clearly show the benefits of this technique. As compared to the current state-of-the-art models, the performance of the routing algorithm inspired by nature is much higher. Even a very basic agent model has the potential to boost the network's performance. When trying to maximise the output of a routing protocol, the breadth-first search version is used to find and deterministically weigh all of the possible pathways across a network.

Keywords:

Synonyms: wireless networks, throughput, routing, AI, and robotic hive

Introduction

Wireless networks are now a fundamental part of every communication system [1] due to the widespread use of portable and mobile devices. The requirement for more network capacity is mandated by the ever-increasing demands placed upon the network's resources. Improving wireless network capacity necessitates the use of effective algorithms and protocols. The throughput of wireless networks may also be improved with the use of these techniques. Multiple nodes in a wireless network are responsible for data receipt and transmission [2]. In order to guarantee that data is sent to the network nodes quickly and efficiently, it is necessary to have well-designed network protocols. These protocols are critical to the functioning of a wireless network. Enhanced methods and schemes are required to back up the features of next-generation networks. Current network requirements are being met in part by the efforts of a number of academics who are creating cutting-edge methods. In order to create cutting-edge and contemporary wireless networks, researchers have studied the networks found in insects and other species [3]. Through the power of wireless networks, users from all over the world may be quickly located and linked together. The power of a wireless network's signal weakens as it travels farther away from its source owing to factors such as weather and geography. Wider signal transmission over the region of the sensor network is required to guarantee reliable data transfer between the source

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and the destination. Wireless networks have several benefits, and their use across large network regions are one of them [4]. From inside the network, a cognitive system may monitor how the individual nodes are doing. In this setup, the network capacity determines the degree to which network pieces may self-recover [5]. The knowledge plane (KP) is the central component of a distributed cognitive system that may be utilised to provide system control, learning, and thinking capabilities. This method may be used to develop and update a comprehensive model of a network [6]. Making sure the network always makes the best possible routing choice may also help boost throughput. Using knowledge plan, it is possible to improve knowledge-based networks by facilitating the routing of information and reasoning on a global and local scale. Improve network performance and routing efficiency with this savvy function [7]. The appropriate instructions are supplied into the cognitive system so that one person may recognise the notion in the context of the hypotheses already provided. In order to assess network efficiency and exert control over other network components, the system is able to decipher the cognitive properties of individual nodes. Knowing the network environment inside and out is crucial for improving performance [8].

Contents and Plans

Flexibility in wireless routing is optimised by using AI principles to increase network performance. One of the greatest benefits of wireless networks is the ease with which data may be sent across great distances [7]. To maximise network efficiency, data transmission paths are optimally selected between sender and recipient. If a data packet's intended path is congested, the next shortest path is taken. However, there are certain limitations to wireless networks, such as interference. In this configuration, several nodes in the network share the same channel and bandwidth. As a consequence of this interference, the throughput of the network as a whole suffers. Diverse factors and their performance values altering in a systematic way, as well as the vast operating environment coverage range [11], motivate the construction of certain scenarios. The method may be conceived via brain storming to include the three broad areas of network engineering: quantum traffic engineering, hybrid traffic engineering, and practical applications. When better statistical performance values are sought after over numerous tries, quantum traffic engineering may be employed to provide repeatable abstraction patterns [12]. The estimated performance numbers are the mean of five experiments. The average values obtained do away with the randomness introduced by the method. The suggested method handles multimedia traffic in several ways, including the usage of the G.711 codec, concurrent Voice over IP sessions [13], and one sample per packet. It has been determined that a connection speed of about 64 kbps is necessary for the functioning of a Voice over IP session.

The suggested method is effective in meeting all criteria, including the delivery of packets with the specified latency and jitter. Current experiments with simulating and implementing comparable concepts are exciting. The present experiment makes advantage of the available software and hardware resources to run the realisable optimised artificial bee colony method on a core 2 duo CPU. The use of this technique in practical network settings has yielded a number of useful outcomes. It's possible to use this method to massive network designs as well. With the use of data science, the extracted data is transformed into actionable insights. Multiple machine learning, deep learning, and other AI algorithms study the data and make predictions based on what they've learned. Learning mechanisms within a wireless network's environment offer smart capabilities and context awareness in a variety of wireless communication domains. These algorithms have been widely used due to their ability to improve network speed and quality of service.

These algorithms, thanks to their smart behaviour, are able to adapt to the constantly altering, complicated wireless settings. Integrating automation features into wireless networks allows for the implementation of self-optimization and self-healing strategies. Data-driven methods are examined in the context of cellular networks, cognitive radio networks, wireless body area networks, wireless sensor networks, and mobile ad hoc networks. These methods are used to a wide range of problems, such as spectrum sensing, energy harvesting communication, localisation, data clustering and aggregation, routing, and medium access control. Problems with anomaly detection, grouping, classification, and regression are some of the most common applications of machine learning methods.

Dissertations and Outcomes

Deduced experimental findings are expounded upon here. Both the findings of the simulation and those of applying the method on real-time networks are reviewed. To ensure the protocol's efficacy, a new framework has been developed. Model validation and implementation are both performed in MATLAB. From these traffic pattern data, MATLAB infers those comparable patterns and outcome are found on the selected methods. Pattern creation on virtual computers running Linux is compared to pattern generation on physical

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 8,Issue 4, oct 2020

machines running other operating systems, all while utilising different real-world networks. The optimization network protocol inspired by artificial bee colonies allows for simple real-time and virtual concept tracking of similarity. For the sake of experimentation, many real-world networks have been put up. In these settings, intelligent routing strategies are tested and compared.

Experiments in Network Traffic Learning

Certain experiments are used to verify the traffic network performance, its learning, and its improvements. During the course of the trials, the values of numerous parameters are changed. As the network approaches capacity, its behaviour must be analysed. The network's behaviour is analysed by systematically adjusting each parameter. Changing the number of repetitions in addition to the other parameters allows one to examine the effect on network traffic burden. These tests are conducted in a real-time network utilising a Linux router and the MATLAB software package. Parameter values and virtual machine values are matched to ensure consistency. In these trials, increasing the number of iterations has been shown to have a favourable effect on the network's performance. The intelligent routing protocol boosts production by assimilating information about the system's environment. With regards to the simulation iterations, the best-cost results are shown in Figures 1, 2, and 3.

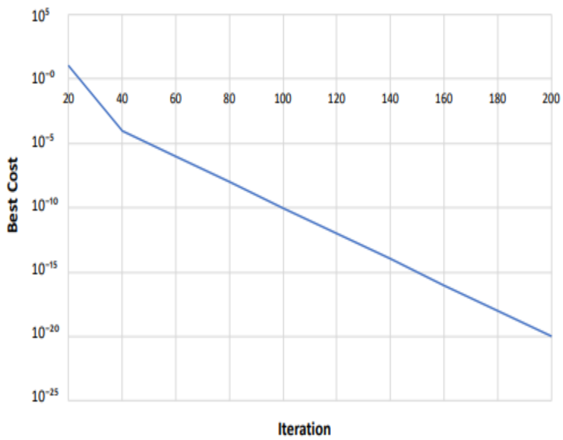

Figure 1: Simulation for 200 iterations

The results of the simulation show that the number of delivered packets grows proportionally with the number of simulated iterations. The routing algorithm improves its performance over time by using the data collected from the wireless network. Some packets go across the network more slowly than others because of the queueing function. However, this latency varies considerably across different simulation sessions and between different networks in the actual world. The bits, signals, and physical medium are kept in check while the wireless physical layer handles functions including transmission mode management, forward error correction, coding, bit-by-bit delivery, and modulation. Artificial neural networks (ANN) may be used to improve the efficiency of the wireless physical layer in a variety of contexts. In the absence of knowledge about the transmission channel, an end-to-end transmission model may be constructed using a feed forward neural network. This technique is useful for determining how to connect the channel's gain values with the hidden layers, as well as the receiver's output and the transmitter's input. By doing so, a specialised mathematical model of the channel is not required. Since this approach may be used to continuous data for signal rectification and detection, spiking neural networks (SNN) can enhance the quality of sent signals. The SSN may be used to identify incoming signals by using previously obtained signal pattern recognition knowledge. As an added option, erroneous signals may be identified and fixed. Convolution neural networks (CNN) and deep neural networks (DNN) may be used for modulation categorization because of their data extraction and storing capabilities (DNN). ANNs are used to investigate problems including channel decoding, learning transmitted symbols, and signal identification in physical layer design. ANNs may be used for physical layer design applications such collision detection, carrier sensing, classification, modulation control, signal rectification, signal detection, channel coding, and decoding.

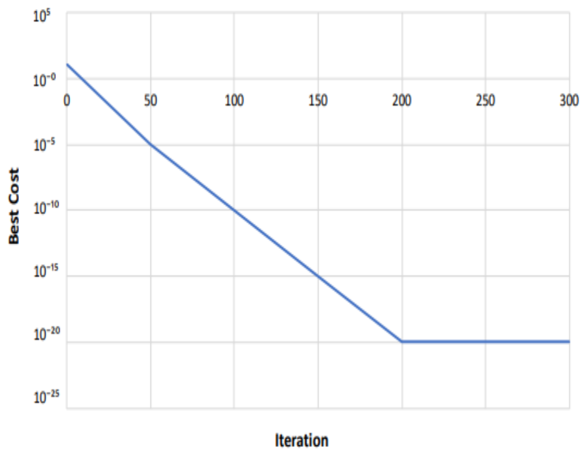

Figure 2: Simulation for 300 iterations

Due to the time-varying activation value of each spiking neuron in SNN, the "weight" or "connection strength" between any two neurons might change over the course of a given period of time. SNN's representation of weight reduction or increase, respectively, is known as depression and potentiation, respectively. Modifications are divided into "short term" and "long term" categories according to the length of time it takes for their effects to become apparent. Based on how long an

ISSN 2347–3657
Volume 8,Issue 4, oct 2020

individual feels the effects of a weight shift, there are four main categories: short-term depression (STD), short-term potentiation (STP), long-term depression (LTD), and long-term potentiation (LTP). The timing of spikes is known to influence the strength of connections between spiking neurons, as is often established in neurobiological studies. Deep SNN is a fantastic DNN design. Thanks to its event-based computational characteristics, this architecture may significantly enhance the efficiency and latency of DNN. Due to its sophisticated characteristics, deep SNNs may be employed in real time applications where power consumption and performance are crucial. Unfortunately, training strategies for deep SNNs are inadequate despite their computational efficiency. Spike signals cannot be separated out individually. The spiking neuron generates spikes whenever the internal state crosses a threshold. However, when using error backpropagation, differentiable activation functions are required. For these reasons, this algorithm is the method of choice for training DNNs. Deep SNN is used sporadically in a variety of fields. Integration with other cutting-edge technology, however, may help overcome these restrictions. Through the use of ANN, it is possible to execute tremendously independent prediction tasks alongside self-organization and other intelligent activities. Decisions allow the collection of new data, and decisions may be made with the use of data. Predicting user actions like content requests and head movement on wireless networks for VR applications is one potential use of ANN. The spectral and computational resource allocation properties of ANN-based RL algorithms and their predictions make it possible to enhance service quality.

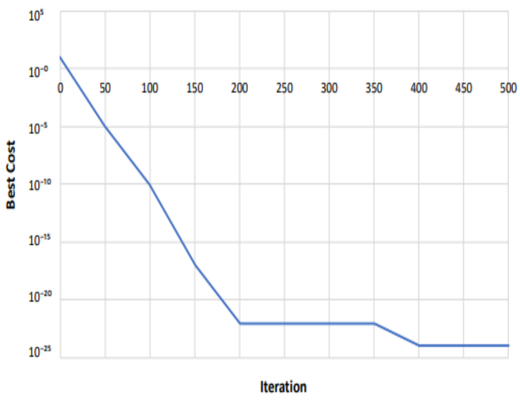

Figure 3: Simulation for 500 iterations

Conclusion

In a lengthy conclusion, the technical and scientific contributions of this study are underlined. The wireless system places an emphasis on knowing and smart routers, and it also makes use of natural engineering. To analyse the qualities of wireless networks, an optimization technique inspired by artificial bee colonies is applied. This kind of algorithm may find use in a wide range of commercial products as a response to technological competition. The organisation and efficiency of honey bee colonies served as a model for this algorithm. This study is inspired by the simple assessment and communication behaviour of bee agents. With the aid of this algorithm, asynchronous and decentralised routing choices may be made. The outcomes of the comprehensive MATLAB simulations show that the suggested technique has various benefits when compared to the current nature-inspired routing algorithms. The candidate method performs better when applied with basic agent models. The routing protocol and its behaviour across wide operating regions are investigated, and the performance results are evaluated against a whole range of network variables. Using a version of breadth first search, the candidate method may examine numerous possible solutions with absolute certainty. This method finds all multiple pathways with a total distance greater than a given threshold. This technique achieves higher performance by randomly sending data packets along various channels. Future research will focus on concurrently finding various pathways with different threshold levels using the routing method, bringing together the best of both stochastic and deterministic approaches.

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