International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 01 | Jan -2017 www.irjet.net p-ISSN: 2395-0072

Artificial Neural Network Analysis in Food Science

[1]Dr.A.Jaganathan, [2]S.Muguntha Kumar

[1]*Principal / Secretary, Food Craft Institute, Hoshiarpur, Punjab, India*
[2]*Assistant professor, Department of Hotel Management & Catering Science*
Muthayammal College of Arts & Science, Namakkal, Tamilnadu, India.

***

Abstract – This paper brings the cultural diversity of culinary practice, as illustrated by the variety of regional cuisines, raises the question of whether there are any general patterns that determine the ingredient combinations used in food today or principles that transcend individual tastes and recipes. We introduce a flavor network that captures the flavor compounds shared by culinary ingredients. In western cuisines show a tendency to use ingredient pairs that share many flavor compounds, supporting the so-called food pairing hypothesis. By contrast, East Asian cuisines tend to avoid compound sharing ingredients. A complete characterization of real networks requires us to understand the consequences of the uneven interaction strengths between a system's components. Solely by changing the nature of the correlations between weights and network topology, the structure of the TSs can change from scale-free to exponential.

In additionally, for some choices of weight correlations, the efficiency of the TSs increases with increasing network size, a result with potential implications for the design and scalability of communication networks. Here we discuss how these approaches can yield new insights both into the sensory perception of food and the anthropology of culinary practice. We also show that this development is part of a larger trend. Over the past two decades large-scale data analysis has revolutionized the biological sciences, which have experienced an explosion of experimental data as a result of the advent of high-throughput technology. We argue that food science is likely to be one of the next beneficiaries of large-scale data analysis, perhaps resulting in fields such as 'computational gastronomy'.

Key Words: Food Science, Artificial Neural Networks, TS, Data analysis.

1. INTRODUCTION

In this study of many complex systems has benefited from representing them as networks. There is now extensive empirical evidence indicating that the degree distribution of the nodes in many networks follows a power law, strongly influencing properties from network robustness to disease spreading. However, to fully characterize these systems, we need to acknowledge the fact that the links can differ in their strength and importance. This is demonstrated, *e.g.*, in social networks where the relationship between two long-time friends presumably differs from that between two casual business associates, and in ecological systems where the strength of a particular species pair-interaction is crucial for the population dynamics.

An artificial neural network, also called as simulated neural network or commonly just neural network is an interconnected group of artificial neurons that uses a mathematical or computational model for information processing based on connectionist approach to computation. In most cases an ANN is an adaptive system that changes its structure based on external or internal information that flows through the network. In more practical terms neural networks are non-linear statistical data modeling tools. They can be used to model complex relationships between inputs and outputs or to find patterns in data. The original inspiration of the technique was from the examination of the central nervous system and the neurons. In a artificial neural network model, simple nodes are connected together to form a network of nodes- hence the term neural network.

A neural network does not have to be adaptive, its practical use comes with algorithms designed to alter the strengths (weights) of the connections in the network to produce a desired signal flow. These networks are also similar to the biological neural networks in the sense that the functions are performed collectively and in parallel by the units, rather than there being a clear delineation of sub-tasks to which various units are assigned. Similar large-scale data analysis methods have more recently arrived in the social sciences as a result of rapidly growing mobile communications networks and online social networking sites. Here too data analysis offers a birds-eye perspective of large social networks and the opportunity to study social dynamics and human mobility on an unprecedented scale. The most recent research areas to be transformed by information technology are the Arts and Humanities, which have witnessed the emergence of 'digital humanities'. As more and more literary and historical documents are digitized, it becomes possible to uncover fundamental relationships that underlie large corpora of literary texts, or long-term historical and political developments. A striking example is the discovery by Lieberman *et al.* that the regularization of verbs across 15 centuries of English is governed by a simple quantitative relationship between the frequency of verb usage and the speed at which it is regularized.

The fact that links in complex networks are weighted rather than binary (present or absent) must be taken into account when considering dynamical network processes like multicast or broadcast, which have important applications in modern computer networks. For instance, when trying to broadcast a message like a new routing table, one must factor in that different paths and links are characterized by varying degrees of time delay, bandwidth, and transmission costs. Consequently, one would attempt to reach all nodes preferably by using as few connections as possible, while at the same time keeping the total weight (*e.g.*, delay) of the traversed links minimal. Similarly, the effective spreading of a computer or biological virus to all nodes in a network would also opt for the low-weight paths. These broadcasting problems all boil down to finding and characterizing the tree structure (TS) of a $(N - 1)$ links reaching all N nodes while minimizing the sum of the link weights.

TSs has received attention as examples of optimal path trees, and recently trees have been invoked to explain properties of trace route measurements of the Internet. At a more fundamental level, TSs are closely connected to invasion bond percolation, which has been studied extensively on regular lattices with both random and correlated link weights, turning IBP into a key model of non-equilibrium statistical mechanics. In this paper, we present the first results on how the structure and efficiency of TSs change as a function of the *correlations* between the link weights and the network topology.

We start by examining the correlations between the weights and the network structure in several real systems. We use the resulting insights to generate weighted scale-free networks, the TSs of which is either scale-free or exponential depending on the nature of the link weight correlations. In contrast, when correlations between weights and topology are removed, we find that the TS degree distribution follows a power law with a degree exponent close to that of the original network, independent of the weight distribution. Finally, we find that the exponential TSs are increasingly more efficient with increasing network size N, while the efficiency of the scale-free TSs quickly saturates at a finite value.

As humans have historically faced the difficult task of identifying and gathering food that satisfies nutritional needs while avoiding food borne illnesses. This process has contributed to the current diet of humans, which is influenced by factors ranging from an evolved preference for sugar and fat to palatability, nutritional value, culture, ease of production, and climate. The relatively small number of recipes in use compared to the enormous number of potential recipes, together with the frequent recurrence of particular combinations in various regional cuisines, indicates that we are exploiting but a tiny fraction of the potential combinations. Although many factors such as colors, temperature, and sound play an important role in food sensation, palatability is largely determined by flavor, representing a group of sensations including odors (due to molecules that can bind olfactory receptors), tastes (due to molecules that stimulate taste buds), and freshness or pungency (trigeminal senses). Therefore, the flavor compound (chemical) profile of the culinary ingredients is a natural starting point for a systematic search for principles that might underlie our choice of acceptable ingredient combinations.

Which over the past decade has received attention among some chefs and food scientists, states that ingredients sharing flavor compounds are more likely to taste well together than ingredients that do not. This food pairing hypothesis has been used to search for novel ingredient combinations and has prompted, for example, some contemporary restaurants to combine white chocolate and caviar, as they share *trim ethylamine* and other flavor compounds, or chocolate and blue cheese that share at least 83 flavor compounds. As we search for evidence supporting (or refuting) any ‘rules’ that may underlie our recipes, we must bear in mind that the scientific analysis of any art, including the art of cooking, is unlikely to be capable of explaining every aspect of the artistic creativity involved. Furthermore, there are many ingredients whose main role in a recipe may not be only flavoring but something else as well. Finally, the flavor of a dish owes as much to the mode of preparation as to the choice of particular ingredients. However, our hypothesis is that, given the large number of recipes we use in our analysis (58,598), such factors can be systematically filtered out, allowing for the discovery of patterns that may transcend specific dishes or ingredients.

Here we introduce a network-based approach to explore the impact of flavor compounds on ingredient combinations. Efforts by food chemists to identify the flavor compounds contained in most culinary ingredients allows us to link each ingredient to 62 flavor compounds on average. We build a bipartite network consisting of two different types of nodes: (i) 381 ingredients used in recipes throughout the world, and (ii) 1,021 flavor compounds that are known to contribute to the flavor of each of these ingredients. A projection of this bipartite network is the *flavor network* in which two nodes (ingredients) are connected if they share at least one flavor compound. The weight of each link represents the number of shared flavor compounds, turning the flavor network into a weighted network. While the compound concentration in each ingredient and the detection threshold of each compound should ideally be taken into account, the lack of systematic data prevents us from exploring their impact.

2. THE BACKBONE OF REAL NETWORKS

To test the performance of the disparity filter algorithm, we apply it to the extraction of the multistage backbone of two real-world networks. We also compare the obtained results with the reduced networks obtained by applying a simple global threshold strategy that preserves connections above a given weight. As examples of strongly disordered networks, we consider the domestic nonstop segment of the U.S. airport transportation system for the year 2006 and the Florida Bay ecosystem in the dry season (19). The U.S. airport transportation system for the year 2006 gathers the data reported by air carriers about flights between 1,078 U.S. airports connected links. Weights are given by the number of passengers traveling the corresponding route in the year summarized to produce an undirected representation. The resulting graph has a high density of connections, _*k*_ = 22, making difficult both its analysis and visualization. The Florida Bay food web comes from the ATLSS Project by the University of Maryland. Trophic interactions in food webs are symbolized by directed and weighted links representing carbon flows (mg C y−1m−2) between species. The network consists of a total of 122 separate components joined by 1,799 directed links.

2.1 NEURAL NETWORK ANALYSIS OF FLAVOUR

The growing availability of network data in a wide variety of research disciplines has made complex network analysis a rapidly growing research area ever since two seminal publications in the late 1990s uncovered fundamental principles that underlie many real-world networks such as social networks, power grids, neural networks and genetic regulatory networks. In recent work we construct a bipartite network of chemical flavor compounds and food ingredients in which a link signifies the natural occurrence of a compound in an ingredient. This data *of Flavor Ingredients,* Using a one-mode projection the bipartite network is converted into a weighted network of ingredients only, in which the weight of a link between two ingredients is given by the number of flavor compounds they share. This weighted network shows a modular organization, with modules corresponding to food types such as fruits, vegetables and meats. While this might be expected, it is particularly interesting to see the location of these modules with respect to each other. Meats for instance lie between fruits and vegetables, and closer to spices and herbs than seafood does. Together with flavor scientists, has suggested that two foods that share chemical flavor compounds are more likely to taste good in combination. By comparing the network of ingredients to a body of 56,498 online recipes, downloaded from epicurious.com, allrecipes.com, and menupan.com, we were able to show that this hypothesis is confirmed in most Western cuisines, but not in Eastern ones. This result indicates that shared compounds may offer one of several possible mechanisms that can make two ingredients compatible.

According to an empirical view known as “the flavor principle, the differences between regional cuisines can be reduced to a few key ingredients with specific flavors: adding soy sauce to a dish almost automatically gives it an oriental taste because Asians use soy sauce widely in their food and other ethnic groups do not; by contrast paprika, onion, and lard is a signature of Hungarian cuisine. Can we systematically identify the ingredient combinations responsible for the taste palette of a regional cuisine? To answer this question, we measure the *authenticity* of each ingredient, ingredient pair, and ingredient triplet (see Methods). We organize the six most authentic single ingredients, ingredient pairs and triplets for North American and Asian cuisines in a flavor pyramid. The rather different ingredient classes (as reflected by their color) in the two pyramids capture the differences between the two cuisines: North American food heavily relies on dairy products, eggs and wheat; by contrast, East Asian cuisine is dominated by plant derivatives like soy sauce, sesame oil, and rice and ginger. Finally, the two pyramids also illustrate the different affinities of the two regional cuisines towards food pairs with shared compounds. The most authentic ingredient pairs and triplets in the North American cuisine share multiple flavor compounds, indicated by black links, but such compound-sharing links are rare among the most authentic combinations in East Asian cuisine.

Our network of ingredients and flavor compounds is just a first step towards a true network of shared flavor compound perception, which would have to include compound concentrations and detection thresholds in order to further investigate the shared compound hypothesis. Its most important purpose is to open up a new way in which data analysis can aid sensory science and the study of culinary practice. In a broader development the increasing availability of data on food usage, food chemistry and sensory biology is likely to result in the establishment of new research disciplines, such as ‘computational gastronomy’.

3. CONCLUSIONS

In our work broader development the increasing availability of data on food usage, food chemistry and sensory biology is likely to result in the establishment of new research disciplines, such as ‘computational in Artificial Neural Network’ . As a criticism, one could say that it only works in the case of systems with strong disorder, where the weights are heterogeneously distributed both at the global and local level. Nevertheless, all filters present limitations; one has to take them into account in relation to the problem under analysis. Which strategy is the most appropriate for a particular problem should be carefully judged and we cannot exclude the possibility that a combination of different techniques turns out to be the most appropriate.

REFERENCES

[1] Strogatz S. H., *Nature*, 410 (2001) 268; Albert R. and Barab´asi A.-L., *Rev. Mod. Phys.*, 74 (2002) 47; Newman M. E. J., *SIAM Rev.*, 45 (2003) 167; Newman M. E. J., Barab´asi A.-L. and Watts D. J., *The Structure and Growth of Networks* (Princeton University Press, Princeton) 2005.

[2] Sherman, P. W. & Hash, G. A. *Why vegetable recipes are not very spicy*. Evolution and Human Behavior 22, 147–163 (2001).

[3] Harris, M. Good to eat: riddles of food and culture (Waveland Press, 1998).

[4] Counihan, C. & van Esterik, P. (eds.) *Food and culture* (Routledge, 2007).

[5] Kinouchi, O., Diez-Garcia, R. W., Holanda, A. J., Zambianchi, P. & Roque, A. C. *The non-equilibrium nature of culinary evolution*. *New Journal of Physics* 10, 073020 (2008).

[6] This, H. Molecular gastronomy: exploring the science of flavor (Columbia University Press, 2005).

[7] A.S.Syed Navaz, C.Prabhadevi & V.Sangeetha"Data Grid Concepts for Data Security in Distributed Computing" January 2013, International Journal of Computer Applications, Vol 61 – No 13, pp 6-11.

[8] A.S.Syed Navaz, V.Sangeetha & C.Prabhadevi, "Entropy Based Anomaly Detection System to Prevent DDoS Attacks in Cloud" January 2013, International Journal of Computer Applications, Vol 62 – No 15, pp 42-47.

[9] A.S.Syed Navaz, A.S.Syed Fiaz, C.Prabhadevi, V.Sangeetha & S.Gopalakrishnan "Human Resource Management System" Jan – Feb 2013, International Organization of Scientific Research Journal of Computer Engineering, Vol 8, Issue 4, pp. 62-71.

[10] A.S.Syed Navaz, S.Gopalakrishnan & R.Meena "Anomaly Detections in Internet Using Empirical Measures" February 2013, International Journal of Innovative Technology and Exploring Engineering, Vol 2 – Issue 3. pp. 58-61.

[11] A.S.Syed Navaz, M.Ravi & T.Prabhu, "Preventing Disclosure of Sensitive Knowledge by Hiding Inference" February 2013, International Journal of Computer Applications, Vol 63 – No 1. pp. 32-38.

[12] A.S.Syed Navaz , T.Dhevisri & Pratap Mazumder "Face Recognition Using Principal Component Analysis and Neural Networks" March -2013, International Journal of Computer Networking, Wireless and Mobile Communications. Vol No – 3, Issue No - 1, pp. 245-256.

[13] A.S.Syed Navaz, H.Iyyappa Narayanan & R.Vinoth." Security Protocol Review Method Analyzer (SPRMAN)", August – 2013, International Journal of Advanced Studies in Computers, Science and Engineering, Vol No – 2, Issue No – 4, pp. 53-58.

[14] Johnson, J. & Clydesdale, F. *Perceived sweetness and redness in colored sucrose solutions*. Journal of Food Science 47, 747–752 (1982).

[15] Shankaer, M. U. & Levitan, C. A. *Grape expectations: the role of cognitive influences in color-flavor interactions*. Conscious Cogn. 19, 380–390 (2010).

[16] Albert R., Jeong H. and Barab´asi A.-L., *Nature*, 406 (2000) 378; Cohen R., Erez K., ben-Avraham D. and Havlin S., *Phys. Rev. Lett.*, 85 (2000) 4626; Callaway D. S., Newman M. E. J., Strogatz S. H. and Watts D. J., *Phys. Rev. Lett.*, 85 (2000) 5468.

[17] Pastor-Satorras R. and Vespignani A., *Phys. Rev. Lett.*, 86 (2001) 3200.

[18] Yook S. H., Jeong H., Barab´asi A.-L. and Tu Y., *Phys. Rev. Lett.*, 86 (2001) 5835.

[19] Goh K.-I., Kahng B. and Kim D., *Phys. Rev. Lett.*, 87 (2001) 278701

[20] Barrat A., Barth´elemy M., Pastor-Satorras R. and Vespignani A., *Proc. Natl. Acad. Sci. U.S.A.*, 101 (2004) 3747.

[21] Toroczkai Z. and Bassler K. E., *Nature*, 428 (2004) 716.

[22] Granovetter M., *Am. J. Soc.*, 78 (1973) 1360.

[23] Berlow E. L., *Nature*, 398 (1999) 330.

[24] A.S.Syed Navaz & K.Girija "Hacking and Defending in Wireless Networks" Journal of Nano Science and Nano Technology, February 2014, Volume- 2, Issue – 3, pp - 353-356.

[25] A.S.Syed Navaz & R.Barathiraja "Security Aspects of Mobile IP" Journal of Nano Science and Nano Technology (International), February 2014, Volume- 2, Issue – 3, pp - 237-240.

[26] A.S.Syed Navaz, G.M. Kadhar Nawaz & B.Karthick." Probabilistic Approach to Locate a Mobile Node in Wireless Domain", April – 2014, International Journal of Computer Engineering and Applications, Vol No – 6, Issue No – 1, pp.41-49.

[27] A.S.Syed Navaz & G.M. Kadhar Nawaz, "Ultra Wideband on High Speed Wireless Personal Area Networks" August – 2014, International Journal of Science and Research, Vol No – 3, Issue No – 8, pp.1952-1955.

[28] A.S.Syed Navaz & Dr.G.M. Kadhar Nawaz & A.S.Syed Fiaz "Slot Assignment Using FSA and DSA Algorithm in Wireless Sensor Network" October – 2014, Australian Journal of Basic and Applied Sciences, Vol No –8, Issue No –16, pp.11-17.

[29] A.S.Syed Navaz, S.Ravishankar & M.Sudarson, "Tracking Objects Using Multiple Acoustic Video Systems DISCOVERY The International Daily journal, September 2015, Volume – 37, Issue - 168, pp - 59-64.

[30] A.S.Syed Navaz & A.S.Syed Fiaz, "Load Balancing in P2P Networks using Random Walk Algorithm" March – 2015, International Journal of Science and Research, Vol No – 4, Issue No – 3, pp.2062-2066.

[31] A.S.Syed Navaz, J.Antony Daniel Rex, S.Jensy Mary. “Cluster Based Secure Data Transmission in WSN” July – 2015, International Journal of Scientific & Engineering Research, Vol No - 6, Issue No - 7, pp. 1776 – 1781.

[32] A.S.Syed Navaz, J.Antony Daniel Rex, P.Anjala Mary. “An Efficient Intrusion Detection Scheme for Mitigating Nodes Using Data Aggregation in Delay Tolerant Network” September – 2015, International Journal of Scientific & Engineering Research, Vol No - 6, Issue No - 9, pp. 421 – 428.

[33] A.S.Syed Navaz, P.Jayalakshmi, N.Asha. “Optimization of Real-Time Video Over 3G Wireless Networks” September – 2015, International Journal of Applied Engineering Research, Vol No - 10, Issue No - 18, pp. 39724 – 39730.

[34] M.Ravi & A.S.Syed Navaz. “Development of Mail Tracking System” October – 2015, International Journal of Innovative Research in Computer and Communication Engineering, Vol No - 3, Issue No - 10, pp.9757-9762.

[35] S.Jensy Mary, A.S Syed Navaz & J.Antony Daniel Rex, “QA Generation Using Multimedia Based Harvesting Web Information” November – 2015, International Journal of Innovative Research in Computer and Communication Engineering, Vol No - 3, Issue No - 11, pp.10381-10386.

[36] A.S Syed Navaz & A.S.Syed Fiaz “Network Intelligent Agent for Collision Detection with Bandwidth Calculation” December – 2015, MCAS Journal of Research, Vol No – 2, pp.88-95, ISSN: 2454-115X.

[37] A.S Syed Navaz & K.Durairaj “Signature Authentication Using Biometric Methods” January – 2016, International Journal of Science and Research, Vol No - 5, Issue No - 1, pp.1581-1584.

[38] Dr. A.Jaganathan, “Production of Rice Flour and Peanut Paste in Yellow Cake”, International Journal of Scientific Research, Vol -5, Issue – 9, September 2016. Pp. 597-600.

[39] Dr. A.Jaganathan, M.Mohanraj” A study on Cultural effects on Tourism in India”, International Research Journal of Engineering and Technology, Vol -3, Issue – 11, November 2016. Pp. 1133-1138.

[40] Dr. A.Jaganathan, S.Kuppuraj” Artificial Neural Networks Methods for Predicting the Performance and Process in the Milk Industry”, International Research Journal of Engineering and Technology, Vol -3, Issue – 11, November 2016. Pp. 1127-1132.

[41] Dr. A.Jaganathan, S.Muguntha Kumar” A NOVEL APPROACH OF CASSAVA BAGASSE IN DIFFERENT FROM TWO STARCH AND EFFECT OF HYDROCHLORIC ACID”, International Research Journal of Engineering and Technology, Vol -3, Issue – 10, October 2016. Pp. 282-286.

[42] Dr. A.Jaganathan, S.Muguntha Kumar” A Survey on Native Cassava Starch and Fruit Harvesting Maturity”, International Research Journal of Engineering and Technology, Vol -3, Issue – 10, October 2016. Pp. 277-281.

[43] M.Ravi & A.S.Syed Navaz "Rough Set Based Grid Computing Service in Wireless Network" November - 2016, International Research Journal of Engineering and Technology, Vol No - 3, Issue No - 11, pp.1122– 1126.

[44] Dr. A.Jaganathan ” Beneficial and Deleterious effects of Wine”, International Journal of Advanced Research in Computer and Communication Engineering, Vol -5, Issue – 10, October 2016. Pp. 34-41.

[45] A.S.Syed Fiaz, N.Asha, D.Sumathi & A.S.Syed Navaz “Data Visualization: Enhancing Big Data More Adaptable and Valuable” February – 2016, International Journal of Applied Engineering Research, Vol No - 11, Issue No - 4, pp.–2801-2804.

[46] A.S.Syed Navaz & Dr.G.M. Kadhar Nawaz “Flow Based Layer Selection Algorithm for Data Collection in Tree Structure Wireless Sensor Networks” March – 2016, International Journal of Applied Engineering Research, Vol No - 11, Issue No - 5, pp.–3359-3363.

[47] A.S.Syed Navaz & Dr.G.M. Kadhar Nawaz “Layer Orient Time Domain Density Estimation Technique Based Channel Assignment in Tree Structure Wireless Sensor Networks for Fast Data Collection” June - 2016, International Journal of Engineering and Technology, Vol No - 8, Issue No - 3, pp.–1506-1512.

[48] Kilpatrick A. M. and Ives A. R., *Nature*, 422 (2003) 65.

[49] Oliveira C. A. S. and Pardalos P. M., *Comput. Oper. Res.*, 32 (2005) 1953.

[50] Abdel-Wahab H., Stoica I., Sultan F. and Wilson K., *Inf. Sci.*, 101 (1997) 47.

[51] Wan P. J., Calinescu G., Li X. Y., Frieder O., *Wireless Netw.*, 8 (2002) 607.

[52] Braunstein L. A. *et al.*, *Phys. Rev. Lett.*, 91 (2003) 168701.

[53] Sreenivasan S. *et al.*, *Phys. Rev. E*, 70 (2004) 046133.

[54] Clauset A. and Moore C., *Phys. Rev. Lett.*, 94 (2005) 018701.

[55] Barab´asi A.-L., *Phys. Rev. Lett.*, 76 (1996) 3750.

[56] Schmittbuhl J., Vilotte J.-P. and Roux S., *J. Phys. A*, 26 (1993) 6115.

[57] Vicsek T.,*Growth Phenomena* (World Scientific, Singapore) 1992; Stauffer D. and Aharony A., *Introduction to Percolation Theory* (CRC Press) 1994.

[58] Almaas E. *et al.*, *Nature*, 427 (2004) 839.

[59] Barab´asi A.-L. and Albert R., *Science*, 286 (1999) 509.

[60] Barrat, A., Barthélemy, M., Pastor-Satorras, R. & Vespignani, A. *The architecture of complex weighted networks*. *Proc. Nat. Acad. Sci.* 111, 3747 (2004).

[61] Serrano, M. A., Boguñá, M. & Vespignani, A. *Extracting the multiscale backbone of complex weighted networks*. Proceedings of the National Academy of Sciences 106, 6483–6488 (2009).

[62] Lee, S. H., Kim, P.-J., Ahn, Y.-Y. & Jeong, H. *Googling social interactions: web search engine based social network construction*. PLoS One 5, e11233 (2010).

[63] Dobrin R. and Duxbury P. M., *Phys. Rev. Lett.*, 86 (2001) 5076.

[64] Barrat A. and Barthelemy M. and Vespignani A., *Phys. Rev. E*, 70 (2004) 066149.

[65] Hogg R. V. and Craig A. T., *Introduction to Mathematical Statistics*, 5th edition (Macmillan, New York) 1995.

[66] Krapivsky P. L. and Redner S., *Phys. Rev. E*, 63 (2001) 066123.

[67] Taking into account the degree-degree correlations of our model [25], we find the same *w*_ 1 limiting behavior as that of eqs. (1)-(3).

[68] A.S.Syed Fiaz, I.Alsheba & R.Meena "Using Neural Networks to Create an Adaptive Character Recognition System", Sep 2015, Discovery - The International Daily journal, Vol.37 (168), pp.53-58.

[69] A.S.Syed Fiaz, M. Usha and J. Akilandeswari "A Brokerage Service Model for QoS support in Inter-Cloud Environment",March 2013, International Journal of Information and Computation Technology, Vol.3, No.3, pp 257-260,

[70] A.S.Syed Navaz, R.Pushpapriya, S.Kirubashini & M.Sathya "Generation and allocation of subscriber numbers for telecommunication",March2013, InternationalJournal of Computer Science Engineering and Information Technology Research, Vol No: 3; Issue No: 1, pp. 257-266.

[71] A.S.Syed Fiaz, N.Devi, S.Aarthi "Bug Tracking and Reporting System", March 2013, International Journal of Soft Computing and Engineering, Vol No: 3; Issue No: 1, pp. 257-266.

[72] "An efficient QoS framework for Cloud Brokerage Services", Dec. 2012, International Symposium on Cloud and Service Computing, pp: 76-79, 17-18, IEEE Xplore.

[73] Barab´asi A.-L., de Menezes M. A., Balensiefer S. and Brockman J., *Eur. Phys. J. B*, 38 (2004) 143.

[74] Prim R. C., *Bell Syst. Tech. J.*, 36 (1957) 1389.

[75] Szab´o G., Alava M. and Kert´esz J., *Physica A*, 330 (2003) 31.

[76] Barrat A, Barthélemy M, Pastor-Satorras R, Vespignani A (2004) The architecture of complex weighted networks. *Proc Natl Acad Sci USA* 101:3747–3752.

[77] Jolliffe I (2002) *Principal Component Analysis* (Springer, New York), 2nd Ed.

[78] Kim BJ (2004) Geographical coarse graining of complex networks. *Phys Rev Lett* 93:168701.

[79] Song C, Havlin S, Makse HA (2005) Self-similarity of complex networks. *Nature* 433:392–395.

AUTHOR'S BIOGRAPHY

Dr. A.Jaganathan received the B.Sc in HCM at Madras University, M.Sc HM at Annamalai University, M.A TM in Madurai Kamaraj University and his Ph.D in Periyar University. He has completed NET 2 times in Tourism Administration and Management & Home Science. He is having more than 20 years experience. Currently he is working as Principal / Secretary in Food Craft Institute, Hoshiarpur, Punjab, India. His Areas of interest are Food Science & hotel management.

S.Muguntha Kumar received his B.Sc from PGP College of Arts & Science and MBA from NBharathiyar University. Currently he is working as an Assistant Professor at Muthayammal College of Arts & Science, Rasipuram, Namakkal. India. His Areas of interest are Food Science & hotel management.