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- Retrieval from Biological Databases
- Rectangular Microstrip Antenna
- Analysis of Routing Protocols
- Clustered Wireless Sensor Networks

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Biomining:-An Efficient Data Retrieval Tool for Bioinformatics to Avoid Redundant and Irrelevant Data Retrieval from Biological Databases

By C.Sumithiradevi, Dr.M.Punithavalli, S.Suresh
Bharathiar University, Coimbatore, TamilNadu, INDIA

Abstracts - : MINING biological data is an emerging area of intersection between data mining and bioinformatics. Bioinformaticians have been working on the research and development of computational methodologies and tools for expanding the use of biological, medical, behavioral, or health-related data. Data mining researchers have been making substantial contribution to the development of models and algorithms to meet challenges posed by the bioinformatics research. Mining these databases tend to develop data quality issues like data anomaly and duplication. For biological data to be corrected, methods and tools must be developed. This paper proposes one such tool, called BIOMINING that is designed to eliminate anomalous and redundancy in biological web content.

Keywords: *Anomalies, Bio mining, redundancy, bioinformatics, Databases.*

Classification: *GJCST H.2.8, H.2.m*

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Biomining:-An Efficient Data Retrieval Tool for Bioinformatics to Avoid Redundant and Irrelevant Data Retrieval from Biological Databases

C.Sumithiradevi[1], Dr.M.Punithavalli[2], S.Suresh[3]

Abstract: MINING biological data is an emerging area of intersection between data mining and bioinformatics. Bioinformaticians have been working on the research and development of computational methodologies and tools for expanding the use of biological, medical, behavioral, or health-related data. Data mining researchers have been making substantial contribution to the development of models and algorithms to meet challenges posed by the bioinformatics research. Mining these databases tend to develop data quality issues like data anomaly and duplication. For biological data to be corrected, methods and tools must be developed. This paper proposes one such tool, called BIOMINING that is designed to eliminate anomalous and redundancy in biological web content.

Keywords:Anomalies, Bio mining, redundancy, bioinformatics, Databases.

I. Introduction

With the development of molecular biology in the last decades, both the Web mining [3] uses data mining techniques to automatically retrieve, extract, and evaluate information for knowledge discovery from the Web. Almost 99% of the data in the Web is useless for a particular user, and often it does not represent any relevant information that the user is looking for [4]. For example, if we are searching the information about Human insulin in the biological search engine Entrez, it will display the information about Human insulin as well as Musmusculas insulin. Taking into account the huge amount of data storage and manipulation needed for (say) a simple query, the processing essentially requires adequate tools suitable for extracting only the relevant, sometimes hidden, knowledge as the result of the problem under consideration.

About[1]: Research Scholar, Bharathiar University, Coimbatore, TamilNadu, INDIA.(E-mail:- sumithradevic@yahoo.co.in)
About[2]: Director, Department of computer science, SNS College of Arts & Science, Coimbatore, Tamilnadu, INDIA. (Email:-mpunitha_srcw@yahoo.co.in)
About[3]: Department of Bioinformatics, Bharathiar University, Coimbatore, India. (Email:-sureshsubramani@hotmail.com)

II. Database Techniques for Biological Datasets

Indexing and mining technology on biological databases are essential to summarize the information of biological data.A database index is meant to improve the efficiency of data lookup at rows of a table by a key access indexed to meet performance requirements [5]. DNA sequence databases are normally as large as billions of bps (base pairs). Special indices [6, 7, 8, 9] are designed according to the characteristics of DNA sequences to address the efficiency and the effectiveness of the results. Since the biological data becomes tremendous with the growing research interests and the revolution of research approaches, it becomes more and more important and necessary to analyze and understand biological data and the relationships between various data sets using computational approaches.The research in Web mining aims to develop new techniques to effectively extract and mine useful knowledge or information from these databases[10]. Due to the heterogeneity and lack of structure of Web data, automated discovery of targeted or unexpected knowledge/information is a challenging task. Web content mining aims to extract/mine useful information from the biological database based on their contents [11], [12], [13], [14]. Two groups of web content mining are those that directly mine the content of documents and those that improve on the content search of other tools like search engine [15]. As many existing search methods are based on sequential scanning on databases, the growth in database size will adversely affect the efficiency of these search methods. Due to limited PC memory and the sequential-scan schema of the existing approaches, the query speed on large databases is not satisfied. This motivated us to either develop new and more efficient methods or enhance existing methods to be more scalable to the size of databases.Consequently, we designed the Biomining to speed up the query process on desktop PC.

III. Computation of the Proposed System

BIOMINING is a toolkit for biological information retrieval systems that is designed to eliminate anomalous and redundancy in biological web content. This system consists two functions: -(i). On-Topic Search (ii). Related search.On-Topic Search: returns far better results for "on topic" queries as compared with standard Web search engines.Related search: returns relevant results in response to user queries. In this system, the user supplies a organism and protein name as a query to the web. First key words are splitted into the terms. In the On topic search, web pages are mined for the terms and the appropriate information is retrieved. In the related search, web pages are mined for the terms and the relevant information is retrieved

A. Algorithm for On- Topic and Related Search

```
INPUT: User query (Organism and protein name)
OUTPUT: Exact and Related sequences
VARIABLES: $query, $result, $newarr, $arrcount, $arr
```

```
function getdata ($table,$arr,$connect,$query)
 {
  $query="select seq from $table where"."$query";
  $result=mysql_query ("$query",$connect);
  while ($row=mysql_fetch_array ($result))
  {
   array_push ($arr,($row['seq']));
  }
  //Eliminate the redundancy
  $arr=array_unique($arr);
  return $arr;
 } //Split key word term1,term2...termn
 $newarr=explode (" ", $search);
 $arrcount=count ($newarr);
 $query=" seq like '%". $newarr [0]."%'";
 //If on topic search
 //Match term1 and term2 and termn with DB
 if($Operation == "On Topic Search")
 {
  print "On Topic Search<br><br>";
  for($i=1;$i<$arrcount;$i++)
  {
   $query=$query." and seq like '%".$newarr[$i]."%'";
  }
 }
 //If Related Search
 //Match term1 or term2 or termn with DB
 if($Operation == "Related Search")
 {
  print "Related Search<br><br>";
  for($i=1;$i<$arrcount;$i++)
  {
   $query=$query." or seq like '%".$newarr[$i]."%'";
  } }
 //Retrieve information in database1
 $arr=getdata ("biotable",$arr,$connect,$query);
 //Retrieve information in database2
 $arr=getdata ("biotable2",$arr,$connect,$query);
 //Display information
 foreach ($arr as $value)
 {
  echo "$value <br /><br />";
 }
```

The BIOMINING is able to offer integrated information retrieval through the use of two types of connection between database entries: neighboring and hard links. The neighboring connects entries within a given database while the hard link is applied between entries in different databases and exists everywhere there is a logical connection between entries.

B. Flow chart for the proposed system

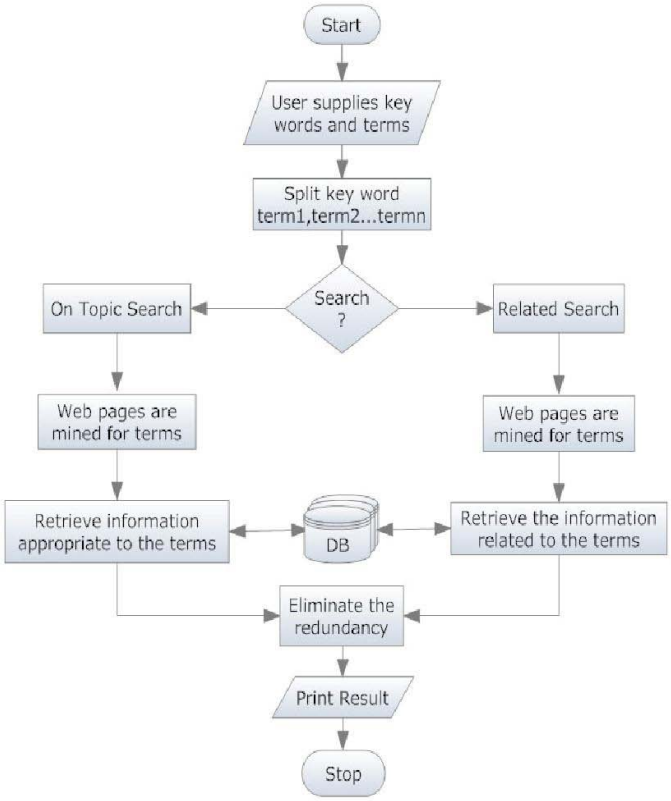

Fig 1: Flow chart for the proposed system

The figure 1 shows the flow chart for the proposed system. In that, user query is split into terms it is checked against database. In the "On- topic search", exact match information are returned. In the "Related" search, relevant information is retrieved.

IV. Implementation

BIOMINING implemented using PHP, MYSQL and HTML. Figure2 shows the interface of the system.

Figure 2. Interface of the BIOMINING

The user can enter a query in the top frame. This query is then splitted into terms and it is checked against database. In the "On-topic search," exact match information are returned. In the "Related" search, relevant information is retrieved. The results are then formatted, with the exact matches listed first, and displayed to the user. When searching, if the user wants to search for the organism and protein names with exact match, he or she clicks on the"On-topic search" button. If the user wishes to search for any related matches to the organism, he or she would click on the button "Related." Finally, redundancies are eliminated. The results of the search appear in the window.

V. Experments and Result

To see how the proposed technique helps to gather a more complete set of sequences related to a protein name, we conducted the following experiments. In the Figure 3, when the query is "insulin Homo sapiens" and the "On-Topic" button is clicked,only sequence of insulin and Homo sapiens will be returned.

Figure 3: On topic Search

However, if we click on the "Related" button when submitting the query "insulin Homosapiens", all the sequences of insulin Homo sapiens, Insulin I Mus musculus, insulin Cavia porcellus, keratin Homo sapiens, Myosin Homo sapiens etc will be returned Figure 4. Because the term "Insulin" present in Homo sapiens as well as Mus musculus, Cavia porcellus. Also the term "Homo sapiens" present in insulin as well as keratin and myosin.

Fig 4: Related search

Experimental results ensure that search time and run time gets reduced. As the efficiency of web content is increased, the quality of the search engines also gets increased. This tool is very simple to implement. The proposed algorithm is used by the bioinformaticians who have been working on the research and development of computational methodologies.

Table 1. FASTA FORMAT of the protein sequence, protein name and organism

S.NO	FASTA format Protein Sequence (Protein name, Organism)
1	>gi|30582455|gb|AAP35454.1| insulin [Homo sapiens] MALWMRLL.....
2	>gi|387059|gb|AAA37041.1| insulin [Cavia porcellus] MALWMHLL.....
3	>gi|148877646|gb|AAI45871.1| Insulin I [Mus musculus] MALLVHFLPLL.....
4	>gi|387392|gb|AAA39370.1| keratin [Mus musculus] EVVKKQCIGV.....
5	>gi|7717238|gb|AAB30058.2| keratin [Homo sapiens] VTLARTDLEMQIEGL.....

Table 2. FASTA FORMAT of the protein sequence, protein name and organism

S.NO	FASTA format P rotein Sequence (Protein name, Organism)
1	>gi|558669|emb|CAA86293.1| Myosin [Homo sapiens] MSASSDA.....
2	>gi|1945080|dbj|BAA19691.1| myosin [Mus musculus] MAQKGQLSDDE.....
3	>gi|178344|gb|AAA98797.1| albumin [Homo sapiens] MKWVTFIS.....
4	>gi|30582455|gb|AAP35454.1| insulin [Homo sapiens] MALWMRLL.....
5	>gi|7717238|gb|AAB30058.2| keratin [Homo sapiens] VTLARTDLEMQIEGL.....

Table 3. On Topic Search Search for "insulin homo sapiens"

S.NO	FASTA forma t Pro tein Sequence (Pro tein name , Or ganism)
1	>gi|30582455|gb|AAP35454.1| insulin [Homo sapiens] MALWMRLL.....

Table 4. Related Search Search for "insulin homo sapiens"

S.NO	FASTA format Protein Sequence (Protein name, Organism)
1	>gi|30582455|gb|AAP35454.1| insulin [Homo sapiens] MALWMRLL.....
2	>gi|387059|gb|AAA37041.1| insulin [Cavia porcellus] MALWMHLL.....
3	>gi|148877646|gb|AAI45871.1| Insulin I [Mus musculus] MALLVHFLPLL.....
5	>gi|7717238|gb|AAB30058.2| keratin [Homo sapiens] VTLARTDLEMQIEGL.....
6	>gi|558669|emb|CAA86293.1| Myosin [Homo sapiens] MSASSDA.....
8	>gi|178344|gb|AAA98797.1| albumin [Homo sapiens] MKWVTFIS.....

In the above tables, Table 1 shows. Fasta Format of the protein sequence, protein name and organism which are stored in the database.Table 2 describe the Fasta Format of the protein sequence, protein name and organism which are stored in the second databse. Table 3 displays the information, which is retrieved during the "on topic" search. Table 4 shows the information which is retrieved during the "related" search. Many different measures for evaluating the performance of information retrieval systems have been proposed. The measures require a collection of documents and a query.

VI. Conclusion

Today, most biological databases combine user-friendly interfaces with powerful functionality, breadth of coverage and extensive linking to related databases However, the results produced by most of the search engine do not necessarily produce result that is best possible catering to the user needs. This paper presents

BIOMINING, a tool for improving the results of web content mining by detecting relevant web documents.

References Références Referencias

1) Benson, D.A., Boguski, M.S., Lipman,D.J., Ostell, J., and Ouellette, B.F., 1998,"Genbank Nucleic Acids Research",26:1-7.
2) Benson, D.A., Karsch-mizrachi, I., Lipman, D.J., Ostell, J., Rapp, B.A., and Wheeler, D.L., 2000, "Genbank. Nucleic Acids Research", 28:15-18.
3) Kohavi, R., Masand, B., Spilipoulou, M., and Srivastava, J. 20002, "Web mining,Data Mining and Knowledge Discovery", vol. 6, pp. 5-8.
4) Sushmita Mitra Tinkuacharya, 2003,"Data Mining Multimedia,soft Computing and Bioinformatics", A John Wiley & Sons, inc., Publication.
5) Cui.B., 2003, "Indexing for Efficient Main Memory Processing", PhD thesis, School of Computing, National University of Singapore.
6) Kahveci, T., and Singh, A., 2001, "An efficient index structure for string databases",in VLDB.
7) Meek, C., Patel, J.M., and Kasetty, S., 2003, "Oasis: An online and accurate technique for local-alignment searches on biological sequences", in VLDB, pages 910-921.
8) Tan, Z., Cao, X., Ooi, B.C., and Tung,A.K.H. ,2003, "The ed-tree: An index for large dna sequence databases. In SSDBM, pages 151-160.
9) Williams,H.E.and Zobel,J,2002 "Indexing and retrieval for genomic databases.IEEE Transactions on Knowledge and Data Engineering", 14:63-78.
10) Chakrabarti, S. 2002, "Mining the Web:Discovering Knowledge from Hypertext Data", Morgan Kaufmann Publishers.
11) Bing Liu, Kevin Chen- Chuan Chang ,"Editorial: Special issue on Web Content Mining",SIGKDD Explorations, Volume 6, Issue 2.
12) Hongqi li, Zhuang Wu, Xiaogang Ji, IEEE 2008, "Research on the techniques for Effectively Searching and Retrieving Information from Internet", International Symposium on Electronic Commerce and Security.
13) Poonkuzhali, G., Thiagarajan, K., andSarukesi, K., Jan 2009 "Set theoretical Approach for mining web content through outliers detection", International journal on research and industrial applications, Volume 2.
14) Poonkuzhali, G., Thiagarajan, K and Sarukesi, K.Apr 2009," Elimination of redundant Links in web pages- Mathematical Approach, Proc. Of World Academy of Science", Engineering and Technology, Volume 40, pp555-562
15) Poonkuzhali,G.,Thiagarajan K.,Sarukesi K., and G.V.Uma, 2009,"Signed Approach for Mining Web Content Outliers", Proc. Of World Academy of Science, Engineering and Technology, Volume 56.

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ANFISGA -Adaptive Neuro-Fuzzy Inference System Genetic Algorithm

By Mohammad Jalali Varnamkhasti
University Putra Malaysia

Abstracts - In optimization, when the genetic algorithm fails to find the global optimum, the problem is often credited to premature convergence. Premature convergence is influenced by different parameters. One of the important parameters is diversity population. In this study, we use a novel method to keep diversity in population. A new technique for choosing the female chromosome during sexual selection in a genetic algorithm is proposed. A bi-linear allocation lifetime approach is used to label the chromosomes based on their fitness value. The label will then be used to characterize the diversity of the population. During the sexual selection, the male chromosome is selected randomly. The label of the selected male chromosome and the population diversity of the previous generation are then applied within a set of fuzzy rules and Adaptive Neuro-Fuzzy Inference System Genetic Algorithm to select a suitable female chromosome for recombination. Extensive computational experiments are conducted to assess the performance of the proposed technique with some commonly used sexual selection mechanisms found in a standard GA for solving some numerical functions from the literature. The computational results show that the proposed technique produces higher solutions quality compared to others.

Keywords: *Adaptive Neuro-Fuzzy inference System, genetic algorithm, sexual selection,choice female.*

Classification: *GJCST J.3, I.2.3*

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Keyword:Adaptive Neuro-Fuzzy inference System, genetic algorithm, sexual selection,choice female

I. Introduction

Genetic algorithm (GA) is an optimization algorithm that incorporates the process of evolution. Problems by inspiring an evolutionary process including selection, crossover and mutation are solved. GA uses a population of chromosomes, each representing a solution to the problem that has been solved. In a traditional (GA), chromosomes reproduce asexually: any two chromosomes may be parents in crossover. Gender division and sexual selection here inspire a model of gendered GA in which crossover takes place only between chromosomes of opposite sex. The Sex of chromosomes is not only accountable for preserving diversity in population and maintaining a victorious genetic pool by means of selection, crossover and mutation, but also are accountable for the optimization of the different tasks which are very important to survival. We know that female choice is an important factor in both species recognition and sexual selection. In this study, an obvious characteristic Between the two gender groups, with the possibility of embedding different tasks for each one is considered such as the determination of what partners are suitable for mating and recombination. We suppose a relation between age, effectiveness and fitness as in biological systems affecting the selection procedure. A bi-linear allocation lifetime approach is used to label the chromosomes based on their fitness value. In this paper lifetime is utilized just to label the chromosomes, and here lifetime doesn't mean, the number of iteration that chromosome is remained for generation. The obtained chromosomes labels are used to characterize the diversity of the population. Then the population is divided into two categories, male and female, so that male and female are selected in an alternate way. In each generation the layout of selection for male and female are changed. In optimization, when the genetic algorithm cannot to find the global optimum, the problem is often accredited to premature convergence. Premature convergence is influenced by different parameters. One of the significant parameters is diversity population. To sum up, the aim of this paper is keeping the diversity of population by female choice. Female selection is donethrough a set of fuzzy rules and a new Adaptive Neuro-Fuzzy Inference System (ANFIS) combined with genetic algorithm called Adaptive Neuro-Fuzzy Inference System Genetic Algorithm (ANFISGA). The paper is set up as follows: in section 2, literature review is given. In section 3 fuzzy rules system is considered, in section 4 is reviewed adaptive neuro-fuzzy inference system. Adaptive neuro-fuzzy inference systems genetic algorithm in section 5 is introduced. The experiments and test set are presented in section 6. Algorithms and numerical results are given in section 7 and the conclusion is drawn in section 8.

II. Literature Review

Genetic Algorithm was developed by J. Holland in 1975 [10]. The basic approaches for retarding premature convergence aim to maintain genetic diversity. Different publications are available presenting various ways to better maintain diversity population ([5], [7], [8]). Some researchers studying the occurrence of premature convergence ([10], [11]), or analyzing the interaction of

About: Laboratory of Applied and Computational Statistics, Institute for Mathematical Research,University Putra Malaysia, 43400 UPM Serdang, Selangor, MALAYSIA Department of Basic Science, Islamic Azad University, Dolatabad Branch, Esfahan, IRAN
Email: jalali@inspem.upm.edu.my

different forces inside GAs (e.g. [19]).Work has been performed using mate choice in GA, with encouraging results. Ref. [16] shows how the use of a seduction function based upon a visual measure, such as unitation in the case of the royal road problem [13], where it has been shown that selection of the second parent can improve GA performance. Work in [12] discussed the various ways of sexual selection that can be used in evolutionary computation, and indicate that speciation behaviours may occur when sexual selection is used [15]. Good genes models of sexual selection rely on the idea that fitness is genetic, which contrasts stridently with the non-additive form of genetic quality associated with compatible gene models of sexual selection, which is not generally considered heritable([14], [15]). Theoretical developments have played a critical part in understanding the role of genetic ability in sexual selection by providing new hypotheses and predictions for empiricists to test. Several works in this issue explore new theoretical avenues with respect to genetic ability ([11], [15]). In another research showed that "incest prevention", the exclusion of crossover between identical or very similar strings, can prevent premature convergence [11]. Cavicchio [5] has extended the idea of incest prevention fairly by introducing the concept, of ancestry in other words, solution are prohibited from mating with, say, their grandparents, siblings. Ratford et al. [6] have shown the sexual selection appears to be a robust technique for improving GA performance over wide rang of test problems in the GA literature [15].

III. Fuzzy Rules Systems

Fuzzy knowledge -based systems are rules that built on fuzzy logic and fuzzy set theory. A rule system consisting of a number of rules with a condition part and an action part: IF "condition," THEN "action" The condition part is also known as the rule premise, or simply the IF part. The action part is also called the consequence or the THEN part. A fuzzy rule system is a rule system whose variables or part of its variables are linguistic variables. A linguistic variable is characterized by a quintuple {x, T(x),G,M,U} in which x is the name of the variable, T(x) is the term set of x, that is, a set of linguistic values of x, which are fuzzy sets on the universe (U), G is the syntactic rule for generating the names of values of x, and M is a semantic rule for associating each value with its meaning, that is, the membership function that defines the fuzzy set[18]. In this paper we use a linguistic variable, age, for chromosomes. Figure 1 describes a linguistic variable age: Infant, Teenager, Adult and Elderly are the linguistic values. The membership functions for the linguistic terms are called semantic rules.

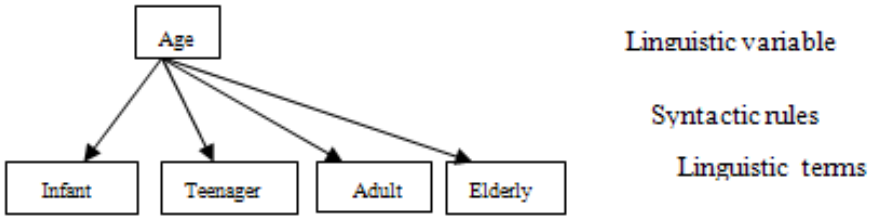


Figure 1. The linguistic variable "age".

In this study to find a membership function, we use fitness value of each chromosome and average of fitness functions in each generation. Each chromosome has its own label determined by membership function. Let

$$\varphi = \frac{f_i - f_{min}}{f_{avr} - f_{min}}, \phi = \frac{f_i - f_{avr}}{f_{max} - f_{avr}} \text{ and } \tau = f_{avr} - f_i$$

then membership function is:

$$\mu(c_i) = \begin{cases} \dfrac{L + \alpha\varphi}{n} & \tau \geq 0 \\ \dfrac{\beta + \alpha\phi}{n} & \tau < 0 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

$$\mu(c_i) = \begin{cases} \dfrac{U - (L + \alpha\varphi)}{n} & \tau \geq 0 \\ \dfrac{U - (\beta + \alpha\phi)}{n} & \tau < 0 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Where i c=chromosome i ,L=minimum age,U= maximum age,i f=fitness value of chromosome i,avr f =average fitness values, min f =minimum fitness values, max f =maximum fitness values in k̃. th generation, n is population sizeα =(U-L)/2 and β(U∓L)/2.Formula (1) is based on a better lifetime for higher fitness value and formula (2) is based on a better lifetime for lower fitness value. This idea is inspired by the idea of lifetime [14]. The fuzzification interface defines for each chromosome the possibilities of being

{Infant, Teenager, Adult, Elderly}.These values determine the degree of truth for each rule premise. This computation takes into account all chromosomes in each generation, and relies on the triangular membership functions shown in Figure 2 (Here we consider L=2 and U=10).

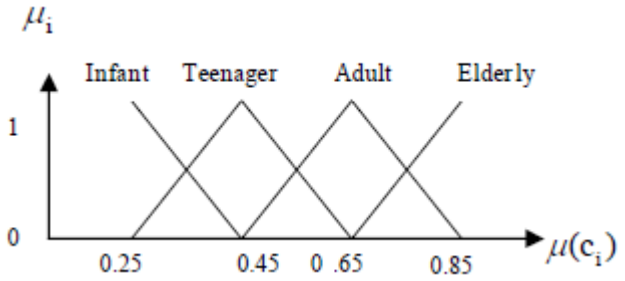


Figure 2: The membership function for Age of chromosomes

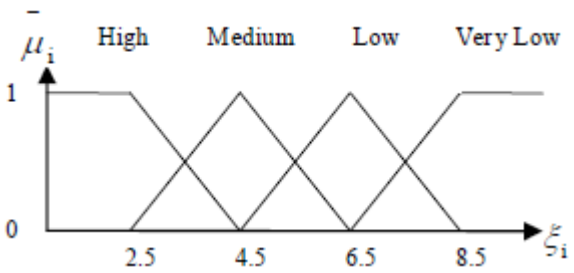


Figure 3: The membership function for Diversity

On the other hand we can consider linguistic rules and membership function for each rule as follow:

$$\text{Linguistic rules and membership function for Age chromosome s} = \begin{cases} \text{Infant} & \mu_1 = \begin{cases} 1 & x < 0.25 \\ -5x + \frac{9}{4} & 0.25 \le x < 0.45 \end{cases} \\ \text{Teenager} & \mu_2 = \begin{cases} 5x - \frac{5}{4} & 0.25 \le x < 0.45 \\ -5x + \frac{13}{4} & 0.45 \le x < 0.65 \end{cases} \\ \text{Adult} & \mu_3 = \begin{cases} 5x - \frac{9}{4} & 0.45 \le x < 0.65 \\ -5x + \frac{17}{4} & 0.65 \le x < 0.85 \end{cases} \\ \text{Elderly} & \mu_4 = \begin{cases} 5x - \frac{13}{4} & 0.65 \le x < 0.85 \\ 1 & x \ge 0.85 \end{cases} \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

With these labels, population can be divided into four levels, Very Low, Low, Medium and High diversity, and relies on the triangular membership functions shown in Figure 3. Where $\xi_i\,(i=1,2,3,4)$ is, average of lifetimes that calculated as follow:

$$\text{lifetime}\ (c_i) = \begin{cases} L + \theta \dfrac{f_i - f_{min}}{f_{avr} - f_{min}} & f_{avr} \ge f_i \\ \dfrac{1}{2}(U+L) + \theta \dfrac{f_i - f_{avr}}{f_{max} - f_{avr}} & f_{avr} < f_i \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$\text{Avrage of labels} = \begin{cases} \xi_r & \psi \le L+t \qquad r=1 \\ \xi_r & L+t < \psi \le L+t+1 \qquad r=2 \\ \xi_r & L+t+1 < \psi \le L+t+2 \qquad r=3 \\ \xi_r & \psi > L+t+2 \qquad r=4 \end{cases}$$

$$\eta = [n/10] \ , \ \xi_r = \frac{\sum_{j=1}^{\psi} \text{lifetime}(c_j)}{\psi} \ (r=1,2,3,4),$$

..... (5)

Where, $\theta = (U- L) / 2$, ψ = the label of half of the population,

$$t = \left[\eta \times \frac{L+U}{n} \right]$$

is a parameter that has correlation with domain of labels in problem,

Lifetime is lifetime of chromosomejc in condition r (r =1 2, 3, 4), nis the population size and ([x] means, nearest integer number tox, for example [2.3] = 2 and [2.8] = 3).

$$\text{Linguistic rules and membership function for Diversity population} = \begin{cases} \text{High} & \bar{\mu}_1 = \begin{cases} 1 & x<2.5 \\ -\frac{1}{2}x+\frac{9}{4} & 2.5 \le x<4.5 \end{cases} \\ \text{Medium} & \bar{\mu}_2 = \begin{cases} \frac{1}{2}x-\frac{5}{4} & 2.5 \le x<4.5 \\ -\frac{1}{2}x+\frac{13}{4} & 4.5 \le x<6.5 \end{cases} \\ \text{Low} & \bar{\mu}_3 = \begin{cases} \frac{1}{2}x-\frac{9}{4} & 4.5 \le x<6.5 \\ -\frac{1}{2}x+\frac{17}{4} & 6.5 \le x<8.5 \end{cases} \\ \text{Very Low} & \bar{\mu}_4 = \begin{cases} \frac{1}{2}x-\frac{13}{4} & 6.5 \le x<8.5 \\ 1 & x \ge 8.5 \end{cases} \end{cases}$$

..... (6)

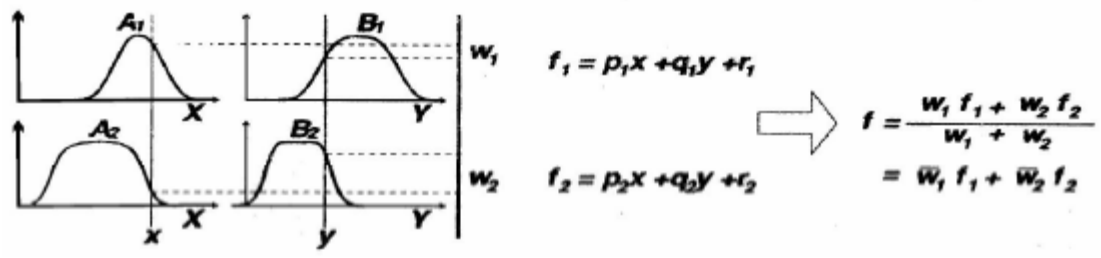
Where $x = \xi_r$, r = 1 ,

IV. Anfis: Adaptive Neuro-Fuzzy Inference System

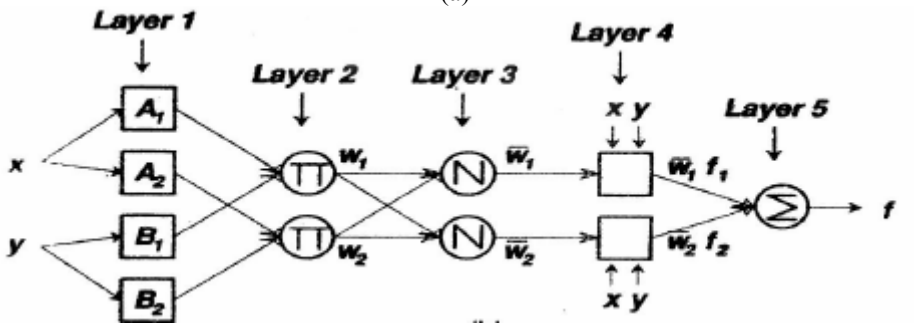
The Sugeno fuzzy model was proposed for a systematic approach to generating fuzzy rules from a given input-output data set. A typical Sugeno fuzzy rule can be expressed in the following form:

IF x1 is A1 AND x2 is A2 …AND xm is Am THEN y=f(x1,x2,..., xm)

Where, x1, x2 ,...,xm are input variables; A1,A2,...,Am are fuzzy sets; and y is either a constant or linear function of the input variables, When y is a Constant or linear function of the input variables. When y is aconstant, we obtain a zero-order Sugeno fuzzy model in which the consequent of a rule is specified by singleton. When y is first-order polynomial, i.e. $y= k_0 + k_1x_1 + k_2x_2 + k_mx_m$ kmxm we obtain a first order Sugeno fuzzy model.Figure 4 shows the ANFIS architecture that corresponds to the first order Sugeno fuzzy model. For simplicity, we assume that the ANFIS has two inputs x1 and x2 and one output y [17].



(a)



(b)

Figure 4: Adaptive neuro-fuzzy inference system

V. Adaptive Neuro-Fuzzy Inference Systems Genetic Algorithm (ANFISGA)

In this study we use Adaptive Neuro-Fuzzy Inference System Genetic Algorithm (ANFISGA). This method is based on Neuro-fuzzy inference system and genetic algorithm. In ANFISGA there are two inputs, x1 Male's age and x2 Diversity of population, and one output y =Female's age. InANFISGA we have five layers. Layer 1 is the input layer. Neurons in this layer simply pass external crisp signal to Layer 2. Layer 2 is the fuzzification layer. Neurons in this layer perform fuzzification.Layer 3 is the rule layer. Each neuron in this layer corresponds to signal Sugeno-type fuzzy rule. Layer 4 is the normalization layer. Each neuron in this layer receives inputs from all neurons in the rule layer, and calculates the normalized firing strength of given rule. Layer 5 is the defuzification layer. Each neuron in this layer is connected to the respective normalization neuron, and also receives initial inputs, and . There are Two important difference between ANFISGA and ANFIS; firstly, normalization and secondly,adaptation. For adaptation of Neuro- fuzzy is used weights, but in our method weights are constant and for adaptation we use sexual selection based on female choice and diversity population. Figure 5 shows the ANFISGA architecture that corresponds to the first order Sugeno fuzzy model with genetic algorithm. We introduce rules for ANFISGA in Table1.

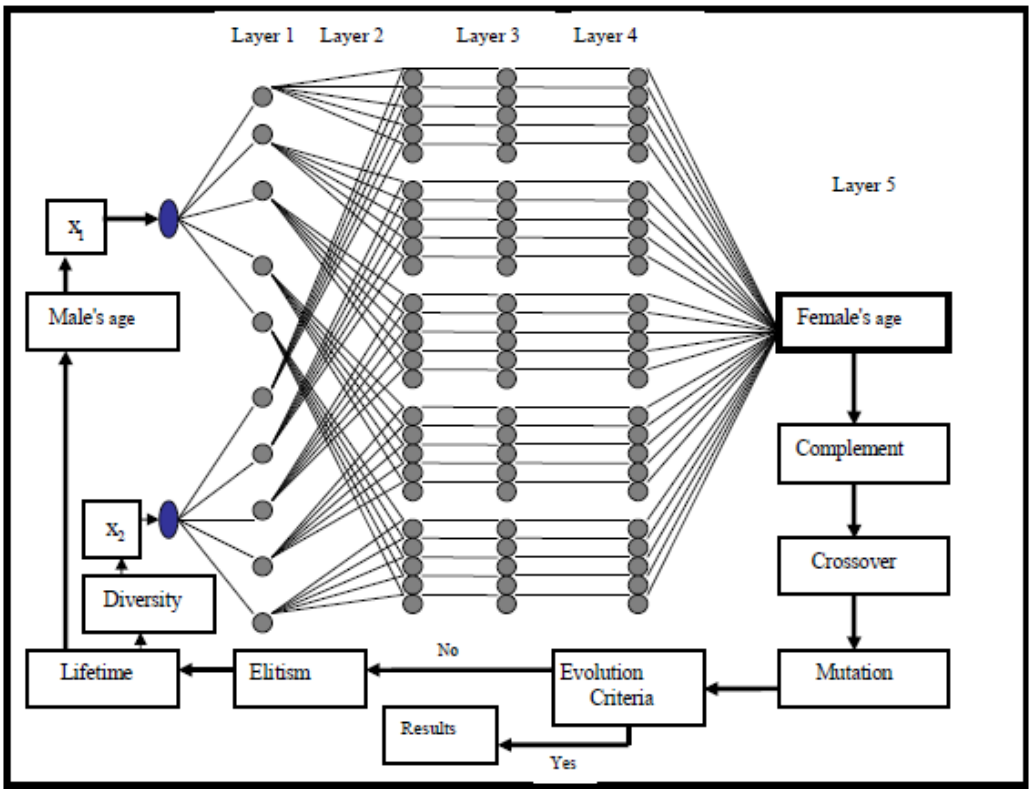


Figure 5: Adaptive Neuro-Fuzzy Inference System Genetic Algorithm (ANFISGA)

Table 1: Rules for ANFISGA

Layer 3	Layer 5	Layer 3	Layer 5
$W_1 = w_1\mu_1 + w_2\bar{\mu}_1$	$D_1 = \bar{W}_1 + \beta$	$W_{13} = w_1\mu_2 + w_2\mu_3 + w_3\bar{\mu}_2 + w_4\bar{\mu}_3$	$D_{13} = \bar{W}_{13} + \beta/1.5$
$W_2 = w_1\mu_1 + w_2\bar{\mu}_1 + w_3\bar{\mu}_2$	$D_2 = \bar{W}_2 + \beta$	$W_{14} = w_1\mu_2 + w_2\mu_3 + w_3\bar{\mu}_3 + w_4\bar{\mu}_4$	$D_{14} = \bar{W}_{14} + \beta/1.5$
$W_3 = w_1\mu_1 + w_2\bar{\mu}_2 + w_3\bar{\mu}_3$	$D_3 = \bar{W}_3 + \beta$	$W_{15} = w_1\mu_2 + w_2\mu_3 + w_3\bar{\mu}_4$	$D_{15} = \bar{W}_{15} + \beta/1.5$
$W_4 = w_1\mu_1 + w_2\bar{\mu}_3 + w_3\bar{\mu}_4$	$D_4 = \bar{W}_4 + \beta$	$W_{16} = w_1\mu_3 + w_2\mu_4 + w_3\bar{\mu}_1$	$D_{16} = \bar{W}_{16} + \alpha/1.5$
$W_5 = w_1\mu_1 + w_2\bar{\mu}_4$	$D_5 = \bar{W}_5 + \alpha$	$W_{17} = w_1\mu_3 + w_2\mu_4 + w_3\bar{\mu}_1 + w_4\bar{\mu}_2$	$D_{17} = \bar{W}_{17} + \alpha/1.5$
$W_6 = w_1\mu_1 + w_2\mu_2 + w_3\bar{\mu}_1$	$D_6 = \bar{W}_6 + \beta/1.2$	$W_{18} = w_1\mu_3 + w_2\mu_4 + w_3\bar{\mu}_2 + w_4\bar{\mu}_3$	$D_{18} = \bar{W}_{18} + \alpha/1.5$
$W_7 = w_1\mu_1 + w_2\mu_2 + w_3\bar{\mu}_1 + w_4\bar{\mu}_2$	$D_7 = \bar{W}_7 + \beta/1.2$	$W_{19} = w_1\mu_3 + w_2\mu_4 + w_3\bar{\mu}_3 + w_4\bar{\mu}_4$	$D_{19} = \bar{W}_{19} + \alpha/1.5$
$W_8 = w_1\mu_1 + w_2\mu_2 + w_3\bar{\mu}_2 + w_4\bar{\mu}_3$	$D_8 = \bar{W}_8 + \beta/1.2$	$W_{20} = w_1\mu_3 + w_2\mu_4 + w_3\bar{\mu}_4$	$D_{20} = \bar{W}_{20} + \alpha/1.5$
$W_9 = w_1\mu_1 + w_2\mu_2 + w_3\bar{\mu}_3 + w_4\bar{\mu}_4$	$D_9 = \bar{W}_9 + \beta/1.2$	$W_{21} = w_1\mu_4 + w_2\bar{\mu}_1$	$D_{21} = \bar{W}_{21} + \alpha/2$
$W_{10} = w_1\mu_1 + w_2\mu_2 + w_3\bar{\mu}_4$	$D_{10} = \bar{W}_{10} + \beta/1.2$	$W_{22} = w_1\mu_4 + w_2\bar{\mu}_1 + w_3\bar{\mu}_2$	$D_{22} = \bar{W}_{22} + \alpha/2$
$W_{11} = w_1\mu_2 + w_2\mu_3 + w_3\bar{\mu}_1$	$D_{11} = \bar{W}_{11} + \beta/1.5$	$W_{23} = w_1\mu_4 + w_2\bar{\mu}_2 + w_3\bar{\mu}_3$	$D_{23} = \bar{W}_{23} + \alpha/2$
$W_{12} = w_1\mu_2 + w_2\mu_3 + w_3\bar{\mu}_1 + w_4\bar{\mu}_2$	$D_{12} = \bar{W}_{12} + \beta/1.5$	$W_{24} = w_1\mu_4 + w_2\bar{\mu}_3 + w_3\bar{\mu}_4$	$D_{24} = \bar{W}_{24} + \alpha/2$
		$W_{25} = w_1\mu_4 + w_2\bar{\mu}_4$	$D_{25} = \bar{W}_{25} + \alpha/2$

Where

$$w_i = i \ , \ \bar{W}_i = \frac{W_i}{\sum |w_i|},$$

α and β are introduced in (1), μ_i is given in (2) , $\bar{\mu}_i$ is taken in (5) and output of Neuro-fuzzy inference system is

$D_i = F_{age}$ that is suggested for selection of female with at least this F_{age} of category females. After the finding F_{age} ,we may not find a chromosome that has this F_{age} then we select a chromosome having the nearest fitness value to F_{age} , or may be we can find more than one chromosome which satisfies having F_{age} condition, therefore we choose a chromosome having the highest fitness value of them. This technique called complement method. In this paper we consider a weak method for crossover, two point

crossovers, because we want to show that our selection technique is robust.

VI. Experiments

Minimization experiments on the test set, described in Subsection 6.1, have been carried out in order to study the behavior of the proposed ANIFSGA in the previous section, the algorithms built in order to do this are described, and finally, in section7, the results are shown and analyzed.

1) *Test Set*

For the experiments, we have considered three frequently used test functions of Benchmark problems:

- Sphere model (f_{Sph}) ([7]):

$$f_{Sph}(x) = \sum_{i=1}^{n} x_i^2 \ , \text{and} -5.12 \le x_i \le 5.12.$$

The fitness of the optimum is $f_{sph}(x^*) = 0$. This test function is continuous, strictly convex, and unimodal.

- Generalized Rosenbrock's function (f_{Ros})([7]):

$$f_{Ros}(x) = \sum_{i=1}^{n-1}[100(x_{i+1} - x_i^2)^2 + (x_i - 1)^2] \quad \text{and} \quad -5.12 \le x_i \le 5.12$$

The fitness of the optimum is $f_{Ros}(x^*) = 0$. f_{Ros} is a continuous and unimodal function, with the optimum located in a steep parabolic valley with a flat bottom. This feature will probably cause slow progress in many algorithms since they must continually change their search direction to reach the optimum.

- Generalized Rastling's function ((f_{Ras}) ([4]) :

$$f_{Ras}(x) = 10n + \sum_{i=1}^{n}(x_i^2 - 10\cos(2\pi x_i)) \text{ and } -5.$$

This function is a scalable, continuous, separable, and multimodal, which is produced from by f_{Sph} modulating it with
$k.\cos(wx_i.)$.

VII. Algorithms

We compare ANFISGA with some methods in GA that Herrera et al. used in [9]. They had been considered a generational GA model that applied a simple crossover operator and a mutation timepiece operator and selection probability calculation followed linear ranking ($_{\eta}$MIN = 0.5). The sampling algorithm was the stochastic universal sampling, and elitist strategy was considered. Also the overall qualities of the fuzzy logic control that they had been considered was the following: the minimum operator was used for conjunction of clauses in the IF part of a rule, the minimum operator was used to fire each rule and the center of gravity weighted by matching strategy as the defuzzification operator was considered. Table 2 shows these algorithms.

Table 2: Algorithms

Algorithms	Features
GA1	$p_m = 0.001$ and $p_c = 0.6$ fixed during the run.
GA2	$p_m = 0.005$ and $p_c = 0.6$ fixed during the run.
GA3	$p_m = 0.01$ and $p_c = 0.6$ fixed during the run.
GA-RAN	$p_m \in [0.001, 0.01]$ for each generation. $p_c = 0.6$.
GA-DET	Deterministic Control of the Mut. Prob. $p_c = 0.6$.
GA-AIL	Adaptive Control at Individual-level of the Mut. Prob $p_c = 0.6$.
GA-SELF	Self-Adaptive Control of the Mut. Prob ($\delta = 0.001$) $p_c = 0.6$.
GA-FLC	Adaptive Control of the Mut. Prob. by FLC (G = 50) $p_c = 0.6$.
ANFISGA	$p_m \in [0.001, 0.2]$ for each generation and $p_c = 0.6$.

Table 3: Population size is 60, and probability crossover is $p_c = 0.60$.

Algorithm	f_{Sph}	f_{Ros}	f_{Ras}
GA1	2.4e -10	1.1e -01	5.9e +00
GA2	7.7e -08	8.5e -03	5.1e -05
GA3	8.0e -06	1.2e -05	6.0e -02
GA-RAN	2.2e -07	6.9e -04	8.4e -05
GA-DET	2.8e -10	5.6e -05	3.3e -02
GA-AIL	2.4e -10	4.3e -02	1.2e +00
GA-SELF	2.4e -10	4.5e -02	1.7e +00
GA-FLC	2.4e -10	6.4e -04	6.1e -08
ANFISGA	2.4e -10	1.3e -07	9.5e -09

With regards to the GA versions that we compared in Table 3, we can say that:

- For the easy test function, f_{Sph} result of ANFISGA technique is the same of the best result of other methods.

- For the function with intermediate complexity, f_{Ras} and for the most complex function, f_{Ros} consequence of ANFISGA system is better of other methods .

Then ANFISGA technique, has the most robust behaviours, since for each function, it returns results that are very similar to the ones of the most successful GAs with intermediate complexity, or better than all them results for the function with intermediate complexity and for the most complex function.

VIII. Conclusions

We have proposed a method for controlling the diversity of population using fuzzy logic techniques and Adaptive Neuro-Fuzzy Inference System (ANFIS). However Weights in ANFIS is constant in our method we used sexual selection for adaptation. The principle conclusions derived from the results of experiments carried out are the following:

- The procedure presented is the most successful one for controlling diversity as compared with other methods proposed in the GA literature that have been considered for the experiments.
- The adaptation capability of this procedure allows suitable parent to be used for producing a robust operation for test function with different difficulties.

Therefore, we may conclude that the female choice by ANFISGA is a suitable way for improvement the results of GAs, and keep the diversity of the population.

References Références Referencias

1) M. Affenzeller and S.Wagner, SASEGASA: An evolutionary algorithm for retarding premature convergence by self-adaptive selection pressure steering, In J. Mira and J. R. Alvarez, editors, Computational Methods in Neural Modeling, volume 268of Lecture Notes in Computer Science, pp. 438-445.Springer-Verlag, 2003.
2) M. Affenzeller and S. Wagner, SASEGASA: A new generic parallel evolutionary algorithm for achieving highest quality results, Journal of Heuristics- Special Issue on New Advances on Parallel Meta-Heuristics for Complex Problems, 10, pp. 239-263, 2004.
3) J. Arabas, Z. Michalewicz,, and J. Mulawka, GAVaPS-A Genetic Algorithm with Varying Population Size, Proc. of the Evolutionary Computation Conf., Part of the IEEE World Congress on Computational Intelligence, Orlando,26- 29 June, IEEE press, pp. 73-78, 1994.
4) T. Back, Self-adaptation in Genetic Algorithms, Proc. of the First European Conf. on Artificial Life, F.J. Varela, P. Bourgine, (Eds.), The MIT Press, Cambridge, MA, pp. 263-271, 1992 .
5) D. Cavicchio, Adaptive Search Using Simulated Evolution, PhD thesis, University of Michigan, 1975.
6) R. Craighurts and W. Martin, Enhancing GA performance through crossover prohibitions based on Ancestry, In Proc. of sixth Int. Conf. on Genetic Algorithm 1995.
7) K. A. DeJong, An Analysis of the Behavior of a Class of Genetic Adaptive Systems, PhD thesis, Department of Computer Science, University of Michigan, 1975.
8) D. E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison Wesley Longman, 1989.
9) F. Herrera, and M. Lozano, Adaptive control of the mutation probability by fuzzy logic controllers, In: Parallel Problem Solving from Nature-PPSN VI , Springer, Berlin, pp. 335-344, 2000.
10) J. H. Holland, Adaptation in Natural and Artificial Systems, University of Michigan Press, 1975. [11] H. Kosko , K. Heubel, Condition-dependence, genotype-by environment interactions and the lek paradox, Genetica 132, pp. 209-216, 2008.
11) G. F. Miller, Exploiting mate choice in Evolutionary computation: sexual selection as a process of search optimization, and diversitification, In T. C. Fogarty, (Ed.) proc. of the AISB workshop on evolutionary computing, Springer Verlag, 1994.
12) M. Mitchell, S. Forrest, and J.H. Holland, The Royal Road for Genetic Algorithm, Fitness Landscapes and GA performance, In Towards a practice of Autonomous Systems: proc. of the First European Conf. on Artificial Life, Cambridge, MA, MIT Press, 1991.
13) B. Neff, T. Pitcher, Mate choice for non-additive genetic benefits: a resolution to the lek paradox, J Theor Biol , pp.147-155 ,2008.
14) T. E. Pitcher, H. L. Mays Jr., An introduction to genetic quality in the context of sexual selection, Genetica, Springer Netherlands,Vol. 134, pp.1-4, 2008.
15) E. Ronald, when selection meets seduction, In Larry I. Eshelman, (Ed.), proc. of the sixth international conf. on Genetic Algorithm, San Francisco, CA, Morgan Kaufmann,1995.
16) T. Takagi, and M. Sugeno, Fuzzy identification of systems and its application to modeling and control, IEEE T. Syst. Man Cyb., SMC-15(1), pp. 116-132, 1985.

17) J. Yaochu, Advanced Fuzzy Systems Design and Applications, Germany, Physica-Verlag Heidelberg 2003.
18) S. Wagner, Looking Inside Genetic Algorithms, Schriften der Johannes Kepler UniversitÄat Linz, Reihe C: Technik und Naturwissenschaften. Universitatsverlag Rudolf Trauner, 2004.

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Simulation Based Performance Analysis of Routing Protocols Using Random Waypoint Mobility Model in Mobile Ad Hoc Network

By Santosh Kumar,S C Sharma, Bhupendra Suman
IIT Roorkee (India)

Abstracts - A mobile ad hoc network is collection of self-configuring and adaption of wireless link between communicating devices (mobile devices) to form an arbitrary topology without the use of existing infrastructure. In wireless network technology, simulative analysis is a significant method to understand the performance of routing protocol. In this paper an attempt has been made to compare the performance of two prominent on-demand reactive routing protocols for mobile ad hoc networks: DSR and AODV, along with the traditional proactive DSDV protocol. The On-demand protocols, AODV and DSR perform better under high mobility simulations than the table-driven DSDV protocol.Although DSDV perform well with respect to all included performance matrices in the paper if it has no constraints of bandwidth. The performance differentials are analyzed using varying network load, mobility, and network size.

Keywords: *MANET, Routing Protocols – AODV, DSDV, DSR, RWMM.*

Classification: *GJCST C.2.2, I.6.m*

Strictly as per the compliance and regulations of:

Simulation Based Performance Analysis of Routing Protocols Using Random Waypoint Mobility Model in Mobile Ad Hoc Network

Santosh Kumar[1], SC Sharma[2], Bhupendra Suman[3]

Abstract: A mobile ad hoc network is collection of self-configuring and adaption of wireless link between communicating devices (mobile devices) to form an arbitrary topology without the use of existing infrastructure. In wireless network technology, simulative analysis is a significant method to understand the performance of routing protocol. In this paper an attempt has been made to compare the performance of two prominent on-demand reactive routing protocols for mobile ad hoc networks: DSR and AODV, along with the traditional proactive DSDV protocol. The On-demand protocols, AODV and DSR perform better under high mobility simulations than the table-driven DSDV protocol.Although DSDV perform well with respect to all included performance matrices in the paper if it has no constraints of bandwidth. The performance differentials are analyzed using varying network load, mobility, and network size.

Keywords:MANET, Routing Protocols – AODV, DSDV, DSR, RWMM.

I. Introduction

A Mobile ad hoc network (MANET), sometimes called a mobile mesh network, is a self-configuring network of mobile devices connected by wireless links. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently [1, 2]. Each must forward traffic unrelated to its own use, and therefore be a router. MANET nodes are equipped with wireless transmitters and receivers using antennas, which may be Omni directional (broadcast), highly directional (point-to-point), possibly steerable, or some combination thereof. Routing protocols occupied to determine the routes subsequent to a set of rules that enables two or more devices to communicate with each other's. In the mobile ad-hoc networks routes are enabled in between the nodes in multi-hop fashion, as the propagation range of the wireless radio is limited. A good routing protocol should minimize the computing load on the host as well as the traffic overhead on the Network. This paper has an outline of protocol evaluation that highlight performance metrics that can help promote meaningful comparisons and assessments of protocol performance.

Routing protocols in mobile networks are subdivided into two basic classes-

- Proactive routing protocols
- Reactive routing protocols

The proactive routing protocols are also called table-driven protocols it maintains the routing information of the all participant nodes and update their routing information frequently irrespective of the routing request. This makes it bandwidth scarce though the routing is simple with prior updated routing information. They usually use link-state routing algorithms flooding the link information [3, 4]. Link-state algorithms maintain a full or partial copy of the network topology and costs for all known links. Examples include the Destination-Sequenced Distance Vector (DSDV) protocol [5, 6]. The reactive routing protocols create and maintain routes only if these are needed, on demand. It uses connection establishment process for communication. These protocols usually use distance-vector routing algorithms that keep only information about next hops to adjacent neighbours and costs for paths to all known destinations. Some pitfalls of reactive protocols are high latency in searching the network and also in finding the routes if there is excessive flooding over the network with route request it may cause network clogging .Examples include the Ad hoc On Demand Distance Vector (AODV) protocol and Dynamic Source Routing (DSR) protocol [7, 8, 9]. Section 2 describes ondemand routing protocols, section 3 describes table-driven protocol, section 4 describes simulation model, section 5 describes performance evaluation & simulation results and section 6 describes conclusion of the paper.

II. The On-Demand Routing Protocols

In this section, paper investigates the on demand routing protocols. The basic idea of these algorithms is

About[1]: Doctoral Candidate, IIT Roorkee (India) since Aug , 2008. Email:amu.santosh@gmail.com
About[2]: Associate Professor, IIT Roorkee (India) since Jan, 1984 till date.Email:subhash1960@rediffmail.com
About[3]: Doctoral Candidate, IIT Roorkee (India) since Jan, 2009. Email:bhupendra.suman@gmail.com

to find and maintain a route only when it is used for communication.

1) *AODV (AD-HOC On-Demand Distance Vector)*

AODV is a routing protocol for mobile ad hoc networks and other wireless ad-hoc networks. This protocol is capable of both unicast and multicast routing [4, 10]. In AODV, the network is silent until a connection is needed. At that point the network node that needs a connection broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time. When a link fails, a routing error is passed back to a transmitting node, and the process repeats. Each request for a route has a sequence number. Nodes use this sequence number so that they do not repeat route requests that they have already passed on. AODV requires more time to establish a connection, and the initial communication to establish a route is heavier than some other approaches.

2) *DSR (Dynamic Source Routing)*

DSR is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. The sender knows the complete hop by hop route to the destination. These routes are stored ina route cache [8, 9]. This protocol is composed of the two main mechanisms of "Route Discovery" and "Route Maintenance", which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network. Other advantages of the DSR protocol include easily guaranteed loop-free routing, support for use in networks containing unidirectional links, use of only "soft state" in routing, and very rapid recovery when routes in the network change. The DSR protocol is designed mainly to work well with very high rates of mobility.

III. Table-driven Protocol

There are few routing table-driven protocols discussed in the literature [4, 5, 6]. In a table-driven type of protocols, one needs periodically to determine the network topology. If any changes happen to the network, this information should be broadcasted, and all of the host in this network will run the route discovery again and store new routing information in the table. In general, when compared to on-demand protocols, table-drive protocols allocate one entry for each host of the whole network, instead of only the destinations of the packets. However, in table-driven protocols, any time when a route is needed, a route is already available in the table, therefore, table-driven can reduce the average delay per packet. This paper describes a destination sequenced distance vector (DSDV) protocol.

1) *DSDV (Destination Sequenced Distance Vector)*

DSDV is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm [5, 6]. The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently. If a router receives new information, then it uses the latest sequence number. If the sequence number is the same as the one already in the table, the route with the better metric is used. Stale entries are those entries that have not been updated for a while. Such entries as well as the routes using those nodes as next hops are deleted. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic networks.

IV. Simulation Model

A detailed simulation model based on ns-2 is used in the evaluation. The Distributed Coordination Function (DCF) of IEEE 802.11 for wireless LANs is used as the MAC layer protocol.

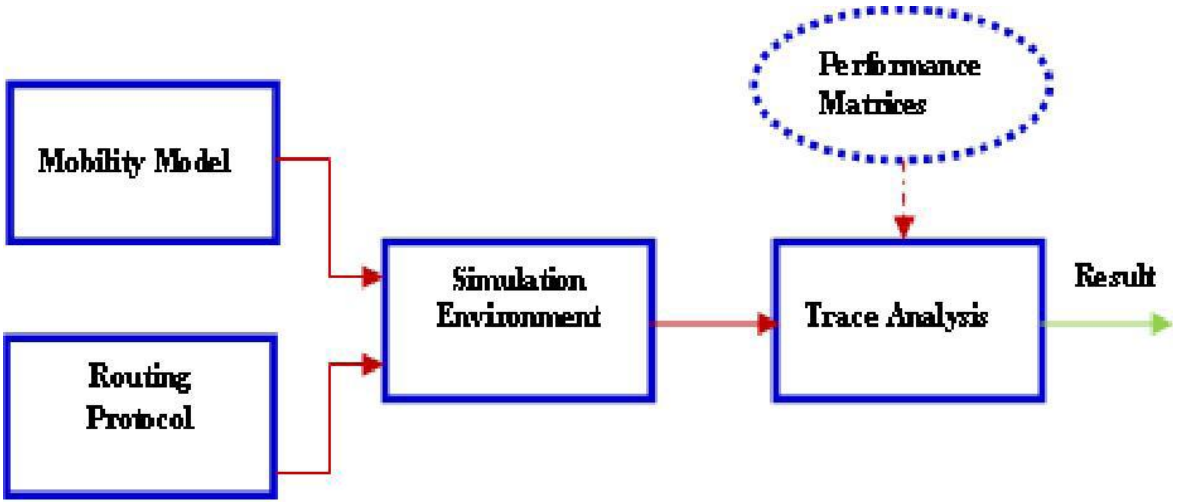

Figure: Implementation Method

1) *The Traffic and Mobility Models*

Constant bit rate (CBR) traffic sources are used. The sourcedestination pairs are spread randomly over the network. Only 512-byte data packets are used. The number of sourcedestination pairs and the packet-sending rate in each pair is varied to change the offered load in the network. The mobility model uses the random waypoint model in a rectangular field. The field configurations used is: 500 m x 500 m field with 10, 30 and 50 nodes. Here, each packet starts its journey from a random location to a random destination with a randomly chosen speed (uniformly distributed 20 m/s). The pause time, which affects the relative speeds of the mobiles, is varied. Simulations are run for 100 simulated seconds. Identical mobility and traffic scenarios are used across protocols to gather fair results.

2) *Performance Metrics*

This paper analyzed the following important performance metrics:

a) *Packet delivery fraction*

the ratio of the data packets delivered to the destinations to those generated by the CBR sources. It reflects the reliability of routing. Figure 3, 7 & 11 demonstrate pd-fraction among the protocols.

b) *Average end-to-end delay of data packets*

This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times. Figure 4, 8 and 12 depicts end-to-end delay among protocols.

c) *Normalized routing load*

The number of routing packets transmitted per data packet delivered at the destination. Each hop-wise transmission of a routing packet is counted as one Transmission. Figure 2, 6,& 10 explore normalized routing load among the protocols.

The first two metrics are the most important for best effort traffic. The routing load metric evaluates the efficiency of the routing protocol. However, that these metrics are not completely independent. For example, lower packet delivery fraction means that the delay metric is evaluated with fewer samples. In the conventional wisdom, the longer the path lengths, the higher the probability of a packet drops. Thus, with a lower delivery fraction, samples are usually biased in favour of smaller path lengths and thus have less delay.

I. *Generating Traffic and Mobility Models*

a) *Traffic model*

Random traffic connections of CBR have been established between mobile nodes using a traffic scenario generator script. The simulations carried out, traffic models were generated for10, 30 and 50 nodes with CBR traffic sources, with maximum connections of 8, 25, 40 at a rate of 8kbps.

b) *Mobility models*

Mobility models were created for the simulations using 10,30 and50 nodes, with pause times of 0, 10,20,30,40, 50, 60, 70 and100 seconds, maximum speed of 20m/s, topology boundary of 500x500 and simulation time of 100secs

v. Performance Evaluation & Simulation Results

In this paper, an attempt was made to compare all the three protocols under the random way mobility scenario. For all the simulations, the same movement models were used, the number of traffic sources was fixed at 10, 30 and 50, the maximum speed of the nodes was set to 20m/s, the pause time was varied as 0, 10, 20, 30 40, 50, 60, 70, 100s, and a fixed topology boundary of 500x500. The On-demand protocols, DSR and AODV performed particularly well, delivering over 85% of the data packets regardless of mobility rate. The average end-to-end delay of packet delivery was higher in both DSR and AODV as compared to DSDV. Routing overhead of DSDV is approximately constant at varying pause time from beginning and end of the simulation as compared to the AODV and DSR. As no. of sources increases at certain limit, it results that the DSDV perform well with respect to all included performance matrices as compared to AODV and DSR.

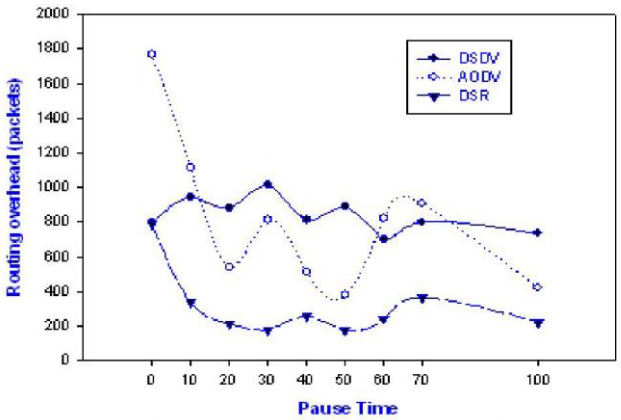

Fig.1 Pause Time vs routing overhead (packets)-Fixed 10 nodes

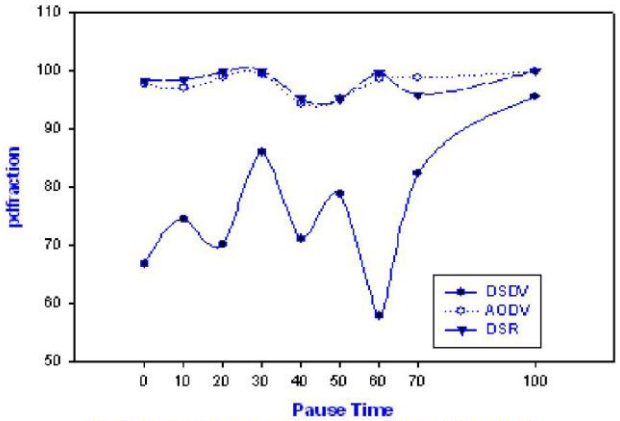

Fig.3 Pause Time vs pdfraction (Fixes 10 nodes)

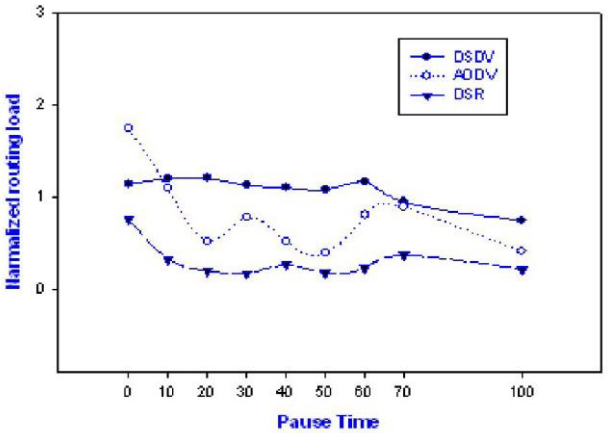

Fig.2 Pause Time vs Normalized routing load (Fixed 10 nodes)

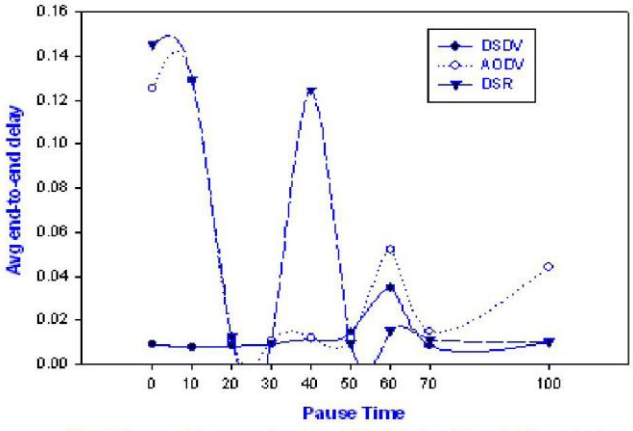

Fig.4 Pause Time vs Avg End-End delay(Fixed 10 nodes)

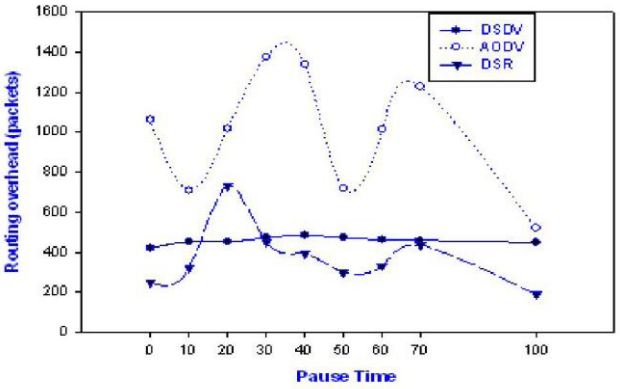

Fig.5 Pause Time vs routing overhead (packets)-fixed 30 nodes

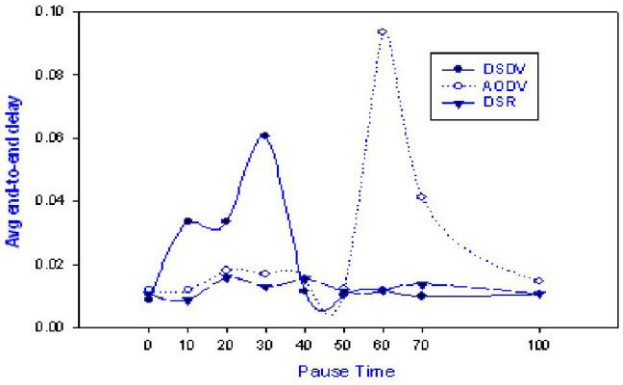

Fig.8 Pause Time vs **Avg end-to-end delay(fixed 30 nodes)**

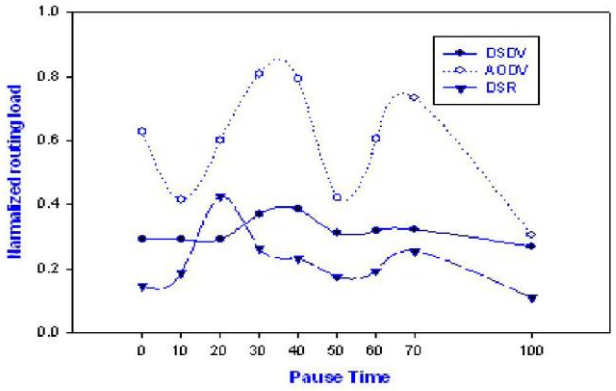

Fig.6 Pause Time vs Normalized routing load (Fixed 30 nodes)

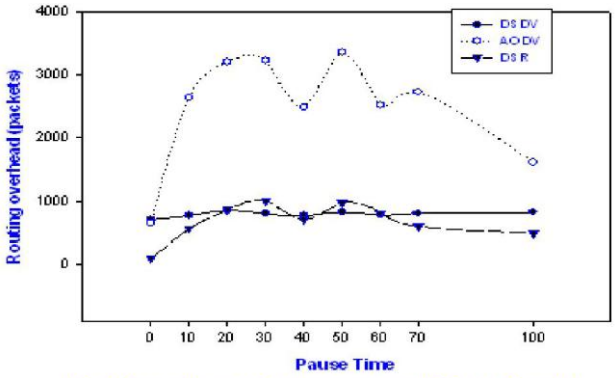

Fig.9 Pause Time vs Routing overhead (Fixed 50 nodes)

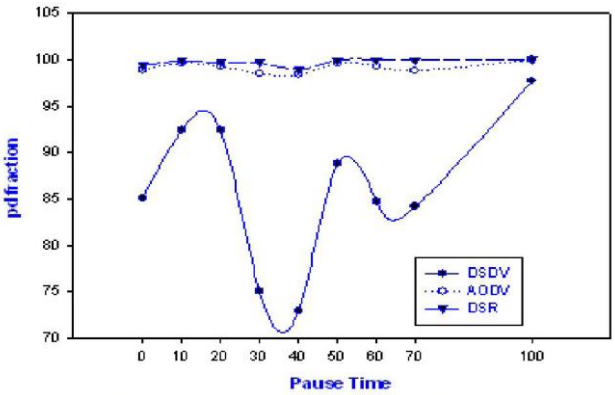

Fig.7 Pause Time vs pd fraction (Fixed 30 nodes)

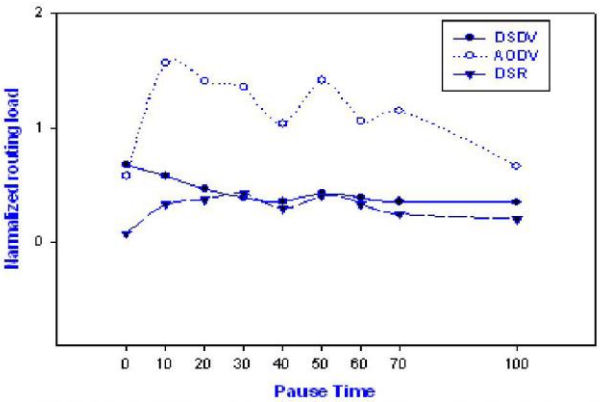

Fig.10 Pause Time vs Narmalized routing load (Fixed 50 nodes)

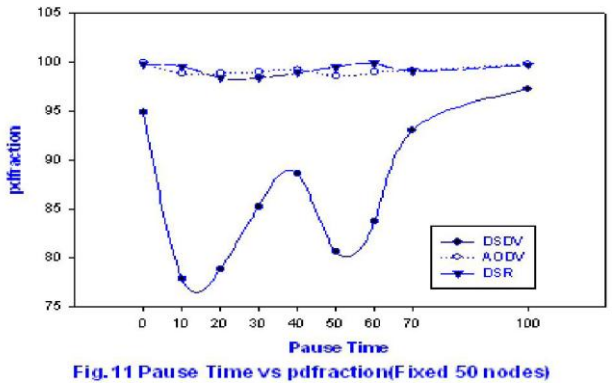

Fig.11 Pause Time vs pdfraction(Fixed 50 nodes)

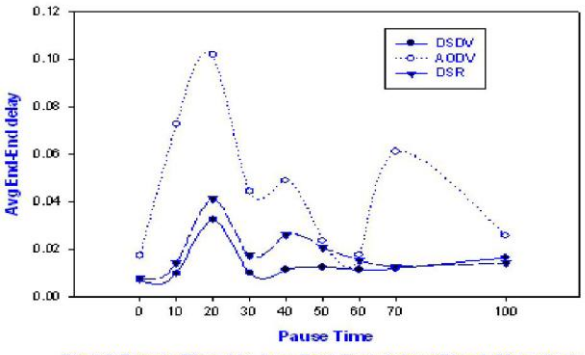

Fig.12 Pause Time Vs Avg End-End delay (Fixed 50 nodes)

VI. Conclusions

Once the route is established, the performance of the AODV protocol for different load condition shows better results throughout the simulation time except the beginning and ending time. The average end-to-end delay of packet delivery was higher in both DSR and AODV as compared to DSDV, when number of nodes increased. Routing overhead of DSDV is approximately constant at varying pause time from beginning and end of the simulation as compared to the AODV and DSR. As number of sources increases at certain limit and no big constraint of bandwidth, it results that the DSDV perform well with respect to all included performance matrices as compared to AODV and DSR. Both AODV and DSR perform better under high mobility simulations than DSDV. In lover mobility scenario generally DSR perform better than AODV due to caching strategy used by DSR but it could be possible only at low offered load. Although AODV, outperforms DSR in more "stressful" in case of increasing more load and higher mobility. High mobility results in frequent link failures and the overhead involved in updating all the nodes with the new routing information as in DSDV is much more than that involved AODV and DSR, where the routes are created as and when required.

References Références Referencias

1) G.S. Lauer, Packet-radio routing, in: Routing in Communications Networks, ed. M.E. Steenstrup (Prentice Hall, 1995) chapter 11, pp. 351–396.
2) S. Ramanathan and M.E. Steenstrup, A survey of routing techniques for mobile communications networks, Mobile Networks and Applications 1 (1996) 98–104.
3) J. Moy, Link-state routing, in: Routing in Communications Networks, M.E. Steenstrup (Prentice Hall, 1995) chapter 5, pp. 135–157.
4) C.E. Perkins and E.M. Royer, Ad-hoc on-demand distance vector routing, in: Proc. of 2nd IEEE Workshop on Mobile Computing Systemsand Applications (1999).
5) C.E. Perkins and P. Bhagwat, Highly dynamic destination sequenced distance vector routing (DSDV) for mobile computers, in: Proc. Of ACM SIGCOMM'94, London, UK (August–September 1994) pp. 234– 244.
6) A. Boukerche, S.K. Das and A. Fabbri, Analysis of randomized congestion control with DSDV routing in ad hoc wireless networks, Journal of Parallel and Distributed Computing (JPDC) 61 (2001) 967–995.
7) G.S. Malkin and M.E. Steenstrup, Distance-vector routing, in: Routing in Communications Networks, ed. M.E. Steenstrup (Prentice Hall, 1995) chapter 3, pp. 83–98.
8) D.B. Johnson and D.A. Maltz, Dynamic source routing in ad hoc wireless etworks, in: Mobile Computing (Kluwer Academic, 1996) chapter 5, pp. 153–181.
9) J. Broch, D.B. Johnson and D.A. Maltz, The dynamic source routing protocol for mobile ad hoc networks, IETF MANET Working Group, Internet-Draft (October 1999).
10) C.E. Perkins, E.M. Royer and S.R. Das, Ad hoc on-demand distance vector (AODV) routing, IETF MANETWorking Group, Internet-Draft (March 2000).

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Algorithm Design for Row-Column Multiplication of N-Dimensional Rhotrices

By Ezugwu E. Absalom,Abiodun O. Ajibade, Junaidu B. Sahalu
Ahmadu Bello University, Samru Zaria-Nigeria

Abstracts - In this paper, a generalized formula for an alternative row-column multiplication method for rhotrices is presented. The concept established in this paper follows the basic rudiment of mathematical axioms that prove the existing relationships between rhotrices and matrices. This is an extension of the same work presented on rhotrices of order three.

Keywords: *Rhotrices, rhotrix, row-column multiplication.*

Classification: *GJCST F.2.1*

Strictly as per the compliance and regulations of:

Algorithm Design for Row-Column Multiplication of N-Dimensional Rhotrices

Ezugwu E. Absalom[1], Abiodun O. Ajibade[2], Junaidu B. Sahalu[3]

Abstract: In this paper, a generalized formula for an alternative row-column multiplication method for rhotrices is presented. The concept established in this paper follows the basic rudiment of mathematical axioms that prove the existing relationships between rhotrices and matrices. This is an extension of the same work presented on rhotrices of order three.

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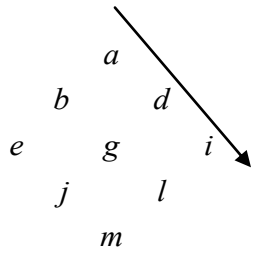
I. Introduction

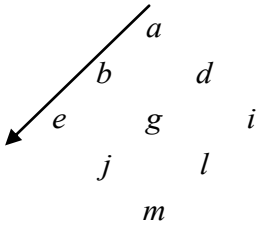
An alternative row-column multiplication method for rhotrices was suggested by B. Sani [3]. His work considered a comparative relationship on some common properties that relate and link rhotrices multiplication to that of the well-known row-column matrices multiplication. The purpose of this extract is to present a formalized equation representing the row column multiplication of some objects, which are in some ways between n x n dimensional matrices and (2n-1) x (2n-1) dimensional matrices for further mathematical enrichment. The name rhotrix came up as a result of the rhomboid nature of the arrangement of some mathematical arrays, which can simply be seen as the combination of matrices [1]. A rhotrix R is called a real rhotrix or an integer rhotrix if all its entries belong to the set of real numbers or set of integer numbers respectively [2]. Rows and column definition of a rhotrix: A set of rhotrices of dimension three was defined in [2] and extension in the dimension was considered possible. For instance, a set of rhotrices of dimension five can be defined as

$$\overset{*}{R} = \left\{ \left\langle \begin{array}{ccccc} & & a & & \\ & b & c & d & \\ e & f & g & h & i \\ & j & k & l & \\ & & m & & \end{array} \right\rangle : a,b,c,\ldots\ldots,m \in \Re \right\}$$

And similarly its rows and columns defined in the following order of arrangements



And



Respectively.

About[1]:MSc Research Student, Computer Science
About[2]:PhD, Mathematics Department of Mathematic Ahmadu Bello University, Samru Zaria-Nigeria
About[3]:Professor, Computer Science: research supervisor

II. Row-Column Multiplication N by N Dimensional Rhotrices

In an attempt to answer the question of "devising a suitable method of solving rhotrices multiplication without having to first perform any form of transformation to coupled matrix and visa-versa" posed in [3][4], an alternative method for multiplication of n-dimensional rhotrices is therefore presented, and thus recorded as follows:

$$R_n \circ Q_n = \left\langle \begin{array}{ccccccccc} & & & a_{11} & & & & & \\ & & a_{31} & a_{21} & a_{12} & & & & \\ & a_{51} & a_{41} & a_{32} & a_{22} & a_{13} & & & \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & & \\ a_{n1} & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & a_{1t} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & & \\ & a_{nt-2} & a_{n-1t-2} & a_{n-2t-1} & a_{n-3t-1} & a_{n-4t} & & & \\ & & a_{nt-1} & a_{n-1t-1} & a_{n-2t} & & & & \\ & & & a_{nt} & & & & & \end{array} \right\rangle \circ \left\langle \begin{array}{ccccccccc} & & & b_{11} & & & & & \\ & & b_{31} & b_{21} & b_{12} & & & & \\ & b_{51} & b_{41} & b_{32} & b_{22} & b_{13} & & & \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & & \\ b_{n1} & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & b_{1t} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & & \\ & b_{nt-2} & b_{n-1t-2} & b_{n-2t-1} & b_{n-3t-1} & b_{n-4t} & & & \\ & & b_{nt-1} & b_{n-1t-1} & b_{n-2t} & & & & \\ & & & b_{nt} & & & & & \end{array} \right\rangle \quad \ldots\ldots\ldots\ldots\ldots\ldots (1.1)$$

The subscript n in equation (1.1) denotes the dimension of the rhotrix, where t = (n+1)/2 and t is the column order of rhotrix Rn and Qn respectively, so that if n=3, then t=(3+1)/2 = 2. If n=5, t=3 and if n=9, t=5. If we defining the rows and columns of rhotrix main entries as:

view a rhotrix as having odd rows as the main entries and even rows as the heart entries all positioned side by side each other, then we can generalize, by

$$\left\langle \begin{array}{cccccccc} a_{n1} & a_{n-11} & .. & a_{11} & & & & \\ & a_{n2} & a_{n-12} & \cdots & a_{12} & & & \\ & & a_{n3} & a_{n-13} & \cdots & a_{13} & & \\ & & & \cdots & \cdots & \cdots & \cdots & \\ & & & & \cdots & \cdots & \cdots & \cdots \\ & & & & & a_{nt} & a_{n-1t} & \cdots & a_{1n} \end{array} \right\rangle \text{ And } \left\langle \begin{array}{cccccccc} & & & & b_{11} & b_{13} & \cdots & b_{1t} \\ & & & b_{31} & b_{32} & \cdots & b_{3t} & \\ & & b_{51} & b_{52} & \cdots & b_{5t} & & \\ & \cdots & \cdots & \cdots & \cdots & & & \\ \cdots & \cdots & \cdots & \cdots & & & & \\ b_{nt} & b_{n2} & \cdots & b_{nt} & & & & \end{array} \right\rangle$$

Respectively and similarly for the hearts entries. Suppose we now represent the n-dimensional rhotrices in equation (1.1)

by $_{n\ ik}$ R = a and $Q_n = b_{kj}$ where a_{ik} and b_{kj} represent the a_{ik} and b_{kj} elements respectively. The multiplication will then be as follow:

$$R_n \circ Q_n = \langle a_{ij} \circ b_{lj} \rangle = \lambda \sum_{k=1}^{t} (a_{ik} b_{2k-1\,j}) + (1-\lambda) \sum_{k=1}^{t-1} (a_{ik} b_{2kj}) \quad \ldots\ldots\ldots\ldots\ldots (1.2)$$

$n \in 2Z^+ + 1$

$t = (n+1)/2$

$i, j = 1,2,3,\ldots\ldots\ldots, n \text{ and}$

$k = 1,2,3,\ldots\ldots, t$ for i mod 2 = 1: $\lambda = 1$

$k = 2,4,6\ldots\ldots, t-1$ for i mod 2 = 0: $\lambda = 0$

Hence, the row-column rhotrix multiplication method is similar to matrix multiplication. However, in this case odd rows of a_{ij} multiply odd columns of $b_{ij,}$ while even rows of a_{ij} will then multiply even columns of b_{ij}.

Algorithm 1: Rhotrix multiplication algorithm For

i: 1 to n

if i mod 2 ≠ 0

{

col: upperbound = (n+1) / 2

β = 1

}

Else

{

col: upperbound = (n-1) / 2

β = 0

}

For j: 1 to upperbound

For k: 1 to upperbound

R[i,j] = R[i,j] + β*A[i,k] * B[2k-1,j] + (1- β) *A[i,k]*B[2k,j]

Endfor

Endfor

Endfor

III. Row-Column Multiplication Process

Consider any two rhotrices say R_9 and Q_9:

$$R_9 \circ Q_9 = \left\langle \begin{array}{ccccccccc} & & & & a_{11} & & & & \\ & & & a_{31} & a_{21} & a_{12} & & & \\ & & a_{51} & a_{41} & a_{32} & a_{22} & a_{13} & & \\ & a_{71} & a_{61} & a_{52} & a_{42} & a_{33} & a_{23} & a_{14} & \\ a_{91} & a_{81} & a_{72} & a_{62} & a_{53} & a_{43} & a_{34} & a_{14} & a_{15} \\ & a_{92} & a_{82} & a_{73} & a_{63} & a_{54} & a_{44} & a_{35} & \\ & & a_{93} & a_{83} & a_{74} & a_{64} & a_{55} & & \\ & & & a_{94} & a_{84} & a_{75} & & & \\ & & & & a_{95} & & & & \end{array} \right\rangle \circ \left\langle \begin{array}{ccccccccc} & & & & b_{11} & & & & \\ & & & b_{31} & b_{21} & b_{12} & & & \\ & & b_{51} & b_{41} & b_{32} & b_{22} & b_{13} & & \\ & b_{71} & b_{61} & b_{52} & b_{42} & b_{33} & b_{23} & b_{14} & \\ b_{91} & b_{81} & b_{72} & a_{62} & b_{53} & b_{43} & b_{34} & b_{14} & b_{15} \\ & b_{92} & b_{82} & b_{73} & b_{63} & b_{54} & b_{44} & b_{35} & \\ & & b_{93} & b_{83} & b_{74} & b_{64} & b_{55} & & \\ & & & b_{94} & b_{84} & b_{75} & & & \\ & & & & b_{95} & & & & \end{array} \right\rangle \quad \ldots\ldots\ldots\ldots\ldots (1.3)$$

We then define multiplication of any two rhotrices using the row-column multiplication method similar to that of the matrices without any special consideration of the rhotrix hearts as separate entities on their own. Similar to the addresses used in identifying the row-column entries in a matrix, we associate the entries in a rhotrix by specific symbols (indexes) which run through all the entries as in the rhotrices R9 and Q9 above respectively. Thus, the multiplication will then be as follows:

$$R_{11} = a_{11}\, b_{11} + a_{12} b_{31} + a_{13} b_{51} + a_{14}\, b_{71} + a_{15}\, b_{91}$$
$$R_{12} = a_{11}\, b_{12} + a_{12} b_{32} + a_{13} b_{52} + a_{14}\, b_{72} + a_{15}\, b_{92}$$
$$R_{13} = a_{11}\, b_{13} + a_{12} b_{33} + a_{13} b_{53} + a_{14}\, b_{73} + a_{15}\, b_{93}$$
$$R_{14} = a_{11}\, b_{14} + a_{12} b_{34} + a_{13} b_{54} + a_{14}\, b_{74} + a_{15}\, b_{94}$$
$$R_{15} = a_{11}\, b_{15} + a_{12} b_{35} + a_{13} b_{55} + a_{14}\, b_{75} + a_{15}\, b_{95}$$

i = 1, j, k = 1, 2, 3, 4, where i is odd

$$R_{31} = a_{31}\, b_{11} + a_{32} b_{31} + a_{33} b_{51} + a_{34}\, b_{71} + a_{35}\, b_{91}$$
$$R_{32} = a_{31}\, b_{12} + a_{32} b_{32} + a_{33} b_{52} + a_{34}\, b_{72} + a_{35}\, b_{92}$$
$$R_{33} = a_{31}\, b_{13} + a_{32} b_{33} + a_{33} b_{53} + a_{34}\, b_{73} + a_{35}\, b_{93}$$
$$R_{34} = a_{31}\, b_{14} + a_{32} b_{34} + a_{33} b_{54} + a_{34}\, b_{74} + a_{35}\, b_{94}$$
$$R_{35} = a_{31}\, b_{15} + a_{32} b_{35} + a_{33} b_{55} + a_{34}\, b_{75} + a_{35}\, b_{95}$$

i = 3, j, k = 1, 2, 3, 4, where i is odd

$$R_{51} = a_{51}\, b_{11} + a_{52} b_{31} + a_{53} b_{51} + a_{54}\, b_{71} + a_{55}\, b_{91}$$
$$R_{52} = a_{51}\, b_{12} + a_{52} b_{32} + a_{53} b_{53} + a_{54}\, b_{72} + a_{55}\, b_{92}$$
$$R_{53} = a_{51}\, b_{13} + a_{52} b_{33} + a_{53} b_{53} + a_{54}\, b_{73} + a_{55}\, b_{93}$$
$$R_{54} = a_{51}\, b_{14} + a_{52} b_{34} + a_{53} b_{54} + a_{54}\, b_{74} + a_{55}\, b_{94}$$
$$R_{55} = a_{51}\, b_{15} + a_{52} b_{35} + a_{53} b_{55} + a_{54}\, b_{75} + a_{55}\, b_{95}$$

i = 5, j, k = 1, 2, 3, 4, where i is odd

$$R_{71} = a_{71}\, b_{11} + a_{72} b_{31} + a_{73} b_{51} + a_{74}\, b_{71} + a_{75}\, b_{91}$$
$$R_{72} = a_{71}\, b_{12} + a_{72} b_{32} + a_{73} b_{52} + a_{74}\, b_{72} + a_{75}\, b_{92}$$
$$R_{73} = a_{71}\, b_{13} + a_{72} b_{33} + a_{73} b_{53} + a_{73}\, b_{72} + a_{75}\, b_{93}$$
$$R_{74} = a_{71}\, b_{14} + a_{72} b_{34} + a_{73} b_{54} + a_{74}\, b_{74} + a_{75}\, b_{94}$$
$$R_{75} = a_{71}\, b_{15} + a_{72} b_{35} + a_{73} b_{55} + a_{74}\, b_{75} + a_{75}\, b_{95}$$

i = 7, j, k = 1, 2, 3, 4, where i is odd

$$R_{91} = a_{91}\, b_{11} + a_{92} b_{31} + a_{93} b_{51} + a_{94}\, b_{71} + a_{95}\, b_{91}$$
$$R_{92} = a_{91}\, b_{12} + a_{92} b_{32} + a_{93} b_{52} + a_{94}\, b_{72} + a_{95}\, b_{92}$$
$$R_{93} = a_{91}\, b_{13} + a_{92} b_{33} + a_{93} b_{53} + a_{94}\, b_{73} + a_{95}\, b_{93}$$
$$R_{94} = a_{91}\, b_{14} + a_{92} b_{34} + a_{93} b_{54} + a_{94}\, b_{74} + a_{95}\, b_{94}$$
$$R_{95} = a_{91}\, b_{15} + a_{92} b_{35} + a_{93} b_{55} + a_{94}\, b_{75} + a_{95}\, b_{95}$$

i = 9, j, k = 1, 2, 3, 4, where i is odd

$$R_{21} = a_{21}\, b_{21} + a_{22} b_{41} + a_{23} b_{61} + a_{24}\, b_{81}$$
$$R_{22} = a_{21}\, b_{22} + a_{22} b_{42} + a_{23} b_{62} + a_{24}\, b_{82}$$
$$R_{23} = a_{21}\, b_{23} + a_{22} b_{43} + a_{23} b_{63} + a_{24}\, b_{83}$$
$$R_{24} = a_{21}\, b_{24} + a_{22} b_{44} + a_{23} b_{64} + a_{24}\, b_{84}$$

i = 2, j, k = 1, 2, 3, 4, where i is even

$$R_{41} = a_{41}\, b_{21} + a_{42} b_{41} + a_{43} b_{61} + a_{44}\, b_{81}$$
$$R_{42} = a_{41}\, b_{22} + a_{42} b_{42} + a_{43} b_{62} + a_{44}\, b_{82}$$
$$R_{43} = a_{41}\, b_{23} + a_{42} b_{43} + a_{43} b_{63} + a_{44}\, b_{83}$$
$$R_{44} = a_{41}\, b_{44} + a_{42} b_{44} + a_{43} b_{64} + a_{44}\, b_{84}$$

i = 4, j, k = 1, 2, 3, 4, where i is even

$$R_{61} = a_{61}\, b_{21} + a_{62} b_{41} + a_{63} b_{61} + a_{64}\, b_{81}$$
$$R_{62} = a_{61}\, b_{22} + a_{62} b_{42} + a_{63} b_{62} + a_{64}\, b_{82}$$
$$R_{63} = a_{61}\, b_{23} + a_{62} b_{43} + a_{63} b_{63} + a_{64}\, b_{83}$$
$$R_{64} = a_{61}\, b_{44} + a_{62} b_{44} + a_{63} b_{64} + a_{64}\, b_{84}$$

i = 6, j, k = 1, 2, 3, 4, where i is even

$$R_{81} = a_{81}\, b_{21} + a_{82} b_{41} + a_{83} b_{61} + a_{84}\, b_{81}$$
$$R_{82} = a_{81}\, b_{22} + a_{82} b_{42} + a_{83} b_{62} + a_{84}\, b_{82}$$
$$R_{83} = a_{81}\, b_{23} + a_{82} b_{43} + a_{83} b_{63} + a_{84}\, b_{83}$$
$$R_{84} = a_{81}\, b_{44} + a_{82} b_{44} + a_{83} b_{64} + a_{84}\, b_{84}$$

i = 8, j, k = 1, 2, 3, 4, where i is even

The resulting multiplicand of the two rhotrices, R_9 **Q9** is also given in the form shown below:

$$\text{Let } R_9 \circ Q_9 = R = \left\langle \begin{array}{ccccccccc} & & & & R_{11} & & & & \\ & & & R_{31} & R_{21} & R_{12} & & & \\ & & R_{51} & R_{41} & R_{32} & R_{22} & R_{13} & & \\ & R_{71} & R_{61} & R_{52} & R_{42} & R_{33} & R_{23} & R_{14} & \\ R_{91} & R_{81} & R_{72} & R_{62} & R_{53} & R_{43} & R_{34} & R_{24} & R_{15} \\ & R_{92} & R_{82} & R_{73} & R_{63} & R_{54} & R_{44} & R_{35} & \\ & & R_{93} & R_{83} & R_{74} & R_{64} & R_{55} & & \\ & & & R_{94} & R_{84} & R_{75} & & & \\ & & & & R_{95} & & & & \end{array} \right\rangle$$

By comparing entries, we have the following resultant equations:Those entries for which i assumes odd values are calculated as:

$$R_{11}=\sum_{K=1}^{5} a_{1K}b_{2k-11}\ ,\ R_{12}=\sum_{K=1}^{5} a_{1K}b_{2k-12}\ ,\ R_{13}=\sum_{K=1}^{5} a_{1K}b_{2k-13}\ ,\ R_{14}=\sum_{K=1}^{5} a_{1K}b_{2k-14}\ ,\ R_{15}=\sum_{K=1}^{5} a_{1K}b_{2k-14}$$

$$R_{31}=\sum_{K=1}^{5} a_{3K}b_{2k-11}\ ,\ R_{32}=\sum_{K=1}^{5} a_{3K}b_{2k-12}\ ,\ R_{33}=\sum_{K=1}^{5} a_{3K}b_{2k-13}\ ,\ R_{34}=\sum_{K=1}^{5} a_{3K}b_{2k-14}\ ,\ R_{35}=\sum_{K=1}^{5} a_{3K}b_{2k-15}$$

$$R_{51}=\sum_{K=1}^{5} a_{5K}b_{2k-11}\ ,\ R_{52}=\sum_{K=1}^{5} a_{5K}b_{2k-12}\ ,\ R_{53}=\sum_{K=1}^{5} a_{5K}b_{2k-13}\ ,\ R_{53}=\sum_{K=1}^{5} a_{5K}b_{2k-13}\ ,\ R_{53}=\sum_{K=1}^{5} a_{5K}b_{2k-13}$$

While those entries for which i takes an even values are similarly calculated as:

$$R_{21}=\sum_{K=1}^{4} a_{2K}b_{2k1}\ ,R_{22}=\sum_{K=1}^{4} a_{2K}b_{2k2}\ ,R_{23}=\sum_{K=1}^{4} a_{2K}b_{2k3}\ ,R_{24}=\sum_{K=1}^{4} a_{2K}b_{2k4}$$

$$R_{41}=\sum_{K=1}^{4} a_{4K}b_{2k1}\ ,R_{42}=\sum_{K=1}^{4} a_{4K}b_{2k2}\ ,R_{43}=\sum_{K=1}^{4} a_{2K}b_{2k2}\ ,R_{44}=\sum_{K=1}^{4} a_{2K}b_{2k4}$$

IV. Generalized Form of Row-Column Multiplication

Splitting equation (1.2), the summations are as follows:

$$R_{i,j} = \sum_{k=1}^{t} a_{ik}b_{2k-1j} \qquad \text{Entries for the odd rhotrix of } R. \qquad \ldots\ldots\ldots\ldots (1.4)$$

$$R_{i,j} = \sum_{k=1}^{t-1} a_{ik}b_{2kj} \qquad \text{Entries for the even rhotrix of } R. \qquad \ldots\ldots\ldots\ldots (1.5)$$

The differences between these two summations are reflected in the two upper bounds (i.e. *t*, and *t-1*), and for index *b (i.e. 2k-1 and 2k-0)*. We want to devise a generalized formula to handle these two sets of entries. Consider the function:

$$f(x) = \begin{cases} 1, & if\ x\ is\ odd \\ 0, & if\ x\ is\ even \end{cases}, \qquad defined\ by \quad f(x) = \tfrac{1}{2}[(-1)^{x+1} + 1], \quad x = 1, 2, \ldots$$

Replacing 1 and 0 with *f(i)* in the index of *b* in equations (1.4) and (1.5) respectively, we have:

$$R_{i,j} = \sum_{k=1}^{t} a_{ik} b_{2k-\frac{1}{2}[(-1)^{i+1}+1]j} \qquad \text{Entries for the order 3 rhotrix of } R_{i,j}. \quad \ldots\ldots(1.6)$$

$$R_{i,j} = \sum_{k=1}^{t-1} a_{ik} b_{2k-\frac{1}{2}[(-1)^{i+1}+1]j} \qquad \text{Entries for the order 2 rhotrix of } R_{i,j}. \quad \ldots\ldots(1.7)$$

Similarly consider these two functions:

$$(x) = \begin{cases} 3, & if\ x\ is\ odd \\ 2, & if\ x\ is\ even \end{cases} \quad defined\ by \quad g(x) = \tfrac{1}{2}[5-(-1)^x], \quad x = 1,2,\ldots n$$

$$g(x) = \begin{cases} 5, & if\ x\ is\ odd \\ 4, & if\ x\ is\ even \end{cases} \quad defined\ by \quad g(x) = \tfrac{1}{2}[9-(-1)^x], \quad x = 1,2,\ldots\ n$$

Replacing only the differences in equations (1.6) and (1.7), for the upper bounds 3 and 2, and 5 and 4 respectively we obtain the equations:

For n = 5

$$\langle R_{ij} \rangle = \sum_{k=1}^{\frac{1}{2}[5-(-1)^i]} a_{ik} b_{2k-\frac{1}{2}[(-1)^{i+1}+1]j} \qquad i = 1,2,\ldots,5 \qquad j,k = 1,2,\ldots,\tfrac{1}{2}[5-(-1)^i] \quad \ldots\ldots(1.8)$$

For n = 9

$$\langle R_{ij} \rangle = \sum_{k=1}^{\frac{1}{2}[9-(-1)^i]} a_{ik} b_{2k-\frac{1}{2}[(-1)^{i+1}+1]j} \qquad i = 1,2,\ldots,9 \qquad j,k = 1,2,\ldots,\tfrac{1}{2}[9-(-1)^i] \quad \ldots\ldots(1.9)$$

This approach can further be extended to n-dimensional rhotrices, finally let us consider the function

$$h(x) = \begin{cases} t, & if\ x\ is\ odd \\ t-1, & if\ x\ is\ even \end{cases} \quad defined\ by \quad h(x) = \tfrac{1}{2}[2t-1-(-1)^x], \quad x = 1,2,3,\ldots n$$

Hence from equation (1.1), we know that t= (n+1)/2, therefore, n = 2t-1, by substituting t and t-1for the function h (i), we obtain this equation.

$$\langle R_{ij} \rangle = \sum_{k=1}^{\frac{1}{2}[n-(-1)^i]} a_{ik} b_{2k-\frac{1}{2}[(-1)^{i+1}+1]j} \qquad i = 1,2,\ldots,n \qquad j,k = 1,2,\ldots,\tfrac{1}{2}[n-(-1)^i] \quad \ldots\ldots(1.10)$$

Equation (1.10) can further be expressed as:

Let $p = \frac{1}{2}[n-(-1)^i]$ and by substituting the value of p into equation (1.10), we have

$$\langle R_{ij} \rangle = \sum_{k=1}^{p} a_{ik} b_{2k-\frac{1}{2}[(-1)^{i+1}+1]j} \qquad i = 1,2,\ldots,n \qquad j,k = 1,2,\ldots,p \quad \ldots\ldots(1.11)$$

Algorithm 2: Extended row-column multiplication

```
For
i: 1 to n
        P=: ½((-1)i+1+1)
        For j: 1 to t
        For k: 1 to t
            R [i,j] = R[i,j]  + A[i,k]*B[2k-p,j]
        Endfor
    Endfor
Endfor
```

V. Conclusion

In this paper, we have shown a more simplified method of rhotrix row-column multiplication by taking a holistic approach in deriving a new form of a generalized equation, the approach used in this paper does not require any form of rhotrix transformation to either matri or coupled matrix before any possible multiplication could be achieved. The approach and results analyzed shows that the equations (1.2) and (1.13) can be used to solve rhotrices of any dimension and yet gives the same result equivalent to the initial method proposed [3].

References Références Referencias

1) Ajibade, A. O.,2003, the concept of rhotrix in mathematical enrichment, International Journal of Mathematical Education in Science and Technology, Vol. 34:2s, 175-179.
2) Mohammed, A., 2009, A remark on classifications of rhotrices as abstract structures, International Journal of Research in Physical Sciences, Vol.4:8, 192-197.

3) Sani, B. 2004, the row-column multiplication of high dimensional rhotrices, International Journal of Mathematical Education in Science and Technology, Vol.35:5, 777-781.
4) Sani, B. 2007, Conversion of a rhotrix to a 'coupled matrix', International Journal of Mathematical Education in Science and Technology, Vol. 38:5, 657-662.

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Evaluation of Improved QoS Routing Algorithm

By Mr.R.Senthil Kumar
Singhania University,Rajasthan,India

Abstracts - Need for Quality of Service (QoS) on the Internet and QoS routing is an important component of the overall QoS framework. The role of a QoS routing strategy is to compute paths that are suitable for the different types of traffic generated by the various applications, while maximizing the utilization of network resources. The fulfillment of these objectives requires the development of algorithms that find multi-constrained paths taking into consideration the state of the network and the traffic requirements, namely, considering its needs in terms of delay, jitter, loss rate and available bandwidth. However, the problem of finding multi-constrained paths has high computational complexity, and thus there is the need to use algorithms that address this difficulty. The path computation algorithm is at the core of QoS routing strategies. Instead of using a shortest path algorithm based on statically configured metrics, as in traditional routing protocols, the algorithm must select several alternative paths that are able to satisfy a set of constraints regarding, end-to-end delay bounds and bandwidth requirements. This proposal presents and discusses the main approaches used to reduce QoS routing algorithm complexity and to improve the overall network performance. An improved QoS multi-constrained delay and bandwidth (MDBCP) routing algorithm is proposed to solve the QoS routing, when the number of independent routing constraints is more than one.

Keywords: *Quality of service, Path computation algorithm, MDBCP.*

Classification: *GJCST D.2.9, G.2.2*

Strictly as per the compliance and regulations of:

Evaluation of Improved QoS Routing Algorithm

Mr.R.Senthil Kumar

Abstract: Need for Quality of Service (QoS) on the Internet and QoS routing is an important component of the overall QoS framework. The role of a QoS routing strategy is to compute paths that are suitable for the different types of traffic generated by the various applications, while maximizing the utilization of network resources. The fulfillment of these objectives requires the development of algorithms that find multi-constrained paths taking into consideration the state of the network and the traffic requirements, namely, considering its needs in terms of delay, jitter, loss rate and available bandwidth. However, the problem of finding multi-constrained paths has high computational complexity, and thus there is the need to use algorithms that address this difficulty. The path computation algorithm is at the core of QoS routing strategies. Instead of using a shortest path algorithm based on statically configured metrics, as in traditional routing protocols, the algorithm must select several alternative paths that are able to satisfy a set of constraints regarding, end-to-end delay bounds and bandwidth requirements. This proposal presents and discusses the main approaches used to reduce QoS routing algorithm complexity and to improve the overall network performance. An improved QoS multi-constrained delay and bandwidth (MDBCP) routing algorithm is proposed to solve the QoS routing, when the number of independent routing constraints is more than one.

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I. Introduction

Fundamental problem of routing in a network that provides quality-of-service (QoS) guarantees is to find a path between a specified source destination node pair that simultaneously satisfies multiple QoS constraints, such as cost, delay, and reliability. Such an environment is commonly modeled by a graph with vertices and edges where the vertices represent computers or routers and the edges represent links. Each edge has weights associated with it, representing cost, delay, and reliability, etc. Weights on edges extend to weights on paths in a natural way. If the edge weights represent cost, delay, and reliability, then the corresponding path weight is obtained by adding (multiplying, in the case of reliability) the weights of the edges on the path. For this reason, such QoS parameters are said to be additive. QoS parameters such as bandwidth are known as bottleneck parameters where the corresponding weight of a path is the smallest of the weights of the edges on the path. Problems involving bottleneck constraints can be easily solved by ignoring all edges whose weights Are smaller than a chosen value. Therefore, restrict the attention of this thesis to additive parameters only.Recognizing the need for an efficient solution to this fundamental problem, many researchers have studied this problem in the last fewyears. Most of the existing works concentrate on the problem with two additive constraints. This special case is known as the delay constrained least cost path problem where the two edge weights are cost and delay, and one seeks a minimum cost path subject to a given delay constraint. The basic system is described one where based on the predicted value of the aggregate traffic at the bottleneck node, a control vector is generated for the non-real-time traffic sources. Note that these sources could all be at different points in the network and hence the propagation delay to each of them from the bottleneck queue is different. Control systems should seek to minimize this delay, since switches will need to buffer any data that arrives after they signal the congestion status but before the end of the delay. A variety of technical goals, some of them conflicting. are desirable for any flow control mechanism. Data should rarely, if ever, be discarded due to exhaustion of switch buffer memory. Such data may have to be retransmitted after a possibly lengthy time-out period, further contributing to network congestion and the delay seen by the user.

II. Literature Review

The existing method, use a linear combination of the two weights and presented a simple algorithm for finding a good linear combination of the two weights. It proved near optimality properties of the two paths found. These heuristics can find a good solution quickly, but do not provide any performance guarantee.[2] Another literature presented a polynomial time heuristic algorithm based on scaling and rounding of the delay parameter so that the delay parameter of each edge is approximated by a bounded integer.[1] The existing method developed a fully polynomial time approximation scheme for the problem on an acyclic graph. This method presented two improvements, one with a time complexity of approximation parameter, and the other with a time complexity of upper bound on the optimal solution value which is no more than times the maximum edge-cost.[5] It has a straightforward extension to general graphs, finds a delay constrained path whose cost is within a factor that of the delay

About:Research Scholar,Singhania University,Rajasthan,India.E-Mail:trskme@gmail.com

constrained least cost path. The path computed by this algorithm does not necessarily satisfy the delay constraint, its delay is at most times the delay constraint, and its cost is at most that of the delay constrained least cost path. Another existing scheme presented a case of acyclic graphs with a time complexity. [6, 7] It presented a pre-computation scheme for QoS routing with two additive parameters. It presented efficient approximation algorithms for QoS routing with inaccurate information. Applications of QoS in multiservice IP networks and their practical significance were provided by the system. The problem with three or more constraints has also been studied. Using simulations they showed that their heuristic provides better performance than other algorithms with comparable computational complexity. It provide a limited granularity heuristic and a limited path heuristic. The proposed method, analyze the problem with additive QoS constraints with a fixed constant. This method developed a novel time approximation algorithm, which uses a single auxiliary edge weight to compute a shortest path. Because of this property, the algorithm is easily implementable in a hop-by-hop environment.

III. System Model

1) *Source and Destination Nodes*

Any data network has bottlenecks, points where more data can arrive than the network can carry. These points are often in switches with multiple ports. Congestion arises when data, destined for a single output port, arrives at many inputs. Each network switch collects information about congestion, and informs, directly or indirectly, the sources of data. This feedback is usually based on the amount of buffer space available or in use in the switch. The sources act to control how much data they send. This control loop has a delay of at least twice the propagation delay between the switch and control point. Control systems should seek to minimize this delay, since switches will need to buffer any data that arrives after they signal the congestion status but before the end of the delay.

2) *Intermediary Links and Nodes Of Interest*

Links between switches should be used at full capacity whenever possible. For instance, if one connection sharing a link reduces the rate at which it sends, the others should increase as soon as possible. All the connections, which are constrained by a bottleneck link, should get fair shares of that link. The flow control mechanism should be robust, loss or delay of control messages, for instance, should not cause increased congestion. The network administrator should not have to adjust any complex parameters to achieve high performance. Finally, the flow control mechanism should have a cost commensurate with the benefits it provides.

3) *Qos Constraint Flow Control*

Any prediction of how well a flow control scheme will work requires a model for the behavior of network traffic. A full-blown model might involve characteristics of applications and higher-level protocols. For our purposes it is enough to distinguish between smooth and bursty traffic.A smooth traffic source offers a constant and predictable load, or only changes in time scales that are large compared to the amount of time the flow control mechanism takes to respond. Such traffic is easy to handle well; the sources can be assigned rates corresponding to fair shares of the bottleneck bandwidth with little risk that some of them will stop sending and lead to underutilized links. Switches can use a small amount of memory, since bursts in traffic intensity are rare.Sources of smooth traffic include voice and video with fixed-rate compression. The aggregate effect of a large number of bursty sources may also be smooth, particularly in a wide-area network where the individual sources are relatively low-bandwidth and uncorrelated. Rate-based flow control works well with smooth traffic.Bursty traffic lacks any of the predictability of smooth traffic, as observed in some computer communications traffic. Some kinds of bursts stem from users and applications. These bursts are sporadic, and typically do not last long enough on a high-speed link to reach steady state over the link round-trip time.

4) *Mp- Bdcp Algorithm*

(Most-Probable Bandwidth-Delay Constrained Path)

1) Using Heuristic most probable Delay constrain path model evaluate delay rate r*D
2) Using modified Dijksta's algorithm for most probable Bandwidth constrain path, evaluate bandwidth rate r*B
3) If r*D and r*B are the same, then return r*D
4) Set N = {r*D, r*B}
5) Set r* = r*D
6) Using modified Dijkstra's algorithm for MP-BCP in the reverse direction, fint the maximum probability satisfying B, from every node u to node t.
7) While $\pi B(r*B) > \pi B(r*) + \epsilon$
8) Using Heuristic MPDCP with some modifications find tmp such that $\pi B(tmp) > \pi B(r*) + \epsilon$
9) Set r* = tmp
10) Set R = R ц {r*}
11) end
12) return N

Given a bandwidth constraint B and a delay constraint D, the problem is to find a path that is most likely to satisfy both constraints. Specifically, the problem is to find a path r* such that for any other path p from s to t.

$$\pi_B(r*) \geq \pi_B(p), \quad \text{and} \qquad (1)$$
$$\pi_D(r*) \geq \pi_D(p), \qquad (2)$$

where $\pi_B(p) \stackrel{\text{def}}{=} \Pr[b(p) \geq B]$ and $\pi_D(p) \stackrel{\text{def}}{=} \Pr[d(p) \leq D]$.

If the b(i, j)'s and d(i, j)'s are constants, the MP-BDCP problem reduces to the familiar bandwidth-delay constrained path problem, which can be easily solved in two steps.

i. prune every link (i, j) for which b(i, j) < B, and
ii. find the shortest path with respect to the delay parameter in the pruned graph.

Using the central limit theorem and Lagrange relaxation techniques, two complementary solutions for the delay case have been provided. These solutions are found to be highly efficient, requiring, on average, a few iterations of Dijkstra's shortest path algorithm. The bandwidth case is rather simple, and is dealt with by transforming it into a variant of the shortest path problem. The solutions for the MP-BCP and MP-DCP problems are then combined to address the MP-BDCP problem. MP-BDCP belongs to the class of multi-objective optimization problems, for which a solution may not even exist. To eliminate the potential conflict between the two-optimization objectives, an approach is proposed in which a subset of nearly non-dominated paths is computed for the given bandwidth and delay constraints.

IV. Experimental Evaluation

Extensive simulations are conducted to evaluate the performance and computational complexity of the aforementioned algorithmic solutions. The interest is not only to assess the betterment of these solutions, but to also demonstrate the potential benefits of the probabilistic approach, as a means of reducing the protocol overhead at no loss in the routing performance. In the probabilistic approach, routers are expected to maintain and advertise two parameters for each QoS measure (e.g., mean and variance for delay, minimum and maximum for available bandwidth). These parameters vary at a much slower pace than the instantaneous delay and bandwidth values. In our simulations, an assumption is made that these statistical parameters are computed and advertised once at the beginning of each simulation run is made. Source nodes then use the one-time advertised information to determine the most-probable path with respect to the delay constraint, the bandwidth constraint, or both. Once this path is computed, its feasibility according to the actual (instantaneous) link values (which are not available to the path selection algorithm) is checked. If the path is feasible according to the actual values, the attempt is called a 'success'. The performance of a path selection algorithm is expressed in terms of the success rate (SR), which is the fraction of returned paths that are feasible.To demonstrate the robustness of the probabilistic approach, contrast it with the standard threshold-based triggered approach. In the triggered approach, the instantaneous bandwidth and delay values are advertised once they exceed certain thresholds, indicated by THB and THD, respectively (for simplicity, express these thresholds in absolute terms). The proposed experiment, evaluate the available bandwidth over a given link. If this bandwidth changes (e.g., following the addition of a new flow or the termination of an existing one) such that the absolute difference between the new value and the most recently advertised one exceeds THB , then a new link state advertisement (LSA) is generated and advertised throughout the domain. The smaller the values of THB and THD, the higher are the SR of the triggered approach. But this performance gain comes at the expense of increased advertisement overhead. The algorithm treats the available state values as if they were exact. Compare the probabilistic and triggered approaches in terms of the normalized SR's and the communications overhead. To measure the communications overhead of the triggered approach, it is computed the percentage of links whose bandwidth and delay values changed to the extent of triggering a state update within a given period. In the simulations the probabilistic approach uses the one-time advertised statistical information.

V. Conclusion

The developed system focused on the problem of controlling the traffic in such way as to minimize the asymptotic tail of the buffer occupancy distribution for a given constraint on the nodal utilization. The system, have developed a heuristic scheme that satisfies the necessary condition for optimality. The interesting fact in this scheme is, since it explicitly takes into account the queuing behavior at the node, decreases the probability of overflow in the network by several orders of magnitude. The overall contributions of the system are

- Present a simple time –approximation algorithm which can be easily used in hop-by-hop routing protocols.
- Present an for one optimization version of the problem with a time complexity.
- Present an for another optimization version of the problem with a time complexity of when there exists a hop path satisfying all QoS constraints. When reduced to the special case, the time complexities of our algorithms compare favorably with existing algorithms.

References Références Referencias

1) Guoliang Xue, Arunabha Sen, Weiyi Zhang, Jian Tang, and Krishnaiya Thulasiraman, "Finding a Path Subject to Many Additive QoS Constraints" IEEE/ACM Transacations on Networking, vol.15, no. 1, Febraury
2) J. M. Jaffe, "Algorithms for finding paths with multiple constraints," Networks, vol. 14, pp. 95–116, 1984.
3) S. Chen and K. Nahrstedt, "On finding multi-constrained paths," IEEE ICC'98, pp. 874–879.
4) X. Chu and B. Li, "Dynamic routing and wavelength assignment in the presence of wavelength conversion for all-optical networks," IEEE/ACM Trans. Netw., vol. 13, no. 3, pp. 704–715, Jun. 2005.
5) T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms. New York: McGraw-Hill, 2001.
6) F. Ergun, R. Sinha, and L. Zhang, "An improved FPTAS for restricted shortest path," Inf. Process. Lett., vol. 83, pp. 287–291, 2002.
7) A. Goel, K. G. Ramakrishnan, D. Kataria, and D. Logothetis, "Efficient computation of delay-sensitive routes from one source to all destinations," in Proc. IEEE INFOCOM 2001, pp. 854–858.
8) R. Guerin and A. Orda, "QoS routing in networks with inaccurate information: theory and algorithms," IEEE/ACM Trans. Netw., vol. 7, no.3, pp. 350–364, Jun. 1999.
9) R. Hassin, "Approximation schemes for the restricted shortest path problem," Math. Oper. Res., vol. 17, pp. 36–42, 1992.
10) C. Huitema, Routing in the Internet, 2nd ed. Englewood Cliffs, NJ: Prentice-Hall PTR, 2000.
11) O. H. Ibarra and C. E. Kim, "Fast approximation algorithms for the Knapsack and Sum of Subset problems," J. ACM, vol. 22, pp. 463–468, 1975.

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A Model of Product Performance Forecasting: A Hybrid

By I .D.Widodo,Alva E. Tontowi,Subagyo
University of Gadjah Mada, Indonesia.

Abstracts - To reduce the risks associated with new product, forecasting becomes very important to estimate success rate of the product. A new model of product performance forecasting is developed by combining Principle Component Analysis and Artificial Neural Network (PCA-ANN). The principle component analysis is used to improve forecasting performance by redefining the correlated dependent variable into new uncorrelated variable. ANN is used to build up forecasting model based on the variable. Comparative study is performed to examine the result. Linear regression and artificial neural network are applied and compared to the proposed model. The result shows that PCA-ANN gives the best measure performance for every segment.

Keywords: *Product performance, success factors, regression, artificial neural network.*

Classification: *GJCST I.2.6*

Strictly as per the compliance and regulations of:

A Model of Product Performance Forecasting: A Hybrid

I .D. Widodo[1], Alva E. Tontowi[2], Subagyo[3]

Abstracts: To reduce the risks associated with new product, forecasting becomes very important to estimate success rate of the product. A new model of product performance forecasting is developed by combining Principle Component Analysis and Artificial Neural Network (PCA-ANN). The principle component analysis is used to improve forecasting performance by redefining the correlated dependent variable into new uncorrelated variable. ANN is used to build up forecasting model based on the variable. Comparative study is performed to examine the result. Linear regression and artificial neural network are applied and compared to the proposed model. The result shows that PCA-ANN gives the best measure performance for every segment.

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I. Introduction

Successful new product development (NPD) is an essential element for the renewal and survival of many manufacturing companies. Both of scientists and managers stated that product design was one major tool to gain competitive advantages (Kotler & Rath, 1984). Some researches showed that the development and introduction of a new product is an inherently risky venture. Crawford (1987) identified that 35 % to 45 % of new products failed to compete in market. Stevens and Burley (2003) even identified that the failure rate of new products was somewhere between 40 % and 75%.To reduce the risks associated with new products, forecasting becomes very important to estimate success rate of the product. Some sales forecasting has become an established practice within the marketing research industry. Despite many claims of high precision, sales forecasting of new products is risky and estimates can often be off the mark. Some forecasting techniques are available. Three broad categories of forecasting methods are Qualitative, Time Series, and Causal. However, qualitative and time series are not quite appropriate to forecast new product Performance because of limited historical data. Causal forecasting methods is the most commonly used because they can find the correlation between demands and environmental factors and use them to develop forecasting model. Several studies have focused on forecasting new-to-the-market product by incorporating market information, market research data, and subjective assessments. Morrison (1996) studied the implementation of diffusion models to forecast sales of a completely new-to-the-market product. He applied a non-linear symmetric logistic curve, using three parameters: the long-run saturation level, the inflection point of the diffusion curve, and the delay factor. Goldfisher *et al.* (1994) proposed a method for determining the success or failure of a new product, which allowed weekly forecasts to be performed. They defined a Sales Index (SI) as a percentage of the difference in sales between two consecutive periods. Their study used Sales Forecast Ratios to predict future sales using SI. Geurts and Whitlark (1993) suggested logistic regression and conjoint analysis for market share forecasting methods besides time series and linear regression the autor emphasizes on identifying and developing forecasting tools to evaluate product performance based on success factors. The model will be developed based on some needs and assumptions, namely, (1) Product success factors tend to be different among different type/level product so estimation model must be developed for each product segment. (2) This model can also be used to evaluate the existing product in market whether it is successful or not so the model is generated based on successful product data. (3) The model is developed based on regression and neural network.

About[1]:lecturer of Industrial Engineering Department, Islamic University of Indonesia and Student of Mechanical and Industrial Engineering Department, University of Gadjah Mada, Indonesia. Email: Imamdjati@fti.uii.ac.id
About[2]:Associate Profesor of Mechanical and Industrial Engineering Department, University of Gadjah Mada, Indonesia. Email: alvaedytontowi@ugm.ac.id
About[3]:Associate Profesor of Mechanical and Industrial Engineering Department, University of Gadjah Mada, Indonesia. Email: Subagyo@ugm.ac.id

II. Literatur Study

I. *Product Success Factors*

Many researchers identified some factors of success (Cooper and Kleinschmidt 1995; Henard & Szymanski, 2001; and Montoya-Weiss & Calentone, 1994), to develop product performance measures (Hopskin, 1981; Barezak, 1995; Calantone *et al.* 1995, and Griffin

and Page, 1993, 1996). However, only few researchers develop product performance estimation model. Montoya-Weiss & Calentone (1994) underlined that many researches done have wide variation in result and they are non-convergent. Based on multivariate analysis, Cooper (1979) identified 11 dimensions (from 77 observed independent variables) of product success. They were product uniqueness/ superiority, market knowledge and marketing proficiency, technical synergy/proficiency, market dynamics, market need (growth and size), price, marketing and managerial synergy, marketing competitiveness and customer satisfaction, newest to firm, strength of marketing communication and launch effort and source of idea/investment magnitude. Henard & Szymanski (2001) developed taxonomy of product success factors that consisted of 4 main factors. They were product characteristics, firm strategies, firm process characteristics, and market characteristics. By using meta-analysis of 60 empirical studies, Henard & Szymanski (2001) also showed 8 important variables of product performance. They were product advantage, product innovativeness, marketing strategy, technological strategy, structured effort, market orientation, cross-functional integration and competitive response intensity. Cooper & Kleinschimidt (2007), based on effect on profitability and impact, identified some critical factors which drive product success. Top four of them were high quality product process, new product strategy, adequate resources, R & D spending.

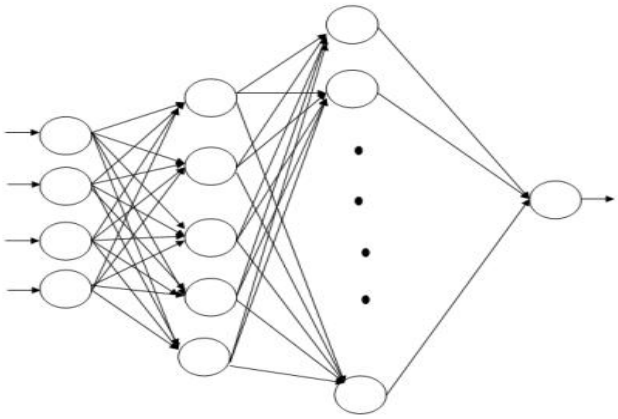
II. *Artificial Neural Network*

An *Artificial Neural Networks* (ANN) are information-processing systems that have certain performance characteristics in common with biological neural network (Fausett, 1994). They have been developed as generalization of mathematical models of human cognition or neural biology based on the assumptions that (1) information processing occurs at many simple element called neurons (2) signal are passed between neurons over connection links (3) each connection link has an associated weight, which, in typical neural net, multiplies the signal transmitted. (4) Each neuron applies activation function to its input (sum of weight input signal to determine output signal. Some important activation functions are:

1. Pure Linear, $y=x$ ..... (1)
2. Binery Sigmoid, $y = \frac{1}{1+e^{-\alpha x}}$ .... (2)
3. Bipolar Sigmoid $y = \frac{1-e^{-x}}{1+e^{-x}}$ .....(3)

The neural network architecture is importance in modeling data sets because it can represent any continuous functional mapping between the input and output variables (Figure 1). Learning in ANN is defined to be any change in the memory (weight matrix) and can be categorized as supervised and unsupervised. Unsupervised learning or self-organization is a process that does not incorporate an external teacher and relies only upon local information and external control strategies. Some examples of unsupervised learning are Hopfield network, bidirectional associative memory, and adaptive resonance theory. Examples of supervised learning are adeline, perceptron back propagation and madaline.

*Figure 1.*The architecture of a three-layer neural network



Back-Propagation Neural Network (BPN) is one kind of popular neural network as the black box that can set up the nonlinear map between the inputs and outputs for the prediction. Standard back propagation (feed forward) is a gradient descent algorithm, in which the network weights are moved along the negative of the gradient of the performance function (Das and Chaudhury, 2007). The term back propagation refers to the manner in which the gradient is computed for non linear multi layer networks. It applies supervised learning to monitor the difference between the true data and the prediction, and then do a sequent revision on the weighting along the branches of BPN so that the difference between true data and the prediction (e^2) will converge gradually within finite steps. This method require the inputs and outputs of a neural network were limited within the ranges from 0 to 1 Properly trained back propagation networks tend to give reasonable answers when presented with inputs that they have never seen. Typically, a new input leads to an output similar to the correct outputs for input vectors used in training. This generalization property makes it possible to train a network on a representative set of input/target pairs and get good results without training the network on all possible input/output pairs (Demuth and Baele, 1994). The training of a BPN includes three stages: (1) feed-forwarding of the input training pattern, (2)

associated error calculation and back-propagation, and (3) weight and bias adjustments. ANN has been successfully applied in some areas of forecasting. Binner *et al.* (2002) applied ANN to model Taiwan's inflation rate resulting in particularly accurate forecasts when divisia monetary measures were used. Thirunavukarasu (2009) successfully applied ANN for Return on Investment in Share Market. ANN successfully has also been applied in some intelligent manufacturing cases (Dagli, 1994) and design (Kuo and Wu, 2006; and Xu, and Yan, 2006). Moshiri and Foroutan (2006) applied ANN to forecast crude oil price. In the hydrological forecasting context, recent experiments have reported that ANNs may offer a promising stream flow prediction (Sivakumaretal, 2002; and Kisi, 2004) and reservoir inflow forecasting (Saad *et al.* 1996 and Jain, *et al.*1999).

III. Conceptual Framework

The conceptual framework of the model is developed based four important factors of product success, namely, price, product advance, innovation, launch timing, and company superiority (Figure 2).

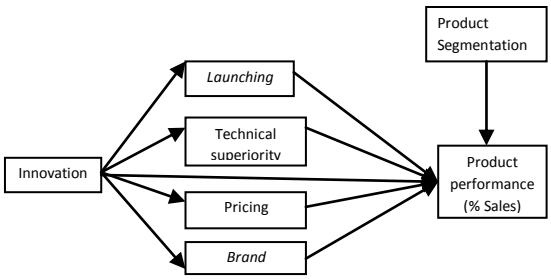


Figure 2. Forecast model

Price is an important factor for customer to buy a product because it can limit someone to buy a product (Kalyanaram dan Winer, 1995; and Foxall and James, 2003). Besides, there are two other significant product characteristic of success, namely product technical superiority and innovation (Kleinschimidt & Cooper, 1991; Henard & Szymanski, 2001; Montoya-Weiss & Calentone 1994, and Goldenberg *et al.* 2001).Launching timing is a very important variable to product success (Hultink and Griffin, 1997; Lee and O'Connor, 2003). Launching new products to market quickly is a pre requisite for acquiring a competitive advantage. The product launch decisions, based on a mix of strategic and tactical decisions, must be reinforcing to produce new product development success.A brand is intended to represent a unique identity that extends beyond the product itself. It can have aesthetic and symbolic value for consumers. A brand can communicate functional characteristics, give a quality impression (functional value), communicate ease of use to customer and as a value added purchase (Creusen and Schoormans, 2005, Foxall and James, 2003 and Page and Herr, 2003).

IV. Methodology

Two steps of research are performed namely success variables identification and product success forecasting model development. Success variables identification is applied by analyzing variables correlation. Regression and ANN are applied to develop the model.The sample consists of more than 200 mobile phone shops in Yogyakarta Indonesia in the period of January until September 2008. The mobile phones are classified into Three class namely low-end, medium-end and high–end product based on their price. The product is classified as low end product if its price is less than $ 150, meanwhile the high product has price more than $ 300. The medium product price is in between of the two classes. The successful mobile phone models/series are selected based on their performance of sales. Pareto chart analysis was applied to select the successful product. The analysis identified 38 successful products series (from 148 product series) that consist of 17 low-end products, 10 medium-end products and 11 high-end products.Some data are involved in this analysis, they are launching date, technical specification and innovation value, price, and brand value. Launching dates are used to determine both launching duration and innovation (with technical specification). Technical superiority values are determined by calculating the average of some technical specifications namely screen resolution, data transfer speed, and features. Likert scoring is used to quantify the features rate based on a technical superiority norm for the technical specifications.Innovation variable is generated based on modification of Booz-Allen & Hamilton norm (Cooper & Kleinschimidt, 1991) to the four product technical specification used in technical superiority analysis. The norm of innovation of all features is in Table 2.This paper uses mobile phone brand value analysis done by SWA and MARS 2008. Brand values are determined based on

brand share, brand awareness, advertisement awareness, customer satisfaction, and gain index. They are analyzed from survey that involved 2648 respondents collected from 7 big cities of Indonesia (Suharjo, 2008).

Table 2. Innovation Norm

Value	Description
5	New to the World Product
4	New Product line to the firm
3	Add to existing line
2	Improvement
1	Reposition

Based on the variables identified, a model is developed for each product segment. Linear Regression and Back Propagation of ANN are applied. Besides, this paper also involves principle component analysis to generate new variable to replace existing correlated variable. The result of the regression, ANN and PCA-ANN are compared to get the best estimation.

V. Result and Discussion

From 80 % mobile phone sales share that can be identified, Nokia has highest % sales by 73 %, followed by Sony-Ericsson (10%), and Motorola (4%). The rest is for LG, Samsung, and other brand. The low-end product has highest market by 58 %. The medium and high products have 16% and 2%. The phenomenon that low-end product has very high shared correlates to the Indonesian income that is still low (less than $3000 per annum).Correlation analysis indicates several finding related to critical variables of each segment and the relation among variables, they are:

1) The variables have different effect to product performance for each segment. Brand is the only variable that positively significant correlates to product performance in all segments. In high-end segment, only one brand dominates the top ranks of products so the correlation cannot be calculated. It indicates that brand is very important to product performance though it cannot be explicitly adjusted.
2) Price negatively correlates to product performance in low and medium end segments. In contrast, price correlates positively to product performance for high-end product.
3) Technical superiority has significantly negative correlation to product performance for low product. In medium and high-end segment, technical superiority indirectly positively correlates to product performance. Technical superiority indirectly correlates to product performance through brand in medium end and through innovation in high end.
4) Launching timing has different effect to product performance for different segment. In low-end segment, time has significantly negative correlation to product performance. Products launched sooner have lower product performance. This is different to medium and high end product that tend to neutral (correlation coefficient is close to 0). These indicate that life cycle of low-end product tends to be shorter than life cycle medium and high end product.
5) Innovation is correlated to product performance for high-end product segment. In low and medium end segment, it cannot be measured because of same innovation value.

Estimation model will be developed based on the factor analysis that involves some significant variables. In low-end segment model is developed based on brand value, launching, technology superiority, and price. Price does not significantly correlate sales but it significantly correlates to technical superiority. Estimation model for medium segment involves price, brand and technical superiority. Meanwhile, price, innovation and technological superiority are used in high end segment.Estimation models are developed based on two estimation techniques for each product segment. Linear regression and back propagation ANN are run to estimate product performance. Data satisfy all assumption of regression for low and medium end, such as collinearity, linearity, and normality, for low-end and medium-end data. The regression model are not fit for high end product because some assumptions are not satisfied especially normalityTo reduce loose of dependent variable that correlates to each other, principle component analysis (PCA) is performed. The correlated variables are technological superiority and price in low-end product segment, technological superiority and brand in medium-end product segment, and technological superiority. Two regression based models are developed for each segment, namely are pure regression model and PCA-regression model. The latest is developed by redefining new variables that correlated each other's. New variables are called as "a" and "b". The two models for low end segment are:

$$y = 5{,}796 - x_1 - 1{,}341\, x_2 - 0.066\, x_3 \quad \ldots\ldots\ldots\ldots (1)$$

$$y = 3.435 - .103\, x_1 + 1.657\, a + .003\, b + .064\, x_3 \quad \ldots\ldots (2)$$

Where: x_1= time from launching, x_2 = tech. superiority, x_3= brand, x_4= price, a, b = new variables Both (1) and (2) are fit model because R of the equations are 0.908, and value R^2 are 0.824 for (1) and 0.825 for (2). The two models for medium end segment are:

$y = 10.166 - 004\ x_4 + .095x_4$ ..... (3)

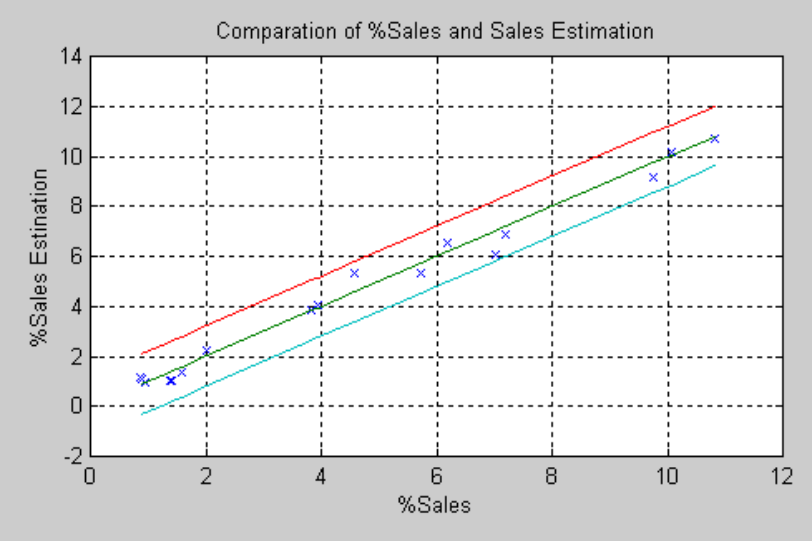
$y = 15.232 - .003\ x_4 + .097\ a - 2.634\ b$ .. ..(4)

Both (3) and (4) are fit model because R and $R^2$of the equations are 0.863 and 0.745 for equation (3) and value are 0.874 for (1) and 0.863 for equation (4).The correlation between price and technical superiority in low-end product can be minimized by redefining the two variables into new variable 'a' and 'b'. By doing so, PCA-ANN is performed the result. In the same way, two variables of medium-end products - technical superiority and brand value - are redefined, meanwhile, for high-end products; variable price, innovation, and technical superiority are redefined. After simulating some architecture, three layers back propagation ANN with the number neurons are 5, 10, and 1 are applied. Activation function of first, second and third layers are pure linear, binary sigmoid and pure linear. The best value for learning rate are 0.3 for low end and medium end and 0.2 for high end segment. PCA-ANN gives better result (based on t-test and smaller mean square error) compared to linear regression for all segments. The comparative study among the methods performed in Table 3.

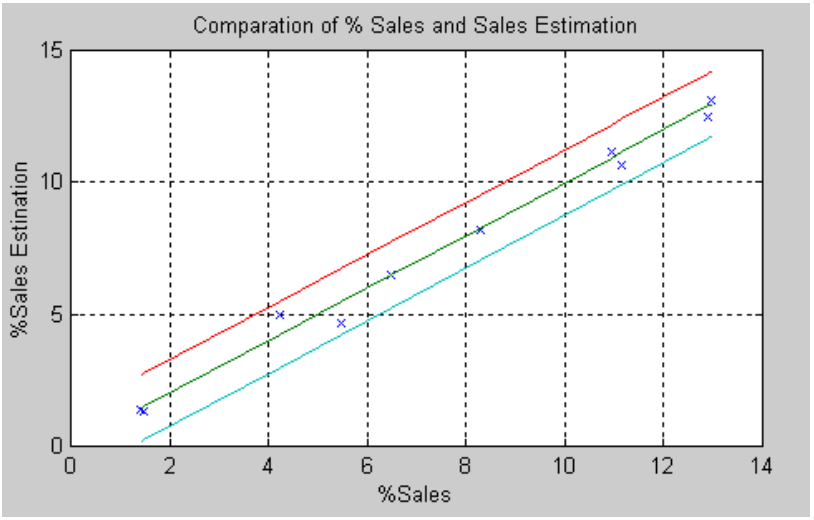
Table 3. The performance comparative study among forecasting methods

	Perf. Charac	Regression	PCA Regression	ANN	PCAANN
Low-end (n=17)	R	0.908	0.9080		
	T test	0.0519	-0.0441	-0.2187	0.1434
	MSE	1.4020	1.39999	0.5108	0.4752
Mediu m-end (n=10)	R	0.863	0.8740		
	T test	0.0807	-1.168	0.2803	0.1374
	MSE	2.1440	2.1885	1.1851	0.5282
High-end (n=11)	R				
	T test	-		-0.1322	0.2177
	MSE	-		3.5387	2.8893

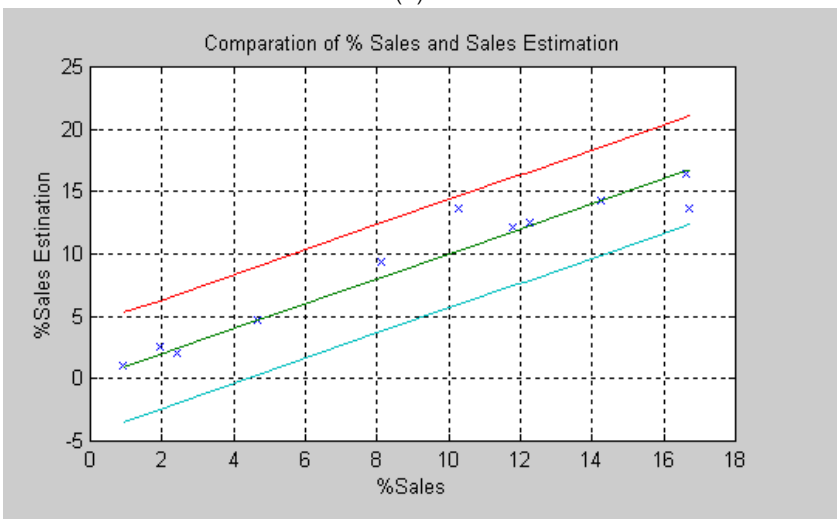
The deviation of forecasted PCA-ANN result and actual value is relative small. They are less than 3 sigma (Figure 3).



(a)



(b)



(c)

Figure 3. PCA-ANN % sales estimation performance VS % sales: (a) Low-end product (b) Medium-end product and (c) High-end product

Model validation is run by analyzing training and testing errors for the architecture. Because of small number data, test error is done by using one leave out method. The

Complete result performs in Table 4. The testing errors shows that all model can perform well because there are no significant different between the fore casting results and the real value ($\alpha = 0.05$).

Table 4. Performance Analysis of The model

No. obs.	Low-end		Medium-end		High-end	
	Training Error	Test Error	Training Error	Test Error	Training Error	Test Error
1	0.3458	-1.3974	0.2425	-0.9784	5.9082	-5.7603
2	-0.0497	0.2028	0.0829	-1.5457	1.6263	0.8797
3	0.3754	-1.0561	0.396	2.2162	0.3598	0.6987
4	0.1959	-1.8978	-0.4288	1.4368	2.2496	-2.4585
5	0.8981	-1.9344	0.0143	-2.9817	0.6647	-1.9921
6	-0.7596	1.8683	0.0365	2.7003	-0.5315	3.2448
7	0.1919	-0.438	0.8230	-2.4726	-1.5860	3.7271
8	-1.0839	2.3504	-0.9640	2.5999	-5.3519	0.4805
9	-0.0409	0.7422	-0.0065	0.9054	0.1568	1.6689
10	0.0844	0.3304	-0.0019	1.8388	-0.6892	2.9438
11	0.0893	0.1716			-0.8239	0.9851
12	0.0140	-0.2807				
13	0.3330	-0.5407				
14	0.1138	-0.0832				
15	-0.1834	0.4404				
16	-0.1189	0.6345				
17	-0.1448	0.6156				
Avg	0.0153	-0.0554	0.0194	0.3719	0.1802	0.4016
SD	0.4403	1.1645	0.4485	2.1652	2.7467	2.8240
T-test	0.1434	-0.1964	0.1374	0.5431	0.2176	0.4716
Concl.	Ho Accepted	Ho Accepted	Ho Accepted	Ho Accepted	Ho Accepted	Ho Accepted

Both average of training and test error is quite small, this indicate that the model can fit to the cases.

VI. Conclusion

1) The proposed model (PCA-ANN) gives better result compared to linear regression for all segments based smallest mean square error
2) The best ANN architecture is three layers back propagation ANN with the number neurons are 5, 10, and 1. Activation function of first, second and third layers are pure linear, binary sigmoid and pure linear.
3) The variables mostly have different effect to product performance for each segment. Brand is the only variable that positively significant correlates to product performance in all segments.

References Références Referencias

1) Barezak, G (1995). New product strategy, structure, process, and performance in the telecommunication industry, *Journal of Product Innovation Management*, 12(2), 71-80
2) Binner, J.M., Gazely, A. M. and Chen, S (2002), Financial innovation and divisia money in Taiwan:A neural network approach, *The European Journal of Finance*, 8, 238–247.
3) Calantone, R., S., Vickery and C. Deoge (1995), Business performance and strategic new product development activity: empirical investigation, *Journal of Product Innovation Management*, 12(3), 214 - 223
4) Cooper, R. G. (1979), The dimensions of industrial new product success and failure. *Journal of Marketing*, 43, 93 – 103
5) Cooper R. G. and Kleinschimidt E. J.(2007), Winning Businesses in product development: critical success factors, *Research Technology Management*, May-June, 52-66
6) Cooper, R. G. and Kleinschmidt, E. J. (1995), Benchmarking the firm's critical success factors in new product development, *Journal of Product Innovation Management*, 12 (5), 374–91.
7) Cooper, R.G. and Kleinschmidt, E.J. (1991), New product processes at leading industrial firms. *Industrial Marketing Management*, 10, 137–147.
8) Crawford, C. Marle (1987), New Product failure rates: a reprise, *Research Management*, 30 (4), 20 – 24

9) Creusen M. E. H., and Schoormans, J.P.L. (2005) The Different Roles of Product Appearance in Consumer Choice, *Journal of Production Innovation Management,* 22, 63–81
10) Dagli, C. H., 1994, *Artificial neural networks: for intelligent manufacturing*, London: Chapman & Hall
11) Das, P. and Chaudhury, S. (2007), Prediction of retail sales of foot wear using feed forward and recurrent neural networks, *Neural Computation & Application*,16, 491–502
12) Demuth, H. Beale, M. (1994), Neural Network Toolbox, the Math Work Inc.
13) Fausett, L., (1994), *Fundamental of neural network: architecture, Algorithm, and application*, New Jersey: Prince Hall
14) Foxall, G. R. and James, V. K. (2003), The behavioral ecology of brand choice: how and what do customers maximize? *Psychology and Marketing*, 20(9), 811-836
15) Geurts, M. D. and Whitlark, D.(1993), Forecasting market share, *The Journal of Business Forecasting Methods & Systems*; Winter; 11, 4, 17-22
16) Goldenberg, J. and Lehmann, D. R., Mazurki, D. (2001), The idea and circumstances of its emergence as predictors of new product success, *Management Science*, 47(1), 69-84
17) Goldfisther, K. and Chan, C. (1994), New product reactive forecasting, *The Journal of Business Forecasting Methods & Systems,* Vol. 13, No. 4, 7-9.
18) Henard, D. H. and Szymanski, D. M. (2001), Why some products are more successful than others, *Journal of marketing Research*, 38, 362-375
19) Hopkins, D. S. (1981), New product winner and losers, *Research Management*, 12(1), 12-17
20) Hultink, E. J. and Griffin, A., (1997), Industrial new product launch strategies and product development performance, *Journal of Product Innovation Management*, 14(4), 234-257
21) Jain, S. K., Das, D. and Srivastava, D. K. (1999), Application of ANN for reservoir inflow prediction and operation, *Journal of Water Resources Planning Management*. ASCE,125, 263-271
22) Kalyanaram dan Winer (1995) Emperical generalization from reference price research, *Marketing Science*, 14, 161-169
23) Kisi, O., (2004), River flow modeling using artificial neural networks, *ASCE Journal of Hydrologic Engineering,* 9(1), 60-63,.
24) Kotler P. and Rath G. E. (1984), Design: a powerful but neglected strategic tool, *Journal of Business Strategy*, 5, 16 - 21
25) Kuo, C. J. and Wu, Y., (2006), Application of a Taguchi-based neural network prediction design of the film coating process for polymer blends, *International Journal Advance Manufacturing Technology* 27:455–461
26) Lee, Y. and O'Connor, G. C., (2003), The impact of communication strategy on launching new product: the moderating role of product innovativeness, *Journal of Product Innovation Management,* 20, 4-21
27) Montoya-Weiss and Calentone, R. S. (1994), Determinants of new product performance: a review and meta-analysis, *The Journal of Product Innovation Management*, 11, 397 – 417
28) Morrison, J., (1996), How to use diffusion models in new product forecasting, *The Journal of Business Forecasting Methods & Systems,* 15, 2, 6-9.
29) Moshiri, S. and Foroutan, F. (2006), Forecasting nonlinear crude oil Future Price, *The Energy Journal*, 81-95
30) Page C. And Herr P. M. (2003), An investigation of the processes by which product design and brand strength interact to determine initial affect and quality judgments, *Journal Of Consumer Psychology*, 12(2), 133–147
31) Saad, M., Bigras, P., Turgeon, A. and Duquette, R. (1996), Fuzzy learning decomposition for the scheduling of hydro electric power systems, *Water Resources.,* 32, 179-186
32) Sivakumar, B., Jayawardena, A. W. and Fernando, T. M. K. G. (2002), River flow forecasting: use of phase space reconstruction and artificial neural net-works approaches, *Journal of Hydrology*, 265, 225-245
33) Stevens, G. A. and Burley, J. (2003), Piloting the rocket of radical innovation, *Research Technology Management*, 46(2), 16–26
34) Suharjo, B. (2008) Metodologi best brand, *SWA*, XXIV (18), 40-60
35) Thirunavukarasu, P.(2009) Estimation of Return on Investment in Share Market through ANN, *Global Journal of Finance and Management*,1 (2), 113-122
36) Xu, and Yan, (2006), An intelligent estimation method for product design time, *International Journal Advance Manufacturing Technology,* 30,601–613

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Optimization of Handoff Method in Wireless Networks

By Venkata Koti Reddy.G,Prof. V. Krishna

Abstracts - Now-a- days many different types of networks communicate among themselves to form of heterogeneous wireless access technologies with diverse levels of performance has been envisioned to characterize the next-generation wireless networks. In heterogeneous wireless networks, handoff can be separated into two parts: horizontal handoff (HHO) and vertical handoff (VHO). VHO plays an important role in fulfilling seamless data transfer when mobile nodes cross wireless access networks with different link layer technologies. Current VHO algorithms mainly focus on when to trigger VHO to improve connection QoS but neglect the problem of how one can synthetically consider all currently available networks (homogeneous or heterogeneous) and choose the optimal network for HHO or VHO from all available candidates. In this paper, we present an analytical framework to evaluate VHO algorithms. This framework can be used to provide guidelines for the optimization of handoff in heterogeneous wireless networks. Subsequently, we extend the traditional hysteresis-based and dwelling-timer-based algorithms to support both VHO and HHO decisions and apply them to complex heterogeneous wireless environments. We refer to these enhanced algorithms as E-HY and E-DW, respectively. Based on the proposed analytical model, we provide a formalization definition of the handoff conditions in E-HY and E-DW and analyze their performance. Subsequently, we propose a novel general handoff decision algorithm GHO to trigger HHO and VHO in heterogeneous wireless networks at the appropriate time. Analysis shows that GHO can achieve better performance than E-HY and E-DW. Simulations validate the analytical results and verify that GHO outperforms traditional algorithms in terms of the matching ratio, TCP throughput, and UDP throughput.

Keywords: *Heterogeneous wireless networks, vertical handoff, horizontal handoff, Wireless area networks*

Classification: *GJCST C.2.1*

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I. A Literature Review

The convergence of heterogeneous wireless access technologies with diverse levels of performance has been envisioned to characterize the next-generation wireless networks (4G). Recent trends indicate that Wireless Wide Area Networks (WWANs) and Wireless Local Area Networks (WLANs) can coexist to complement their different characteristics and provide both universal coverage and broadband access to users. Mobility management is a main challenge in the converged network. It addresses two main problems: location management and handoff management [1]. Location management tracks the mobile terminal for successful information delivery. Handoff management maintains theactiveConnections for roaming mobile terminals as they change their point of attachment to the network. In this paper, we focus on handoff management.Handoff (HO) is the mechanism by which an ongoing connection between a mobile terminal or mobile host (MH) and a correspondent terminal or correspondent host (CH) is transferred from one point of access to the fixed network to another [2]. In cellular networks, such points of attachment are referred to as base stations (BSs), and in WLANs, they are called access points (APs).In heterogeneous wireless networks, handoff can be separated into two parts: horizontal handoff (HHO) and vertical handoff (VHO). A horizontal handoff is made between different access points within the same link-layer technology such as when transferring a connection from one BS to another or from one AP to another. A vertical handoff is a handoff between access networks with different link-layer technologies, which will involve the transfer of a connection between a BS and an AP. Seamless and efficient VHO between different access technologies is an essential and challenging problem in the development toward the next-generation wireless networks. In general, the VHO process can be divided into three main steps: system discovery, handoff decision, and handoff execution [24]. During the system discovery phase.

II. Related Works

There are three strategies for handoff decision mechanisms: Mobile-controlled handoff (MCHO), network-controlled handoff (NCHO), and mobile-assisted handoff (MAHO) [2]. MCHO is used in IEEE 802.11 WLAN networks, where an MH continuously monitors the signal of an AP and Initiates the handoff procedure. NCHO is used in cellular voice networks where the decision mechanism of handoff control is located in a network entity. MAHO has been widely adopted in the current WWANs such as GPRS, where the MH measures the signal of surrounding BSs and the network then employs this information and decides whether or not to trigger handoff. During VHO, only MHs have the knowledge about what kind of interfaces they

About-gvkotireddy@gmail.com,vempati.k@gmail.com

are equipped with. Even if the network has this knowledge, there may be no way to control another network that the MH is about to hand off to. Therefore, MCHO and further assistance from the networks is more suitable for VHO [10]. Two main categories of handoff algorithms are proposed in the research literature [3] based on 1) the threshold comparison of one or more metrics and 2) dynamic programming (DP)/artificial intelligent techniques applied to improve the accuracy of the handoff procedure.The first category is the traditional algorithms widely used in radio cellular systems, which employs a threshold comparison of one or several specific metrics to make a handoff decision. The most common metrics are received signal strength (RSS), carrier-to-interference ratio (CIR),Signal-to-interference ratio (SIR), and bit error rate (BER) [2]. In heterogeneous wireless networks, even though the functionalities of access networks are different, all the networks use a specific signal (beacon, BCCH, or reference channel I) with a constant transmit power to enable RSS measurements. Thus, it is very natural and reasonable for VHO algorithms to use RSS as the basic criterion for handoff decisions.In order to avoid the ping-pong effect, additional parameters such as hysteresis and dwelling timer can be used solely or jointly in the handoff decision process. In [4],in addition to the absolute RSS threshold, a relative RSS hysteresis between the new BS and the old BS is added as the handoff trigger condition to decrease unnecessary handoffs. Marichamy et al. [5] proposes a handoff scheme based on RSS with the consideration of thresholds and hysteresis for mobile nodes to obtain better performance. However, in heterogeneous wireless networks, RSS from different networks can vary significantly due to different techniques used in the physical layers and cannot be easily compared with each other. Thus, the methods in [4] and [5] cannot be applied to VHO directly. Hatami et al. [6] use the dwelling timer as a handoff initiation criterion to increase the WLAN utilization. It was shown in [7] that the optimal value for the dwelling timer varies along with the used data rate or, to be more precise, with the effective throughput ratio. In [8], Ylianttila et al. extend the simulation framework in [6] by introducing a scenario for multiple radio network environments. Their main results show that the handoff delay caused by frequent handoff has a much bigger degrading effect for the throughput in the transition region. In addition, the benefit that can be achieved with the optimal value of the dwelling timer as in [7] may not be enough to compensate for the effect of handoff delay. In [9], Park et all. Propose a similar dwelling-timer-typed approach by performing the VHO if a specific number of continuous received beacons from the WLAN exceed or fall below a predefined threshold. Additionally, in the real-time service, the number of continuous beacon signals should be lower than that of the non-real-time service in order to reduce the handoff delay.More parameters may be employed to make more intelligent decisions. Lee et al. [10] propose a bandwidth aware VHO technique, which considers the residual bandwidth of a WLAN in addition to RSS as the criterion for handoff decisions. However, it relies on the QBSS load Defined in the IEEE 802.11e Standard to estimate the residual bandwidth in the WLAN. In [11], McNair et al. propose a method for defining the handoff cost as a function of the available bandwidth and monetary cost. In [12], actual RSS and bandwidth were chosen as two important parameters for the cost function. Chang et al. [13] propose an adaptive cost-based with predictive RSS approach to perform VHO in heterogeneous wireless networks. One main difficulty of the cost approach is its dependence on some parameters that are difficult to estimate, especially in large cellular networks. Mohanty and Akyildiz [14] developed a cross-layer (Layer 2 + 3) handoff management protocol CHMP, which calculates a dynamic value of the RSS threshold for handoff initiation by estimating MH's speed and predicting the handoff signaling delay of possible handoffs.The second category of handoff algorithms use dynamic programming (DP) [15] or artificial intelligence techniques such as pattern recognition [16], [17], neural networks [2], or fuzzy logic [3], [18], [19] to improve the accuracy and ffectiveness of the handoff procedure. Veeravalli and Kelly [15] pose the handoff problem as a finite-horizon DP problem and obtain the optimal solution through a set of recursive equations. The optimal solution is complicated and nonstationary, and it requires prior knowledge of the MH's exact trajectory. Subsequently, Veeravalli and Kelly [15] derive a simple locally optimal algorithm from the DP solution, which can be designed to be independent of the location of the MH. In [16], pattern- recognition-based handoff algorithms train a system using available metrics (for example, RSS) and the locations where handoff should be made so that the system acquires knowledge of the RSS patterns at such locations. Pahlavan et al. [2] present a simple neural-network-based approach to detect signal decay and make handoff decisions. Guo et al. [19] propose an adaptive multicriteria VHO (AMVHO) decision algorithm.This algorithm uses a fuzzy inference system (FIS) and a modified Elman neural network (MENN). The FIS adopts crucial criteria of the VHO as the input variables and makes the handoff decision based on the defined rule base. The MENN helps in the prediction for the number of users in the after-handoff network, which is a pivotal variable of the FIS.It is important to mention that the complexity of such artificial-intelligence-based algorithms is very high, and its implementation in MHs with limited computing and

storage capability may not be possible. In addition, training of the neural network has to be done beforehand.To sum up, the application scenario of current VHO algorithms is relatively simple. For example, most VHO algorithms only consider the pure VHO scenario, where the algorithm only needs to decide when to use a 3G network and when to use a WLAN [1], [10], [19], [20], [21]. In fact, at any moment, there may be many available networks (homogeneous or heterogeneous), and the VHO algorithm has to select the optimal network for HHO or VHO from all the available candidates. For example, if the current access network of MH is a WLAN, the MH may sense many other WLANs and a 3G network at a particular moment, and it has to decide whether to trigger HHO or VHO. If the HHO trigger is selected, MH then needs to decide which WLAN is the optimal one. Consequently, an analytical framework to evaluate VHO algorithms is needed to provide guidelines for optimization of handoff in heterogeneous wireless networks. It is also necessary to build reasonable and typical simulation models to evaluate the performance of VHO algorithms. In addition to the MR, we also use TCP throughput

III. Assumption and Evaluation Criteria

1) *Assumption*

As mentioned earlier, MCHO and further assistance from the networks is more suitable for VHO. Thus, we assume that the VHO algorithms take the MCHO strategy for handoff decisions, and the network environment satisfies the following conditions (note that we take 3G and IEEE 802.11b WLANs as representative examples of WWAN and WLAN, respectively; however, the proposed analytical framework and handoff algorithms are readily extendible to heterogeneous wireless networks formed by other WWANs and WLANs):

- Neither the WLAN nor the 3G network has network mobility. In other words, the entire network, as a unit, does not change its point of attachment to the Internet and its reachability in the topology.
- Neither the signal strength of the WLAN nor the signal strength of the 3G network will change as time passes. In other words, the signal coverage area is stable.
- We assume that there is no height difference between the AP in a WLAN and the BS in a 3G network. This means that the AP and BS are located in the same 2D space, and the MH only moves in this 2D space.
- There is no object that influences or shelters the wireless signal in the range of MH's movement. There is no restriction on MH's movement either, which means that the MH can move in any direction with any speed. In this paper, we do not consider the influence of the pricing model and user's special preferences for handoff.

The purpose of handoff is to maintain the connection and achieve the best possible QoS.

2) *Evaluation Criteria for Handoff Methods*

In order to evaluate the performance of handoff algorithms, we have defined a new metric, matching ratio, in. Matching means that the decision of the algorithm is the optimum access network at the moment. For example, when the 3G network could provide better QoS, it is said to be matching if the algorithm chooses the 3G network. The matching ratio (MR) is the percentage of the matching period per time unit. Higher MR means that the handoff algorithm can provide better QoS. In addition to the MR, we also use TCP throughput and UDP throughput as evaluation criteria for handoff algorithms.

IV. Architecture of Handoff Management System

Phalavan made a summary of issues related to handoff [2]. These issues are divided into architectural issues and handoff decision algorithms. In this paper, we focus on the design and evaluation of handoff decision algorithms in heterogeneous wireless networks.The fundamental aim of handoff is to make good use of network bandwidth and improve the QoS of applications. In Fig. 1, we show the general modules and procedures of the modules of handoff management system. Our system. Some of these modules collect the link-layer and network-layer information useful for handoff management, and other modules use this information to decide on the appropriate time to initiate handoff and execute the handoff procedures.

V. Analytical Frameworks of Vertical Handoff Methods

During the handoff decision process, two factors should be considered. On one hand, the MH should try maximizing the utilization of a high bandwidth and low cost access network. On the other hand, the number of unnecessary handoffs should be minimized to avoid degrading the QoS of current communication and overloading the network with signaling traffic.

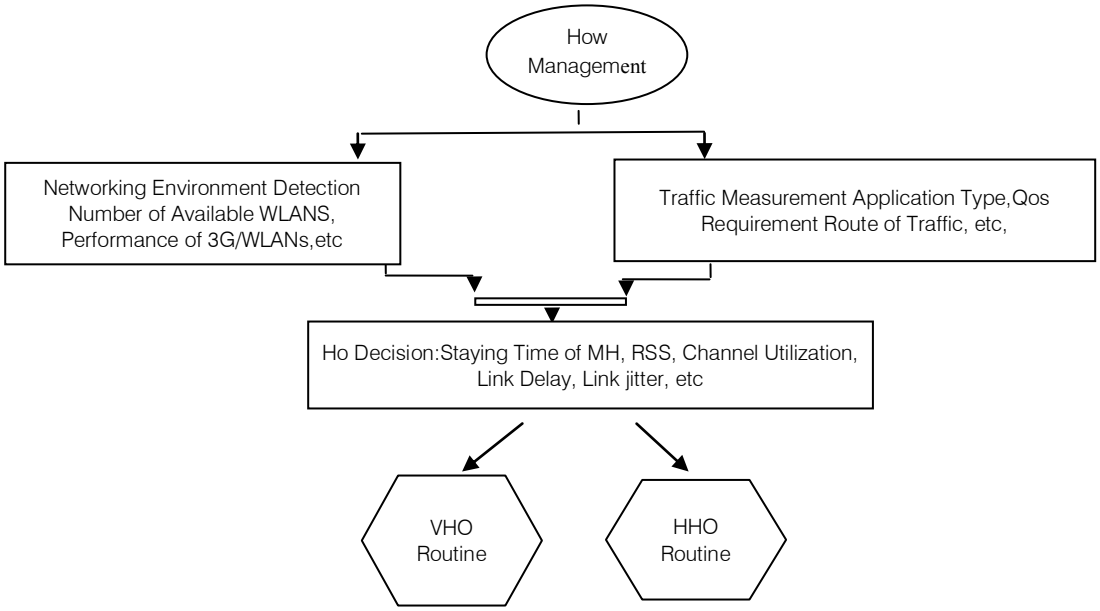

Fig : the modules of handoff management system

VI. Enhancement of Existing Handoff Algorithms and Their Performance Analysis

The hysteresis-based algorithm (HY) is a traditional HHO algorithm that is widely used in radio cellular systems. However, because RSSs measured from different networks display a significant variety due to different techniques in the physical layers and cannot be compared with each other, HY cannot be applied to VHO directly. In this paper, we extend the traditional HY to support both VHO and HHO decisions and apply it to complex heterogeneous Wireless environments. We name the enhanced algorithm as E-HY. Based on the definition of the handoff policy of E-HY can be described by the following (hy denotes hysteresis): ø(N-1)≠Φ(N)↔D≠ø(N-1)(N)<-hy. The relevant deductions for obtaining the above expression are provided in Appendix A.

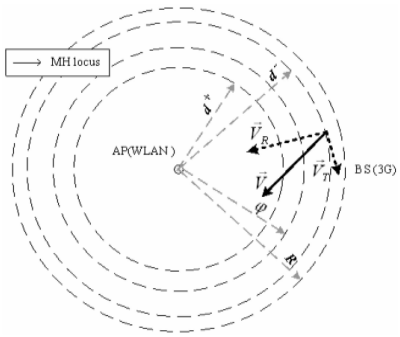

Fig 2. Traversing Scenario for performance analysis.

Thus, we can get the definition of ø(N)in E-HY as In addition, we can extend the traditional dwelling timer-based algorithm to support both VHO and HHO decisions and get the handoff policy of E-DW (tdw denotes the dwelling timer) as Next, we will analyze the performance of E-HY and E-DW during the process of an MH traversing one WLAN. Consider the movement scenario as shown in Fig. 2, where the coverage area of the WLAN is a circle whose center is its AP.

VII. A Novel General Handoff Method and Its Performance

According to the analysis in the previous section, we can see that a simple method to improve the MR is to use the E-HY algorithm when v > vHO and use the E-DW algorithm when v < vHO. However, it is difficult to obtain the velocity of the MH, especially VR. In a practical environment, we must get the position coordinates of the MH and periodically determine their changes to calculate

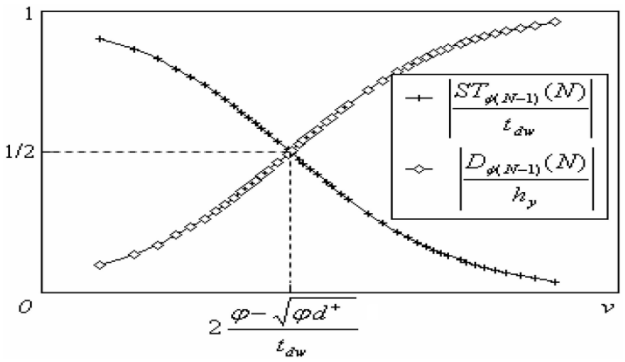

Fig 3. MR of E_HY, E-Dw and GHO as v changes

Fig 3.Analysis of Influence factors in the handoff policy of GHO the velocity of the MH. Constantly monitoring the MH's accurate position is expensive, power consuming, and subject to the influence of the environment. In order to improve the MR, let us examine the handoff conditions of E-HY and E-DW again. we can get the numerical solution of MRGHO. Compared with E-HY and E-DW, GHO can achieve better MR, as shown in Fig. 4. In Fig. 4, the x-axis adopts the logarithmic scale in order to show the instance when v is very large. In addition, the related computing requirement of GHO is very simple to be suitable for mobile devices with limited computing capacity.

VIII. Performance Evaluation

1) *Simulation Scenario*

We design and implement a simulation model, as shown in Fig. 4, to act as a benchmark for the performance evaluation of the VHO algorithms. Assume that MH takes a random rectilinear motion without pause in the square containing four APs, as shown in Fig. 3. The side length of the square is a = 600 m. This square is completely covered by a 3G network. The coverage area of each AP is a circle whose radius is R =150 m. The position coordinates of the four APs are (u ,u)(-u,u)(-u,-u)and(u,-u). By setting u as different values, this model can simulate different handoff scenarios. When u = 150 m, as shown in Fig. 5, there is no overlapping between the coverage areas of the different APs. When u=100 m, as shown in Fig. 5 there is a significant overlap between the overage areas of Product operator is defined as

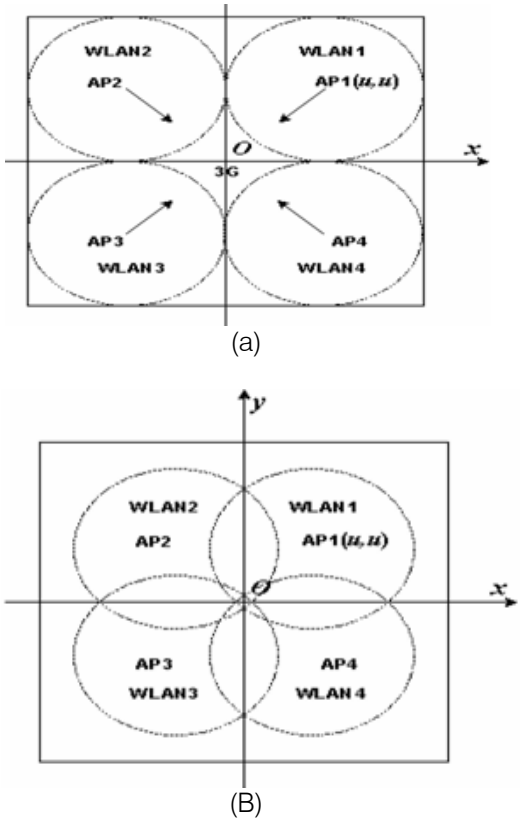

*Fig 4.*Simulation model when model (u,u)

2) *Simulation Results*

Figs. Next 6,7 MR v(m/s),and u(m) in in E-DW, E-HY, and GHO. We can see that as v increases, the MR of E-DW will decrease, whereas, as u increases, its MR increases. In contrast, v has little influence on MR in E-HY. When u increases, E-HY's MR will increase, but the change range is small (between 86.8 percent and 92.1 percent). For GHO, when v is slow, the change trend of its MR is similar to E-DW, whereas, when v is fast, the change trend of its MR is similar to E-HY.When v is slow, the MR of E-DW is about 5 percent higher than E-HY, whereas, when v is fast, E-HY can get about 20 percent higher MR than E-DW. No matter what the value of v is, GHO can get better MR than E-DW and E-HY. This conclusion is consistent with the analytical results in the previous sections.In our simulations, we respectively set u = 150 m; 145 m; 140 m; . . . ; 100 m. Random rectilinear motion means that the MH randomly chooses the destination in the square area, moves straight to the destination with constant speed v, and then repeats the procedure. Choosing a destination and changing the direction will not consume time. Destination selection satisfies a uniform distribution in the square area. In order to get rid of random causes, each simulation includes more than 10,000 continuous random rectilinear motion procedures. In order to evaluate the performance of the algorithms under different moving speeds of the MH, for each value of u, we respectively

set v as 1, 2, 5, 10, and 20 m/s when performing the simulations. We can consider 1 and 2 m/s as the speed of pedestrians, whereas 5, 10, and 20 m/s reflect the speed of different vehicles in the city.

IX. Result

Comparison when u=150m

	Algorithm	V=1m/s	V=20m/s
MR	E-DW	97.20%	69.30%
	E-HY	92.10%	92.10%
	GHO	98.20%	95%
TCP throughput	E-DW	191kbps	48kbps
	E-HY	182kbps	89kbps
	GHO	193kbps	94kbps
UDP throughput	E-DW	140kbps	71kbps
	E-HY	134kbps	105kbps
	GHO	141kbps	109kbps

	Algorithm	V=1m/s	V=20m/s
MR	E-DW	91.00%	69.30%
	E-HY	86.80%	92.10%
	GHO	92.00%	95%
TCP throughput	E-DW	207kbps	48kbps
	E-HY	207kbps	89kbps
	GHO	193kbps	94kbps
UDP throughput	E-DW	140kbps	71kbps
	E-HY	134kbps	105kbps
	GHO	141kbps	109kbps

Comparison when u=100m

X. Conclusion and Future Work

In this paper, we first presented an analytical framework to evaluate VHO algorithms. This framework can be used to provide guidelines for the optimization of handoff in heterogeneous wireless networks. Subsequently, we extended the traditional hysteresis-based and dwelling-timer based algorithms to support both VHO and HHO decisions. We referred to these algorithms as E-HY and E-DW, respectively. Analysis showed that the MR of E-HY has no relation with the MH's moving speed. Based on the analysis, we proposed a novel handoff decision algorithm GHO to trigger HHO and VHO at appropriate times in heterogeneous wireless networks. GHO synthetically of E-DW and E-HY. In addition, when the moving speed is slow, the handoff condition in GHO will be more similar to E-DW, and when the moving speed is high, its handoff condition will be more similar to E-HY. Analysis and simulations show that GHO can achieve better performance than E-DW, E-HY, and PreRSS-Cost. In our future work, we will explore the optimal weight values of the influence factors in and how we can determine them in different scenarios. In addition, we will investigate bandwidth-aware VHO techniques, which determine them in different scenarios.

XI. Future Enhancements

11.A. Scope of the Project:

1) A vertical **handoff algorithm** which enables a mobile node to intelligently select **wireless** access **network** among multiple access.
2) Secure Data Transmission through LAN
3) Establishing a call between the wireless communication device and the at least one serving base station.

XII. Biblography

1) A.H. Zahran, B. Liang, and A. Saleh, "Signal Threshold Adaptation for Vertical Handoff in Heterogeneous Wireless Networks," Mobile Networks and Applications, pp. 625-640, 2006.
2) K. Pahlavan, P. Krishnamurthy, and A. Hatami, "Handoff in Hybrid Mobile Data Networks," IEEE Personal Comm., vol. 7, no. 2, pp. 34-47, Apr. 2000.
3) Hou and D.C.O'Brien, "Vertical Handover-Decision-Making Algorithm Using Fuzzy pp. Logic for the Integrated Radio-and-OW System," IEEE Trans. Wireless Comm., vol. 5
4) N. Zhang and J.M. Holtzman, "Analysis of Handoff Algorithms Using Both Absolute and Relative Measurements," IEEE Trans. Vehicular Technology, vol. 45, no. 1, pp. 174-179, Feb. 1996.
5) P. Marichamy, S. Chakrabarti, and S.L. Maskara, "Performance Evaluation of Handoff Detection Schemes," Proc. IEEE Region 10 Conf. Convergent Technologies for the Asia-Pacific (TENCON '03), vol. 2, pp. 643-646, Oct. 2003.
6) A. Hatami, P. Krishnamurthy, K. Pahlavan, M. Ylianttila, J. Makela, and R. Pichna, "Analytical Framework for Handoff in Non-Homogeneous Mobile Data Networks," Proc.10th IEEE Int'l. Personal, Indoor and Mobile Radio Comm. (PIMRC '99), pp. 760-764,Sept. 1999
7) M. Liu, Z.C. Li, X.B. Guo, E. Dutkiewicz, and D.K. Zhang, "Performance Evaluation of Vertical Handoff Decision Algorithms in Heterogeneous Wireless Networks," Proc.
8) M. Ylianttila, J. Makela, and P. Mahonen, "Supporting Resource Allocation with Vertical

Handoffs in Multiple Radio Network Environment," Proc. 13th IEEE Int'l Symp. Personal, Indoor and Mobile Radio Comm. (PIMRC '02), pp. 64-68, Sept. 2002.

9) H. Park, S. Yoon, T. Kim, J. Park, M. Do, and J. Lee, "Vertical Handoff Procedure and Algorithm between IEEE 802.11 WLAN and CDMA Cellular Network," Proc. Seventh CDMA Int'l Conf. (CIC '02), pp. 103-112, 2002.
10) C.W. Lee, L.M. Chen, M.C. Chen, and Y.S. Sun, "A Framework of Handoffs in Wireless Overlay Networks Based on Mobile IPv6," IEEE J. Selected Areas in Comm., vol. 23, no. 11, pp. 2118-2128, Nov. 200

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An Energy Efficient Coverage Method for Clustered Wireless Sensor Networks

By J. Shanbehzadeh,M. Mehrani,A. Sarrafzadeh,Z. Razaghi
Islamic Azad University,Tehran

Abstracts - An important issue in WSN is the regional covering.A coverage algorithm should be able to solve this issue by considering the power consumption to improve the network lifetime. This requires employing the lowest number of sensors. A solution is just to turn on a subset of nodes. This subset should be chosen in such a way to cover the entire region. This can be achieved by partitioning the network nodes and considering a representative for each part in a time slice to perform the responsibilities of all the partition members for full coverage. This will lead to turn on some of the nodes in a time slice rather than all of them. This paper presents a novel algorithm that employs grouping and time scheduling sensor nodes to turn some of them on to cover the entire area. In this algorithm the sensing range of the nodes depends on their energy. The cluster head denotes the sensing range and also turn on time slice of each node by considering node's remained energy and position.

Keywords: *Sensor network; coverage; group; sensing range*

Classification: *GJCST C.2.1*

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An Energy Efficient Coverage Method for Clustered Wireless Sensor Networks

J. Shanbehzadeh[1] , M. Mehrani[2] , A. Sarrafzadeh[3] , Z. Razaghi[4]

Abstract: An important issue in WSN is the regional covering.A coverage algorithm should be able to solve this issue by considering the power consumption to improve the network lifetime. This requires employing the lowest number of sensors. A solution is just to turn on a subset of nodes. This subset should be chosen in such a way to cover the entire region. This can be achieved by partitioning the network nodes and considering a representative for each part in a time slice to perform the responsibilities of all the partition members for full coverage. This will lead to turn on some of the nodes in a time slice rather than all of them. This paper presents a novel algorithm that employs grouping and time scheduling sensor nodes to turn some of them on to cover the entire area. In this algorithm the sensing range of the nodes depends on their energy. The cluster head denotes the sensing range and also turn on time slice of each node by considering node's remained energy and position.

Keywords: sensor network; coverage; group; sensing range

I. Introduction

Wireless Sensor Networks (WSN) consists of a huge number of sensors with energy resource limitation, dispersed in a region. The network nodes sense data from the region and send them to base station. We need a suitable coverage algorithm to get the entire region information. To achieve a suitable coverage scheme, we should select a sub set of nodes to cover the whole network. This action should be able to optimize the overhead. The selection of covering nodes directly affects the network, especially in region covering.Each node just knows about sensing region of its own.The overlap areas will have negative impact on the energy factor. It is because of the possibility of repeating messages.To avoid overlap areas clustering technique can be utilized.The clustering partitions nods into non-overlapping groups and some of the nodes can act as the representatives of the members. In this way, the probability of creating overlapping message will be reduced and consequently energy consumption will Be improved. Meanwhile, as any point of the region will be covered by using the minimum number of nodes, connectivity will also be satisfied.The rest of this paper is as follows. Section 2 reviews related works. Section 3 describes the new algorithm. Section 4 evaluates the performance of the proposed algorithm and, the final section is conclusion and a summary of the contributions of the proposed approach.

II. Related Works

The node-scheduling scheme proposed in [1] introduces "sponsored coverage" which is about covering the same regions by different nodes. This improves energy consumption and, consequently, network lifetime. The original sensing coverage will be maintained after turning off the redundant nodes. The algorithm mentioned in [2] is based on the probability theory and makes relations between the number of nodes' neighbors and the probability of its full coverage.The distributed k-fold pivot t-set algorithm [3] selects the smallest set among the network nodes as pivot nodes to cover the whole network to route the messages. This algorithm starts with an empty set D which contains suitable routing nodes in future. For doing this, at the beginning of algorithm each node selects 4 (for example) nearest nodes - in terms of distance - as a set called t-ball. So, for a typical network with n nodes there are n t-balls at the first round of algorithm. Then each node sends a value 1/(n-1) to the nodes that they are in its t-ball and a value 0 to other nodes that they are out of the t-ball. In this round many values are sent and received by all the network nodes. Each node sends n-1 values and also receives n-1 values. Then some node i adds all the values it has received and names this total number x_i.Each node, that its x-value is equal to (n-1/n-1)=1, introduces itself as a pivot node and broadcasts a message to other nodes to let them know about itself. So, this node adds itself to pivot set D. Then, each node which x-value is equal to n-2/n-1 introduces itself as a pivot node and broadcasts a message to other nodes to let them know about this object.So, this node adds itself to pivot set D. The algorithm continues in this way. During all the above rounds, some node i compares its t-ball with pivot set D and changes its color to gray if it has at least

About[1]: Department of Computer Engineering at Islamic Azad University Science and Research Branch- Tehran, I. R. Iran.(e-mail: jamshid@tmu.ac.ir).
About[2]:postgraduate student in the field of computer in Islamic Azad University, Dezfoul branch, Young Researchers Club. He is interested in wireless sensor networks. (e-mail: mehrani@iaud.ac.ir).
About[3]: Associate Professor and Head of Department of Computing at Unitec, New Zealand. (e-mail: hsarrafzadeh @unitec.ac.nz).
About[4]: Mehralborz IT Department. She is interested in wireless sensor network.

k nodes from its t-ball that they are in pivot set D, too. This algorithm finishes when all the network nodes are gray and all of them have at least k nodes from the pivot set D that they are in t-balls, too. Now the algorithm is finished and all the nodes of the pivot set D are selected as covering ones and they can cover the entire network. A disadvantage of this algorithm is energy consumption for communication between nodes to achieve the pivot set D. The proposed algorithm in [4] lets a node to go to sleep mode if its sensing range is covered by its neighbors. If the complexity of calculations increases there will be some simplifications to solve this problem. Dominating sets are employed in [5] and [6] to cover single points of the region. In [5] the sensing range of nodes is adjustable and nodes are deployed randomly to monitor several targets. To save energy, covering nodes will be organized into some sets and will be activated successively. Each node can be a member of several sets and the targets would be covered by several sets.Dai and Wu [6] state that a set is dominating if either all the hosts or their neighbors are in the set. The size of the dominating sets and their configurations have direct impact on the efficiency of dominating-set-based routing because of the overhead they make. Using k-connected k-dominating set is mention in [7]. K-coverage and having extensions from point coverage to area coverage are proposed in [8].

III. Proposed Algorithm

The problem that the proposed algorithm attempts to solve is to cover all the area by the entire network during its lifetime by employing the remained energy of the nodes to recognize their sensing range. First, the network is to be clustered by the Feed algorithm [9], which is presented for Wsn. Feed selects the cluster heads based on factors such as energy, density, centrality, and distance between nodes. This algorithm improves the network lifetime in a significant way in comparison with two well known clustering algorithms Leach [10] and Heed [11]. Furthermore,Feed algorithm leads the network to be fault tolerant. "Fig. 1" shows the improvement of network lifetime by Feed in comparison to Leach and Heed algorithms. In Feed when the remained energy of a cluster head falls under a threshold, its supervisor node will replace it and the cluster can continue its activity by the new cluster head. This property leads network to be fault tolerant. "Fig. 1" presents that Feed algorithm improves network lifetime in comparison to two other algorithms. Supervisor node replacement can be a reason for this enhancement. "Fig. 2" shows the percentage of total remaining energy of the network nodes after 1, 20 and 50 rounds. After one round, Heed algorithm outperforms the rest, but in later rounds Feed algorithm performance is the best. After round 300 only feed algorithm is still executing, but Leach and Heed algorithms have terminated. "Fig. 2" shows that Feed significantly improves the network energy consumption. "Fig. 3" shows the network clusters made by the Feed algorithm. After clustering there will be some cluster heads and some regular nodes. At the beginning of the proposed algorithm every cluster head divides its neighboring area into four parts each one as a quarter of anassumed circle that we name it circle1.The radius of circle1 would be equal to the distance between cluster head and its hindmost member. We assume this amount as r. So r is the radius of circle1. Then cluster head assumes another circle into circle1 that we name it circle2 and its radius is r/2. All the members of this cluster would be in circle1 and some of them that their distance from cluster head is less then r/2 would be also in circle2.A cluster head should try to cover all the area of the circle1 by using its members. For doing such, cluster head tries to make a strategy for covering each quarter of the circle1 in the network life time. All four quarters of both of circle1 and circle2 should be covered completely during network functioning.There is a group for each circle. Each node whose distance from cluster head is less than r/2 will be put in group2 and if the distance of a node from cluster head is more than r/2 it would be put in group1.

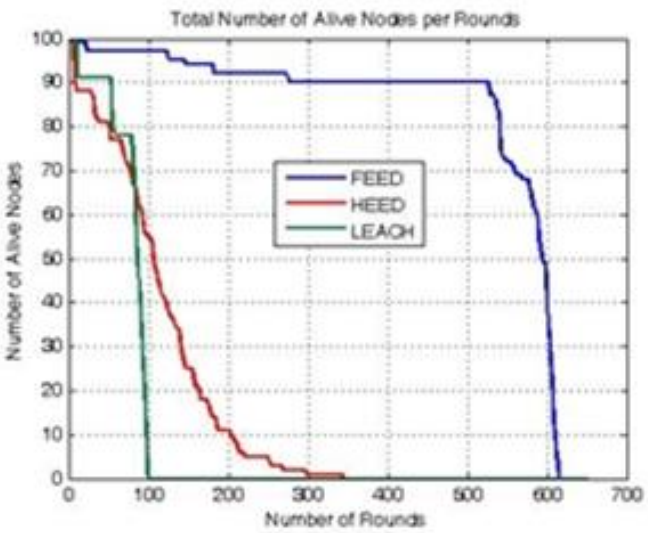

*Figure 1.*Total number of nodes per rounds

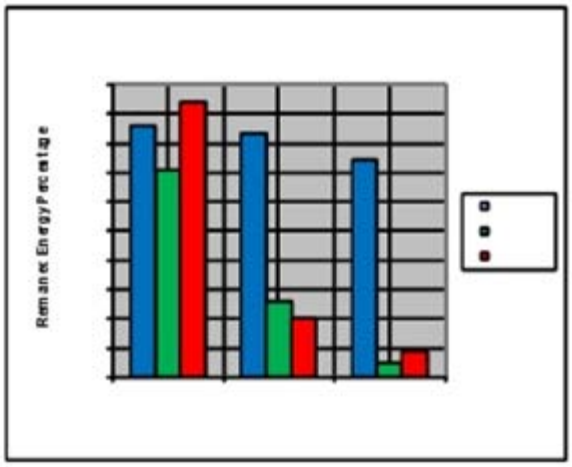

*Figure 2.*Percentage of total remained energy of the network nodes

So, group2 contains the id and angle of those of the nodes that their distance from cluster head is less than r/2 and group1 includes other nodes that their distance from cluster head is between r/2 and r.Each of the mentioned groups is divided into four subgroups and each one corresponds to the circle quarters. "Fig. 4" presents the subgroups' location. The g11, g12, g13, g14 and g21, g22, g23 and g24 are belonging to circle1 and circle2 respectively. Each subgroup has a certain number of nodes. For example subgroupij has nij members with a number of id and angles. The strategy that cluster head assumes is to use some of the nodes of each subgroup for covering the corresponding part of that subgroup. So, cluster head may use one or more nodes for that part in different time slices. The coverage radius considered by cluster head for each node is based on its remained energy. There is a maximum sensing range, which depends on 0.33r, and also there is a minimum sensing range which depends on 0.25r so:

$$MaxSen\sin g \quad \alpha \quad 0.33*r \qquad (1)$$

$$MinSen\sin gR \quad \alpha \quad 0.25*r \qquad (2)$$

MaxSensingR changes in different rounds. Thus, cluster head assumes the sensing rang of each node as follows:

$$MinSen\sin gR <= Sen\sin gRange <= MaxSen\sin gR \qquad (3)$$

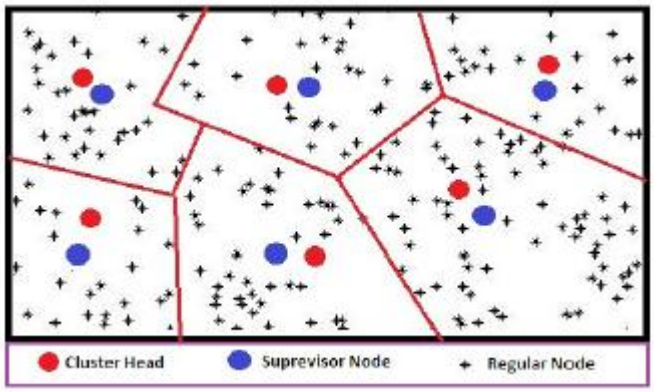

Figure 3. A network clustered by FEED

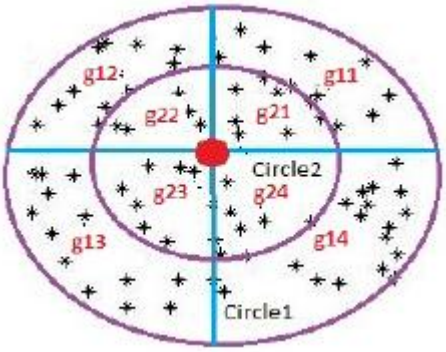

Figure 4. A cluster and its assumed circles

This algorithm presents a way by which almost all over the region is to be covered completely. Moreover each node has a sensing range corresponding to its remained energy:more energy results in a bigger sensing range and vice versa.If the energy of the node is more than a threshold it contributes in covering. Each node of the cluster informs its cluster head about its energy. The threshold amount is based on maximum initialenergy. Thus, if the energy of the node is more than this threshold (assume: threshold = 0.05*initial energy), cluster head decides to contribute it in covering by giving a sensing range between MaxSensingR and MinSensingR to that node. Cluster head selects covering range of every one of its member based on (4):

$$sr = \begin{cases} 0, & node.energy < threshold \\ Max[node.energy * MaxSensingR, (0.25r)], & otherwise \end{cases} \qquad (4)$$

In (4), sr, node.energy, r and MaxSensingR are thesensing range of a node, the percentage of the remained energy of a node, the distance between cluster head and its hindmost member and the maximum sensing range of the node respectively. Based on (4) each node will be aware of its covering range. Furthermore, it gets its turn on time slice from its cluster head. By using this equation if the energy of a node is less than the threshold it will have no contribution in covering and its sensing range is equal to zero, but when a nodes' energy is more than the threshold, its sensing range will be between 0.25r and 0.33r. When the node has the minimum required energy for contributing in covering, its sensing range would be equal to 0.25r and it will have a sensing range equals to 0.33r when it is full of energy.The sensing range of each node that the cluster head denotes is between 0.25r and 0.33r. The usual sensing range of each node is about 8 meters in the FEED algorithm, but it can be changed based on the number of clusters. "Fig. 5" shows part of the region covered by a cluster, which has eight covering active nodes. There are four active nodes in circle1 (red circles) and four active nodes in circle2 (black circles). "Fig. 5" shows that in each cluster always, 8+1 nodes (8 regular nodes and a cluster head) should be in active mode (black, red and blue circles) and the rest can go to sleep, because their neighbors perform their responsibilities. The green nodes in "Fig. 5" are those that are in charge of covering the holes. The covering region of the cluster head is presented by a blue circle at the center of the cluster. By doing such, all over of each cluster will be covered and consequently all over the network will be covered as well.Suppose n be the number of network nodes. The desired percentage of clusters is equal to 0.05*n. So, there will be about twenty nodes in each cluster. As we said just 9 nodes should be in active mode in each time and 11 nodes can go to sleep mode.

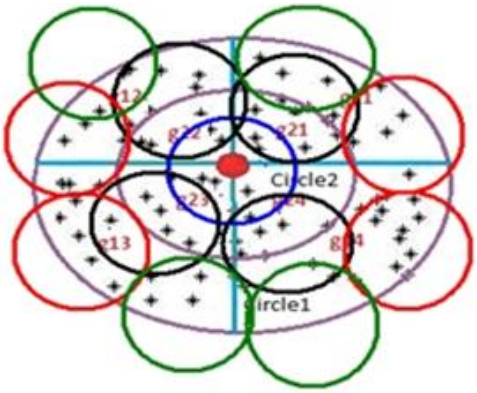

*Figure 5.*A part of region covered by a cluster

The problem that can occur is the existence of holes between covering circles. But, "Fig. 5" presents that the probability of having holes is low. However, if such event happens, then cluster head will turn on the nearest node to that hole. The worst situation that can take place is to have 4 holes between the covering circles. Thus, 7/20 of the cluster nodes will go to sleep and there is at most thirty-five percent energy efficiency in a round for a cluster and consequently for the entire network. In the best condition 11/20 of all the nodes can go to sleep. This means that in each round there is at most about fifty-five percent reduction in the network energy consumption. Thus, network lifetime is increased about fifty five percent. An important point is the percentage of clusters assumed for the network. Usually, this amount is equal to 5%, but it may change to 4% or 6% in some rounds. Changing the percentage of clusters leads to some changes in the functionality of the algorithm as shown in Table. I. By changing the percentage of clusters, percentage of minimum and maximum number of the slept nodes per round will change. In parallel with these changes, the maximum sensing range changes and leads to denoting different sensing range for active nodes. Let a be the usual sensing range of a node which is equal to 8 meters, but it changes when the percent of clusters changes. We relate MaxSensingR to both of A and R, as follows:

$$MaxSensingR = \begin{cases} max(0.25r\,,\ 1.2a) & ,\ a < 0.25r \\ max\ (0.29r\,,\ a) & ,\ 0.25r < a < 0.33r \\ 0.33r & ,\ a > 0.33r \end{cases} \quad (5)$$

Table I. Average percent of active and slept nodes

Percentage of clusters	Number of nodes in each cluster	Min percent of slept nodes	Max percent of slept nodes	Ave percent of slept nodes
4	25	12/25 = %48	16/25 = %6٢	%56
5	20	7/20 = %35	11/20 = %55	%45
6	17	4/17 = %24	8/17 = %47	%35.5

The best situation occurs when the size of the area is 100*100 and the number of nodes is equal to 100, or the size of the area is 200*200 and the number of nodes is equal to 200, or the size of the area is 300*300 and the number of nodes is equal to 300. This models are well known standard models used in several same works. In this models with this condition that the dispersion of the nodes is normal, the usual sensing range (a) is equal to 8 meters. Now, we pay attention to the results of the coverage. Some facts about r, MinSensingR and MaxSensingR are mentioned in "Table. II". "Table. II" shows that energy reduction can be computed, easily. Note that there is well energy reduction for slept nodes, but active nodes are loosing energy. Based on (5), MaxSensingR changes in different implementations of the network and consequently energy reduction will have different kinds, because r changes as a result of changing the implementation of the network. It is possible sometimes for MaxSensingR to be greater than a. So, active nodes will have at most about twenty percent more energy consumption or at most about twenty percent less energy consumption depending on the percent of the clusters. Thus, average percent of energy reduction (AER) can be computed as follows:

$$AER = ASN - (AAN\dot{} 1) * (OEC) \quad (6)$$

In above equation, AER is average percent of energy reduction, ASN is average percent of slept nodes, AAN is average percent of active nodes and OEC is over energy consumption of the active nodes. Also cluster head is active, so we increment AAN.

$$AER\ (worst) = MIPS - (OEC * MAPA) \quad (7)$$

$$AER\ (best) = MAPS - (OEC * MIPS) \quad (8)$$

In (7), AER (worst) is the worst case, the minimum amount of average percent of energy reduction, MIPS is the minimum percent of slept nodes, and MAPA is the maximum percent of active nodes.

In (8), AER (best) is the best case and the maximum amount of average percent of energy reduction, MAPS is the maximum percent of slept nodes and MIPS is the minimum percent of active nodes.

IV. Performance Evaluation

This section presents the performance evaluation of the algorithm. By considering indicated facts and (6), the worst case for average percent of energy reduction (AER (worst)) and best case for average percent of energy reduction (AER (best)) can be computed as shown in Table. III. The results of this method are shown in "Fig. 6." Based on this figure, this method can save energy from % 28 to % 67 during coverage.

Table II. Maximum and minimum sensing range

percentage of clusters	r	MinSensingR = 0.25r	MaxSensingR=0.33r
4	35	9	12
5	28	7	9
6	21	5	7

Table III. Average percent of energy reduction

percentage of clusters	OEC	AER(worst)	AER(best)
4	less than 0.2	48-20=28	64-20=44
5	0	35-0=35	55-0=55
6	less than - 0.2	24+20=44	47+20=67

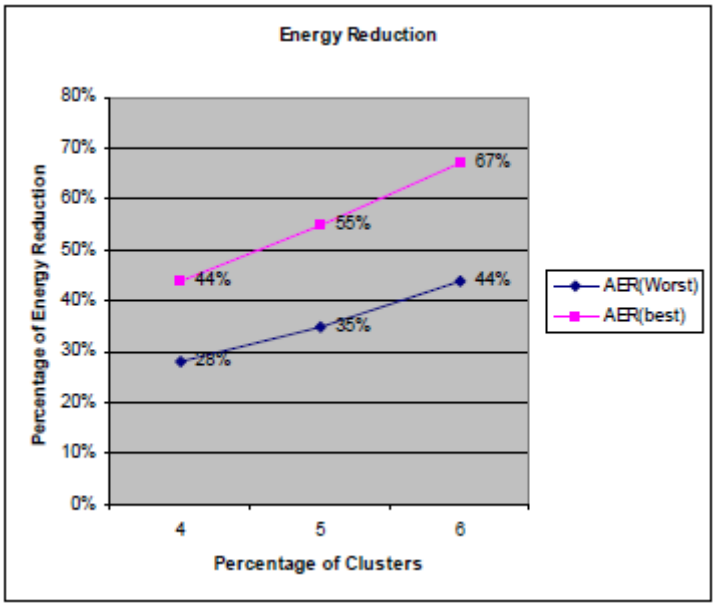

Figure 6. The results of the persented coverage algorithm

By doing such, always every cluster has some nodes to be turning on and other nodes go to sleep mode. The width of circle1 and circle2 is equal to *0.5r,* so having a sensing range greater then *0.33r* is redundant, and if sensing range of a node is less than *0.25r* it will help to make holes. It is possible for a node to be turning on more that once per a round, because after the last node finishes its duty the first node starts covering again, if the round is still continuing. By the proposed algorithm all over the region will be covered completely till end of the network life time. By applying (4), sensing range of each node will be chosen by cluster head during every round in a dynamic way. So, network covering will be under control of cluster heads and they work as the managers of coverage algorithm. This coverage method is at the expansion of a clustering algorithm (FEED) and can be improved, because FEED clustering algorithm selects cluster heads based on important factors like energy, density, centrality and node distances. Furthermore it considers a supervisor node for each cluster to replace the cluster head if it fails.

V. Conclusion

This paper presents a novel coverage method for WSN. This method employs clustering and pays attention to energy of nodes to denote the covering range. Cluster heads are in the charge of denoting these ranges for their members. Some groups are to be created for each cluster region and there are two circles in each, circle1, and circle2 with radius *r* and *r/2*, respectively. For covering all over the region all the groups of all the clusters together should cover their corresponding areas to achieve at region full coverage.

The nodes of each group are to be scheduled to be turn on by cluster head to cover the area. This method can save energy from %28 to %67 during coverage which can significantly improve the network life time.

References Références Referencias

1) D. Tian and N. Georganas. "A coverage preserving node scheduling scheme for large wireless sensor networks." Proc. WSNA'02, pp. 32–41, September 2002.
2) H. O. Sanli, H. C¸ am, and X. Cheng. "Eqos: An energy efficient qos protocol for wireless sensor networks." Proc. WMC'04, Jan. 2004.
3) D. Bein, "Fault-tolerant k-fold Pivot Routing in Wireless Sensor Networks", Proceedings of the 41st Hawaii International Conference on System Sciences, 2008.
4) D. Tian and N. Georganas. "A coverage preserving node scheduling scheme for large wireless sensor networks.", Proc. 1st ACM Workshop on Wireless Sensor Networks and Applications, 2002.
5) M. Cardei, J. Wu, M. Lu, and M. O. Pervaiz. "Maximum network lifetime in wireless sensor networks with adjustable sensing ranges." Proc. IEEE International Conference on Wireless and

mobile computing, Networking and Communications (WiMob), 2005.
6) F. Dai and J. Wu. "An extended localized algorithm for connected dominating set formation in ad hoc wireless networks." IEEE Transactions on Parallel and Distributed Systems, 15(10):908–920, 2004.
7) F. Dai and J. Wu. "constructing k-connected k-dominating set in wireless networks." Proc. IPDPS, Apr. 2005.
8) Z. Jiang, R. Kline, J. Wu, and F. Dai. "Energy efficient k- coverage in wireless sensor networks with connected dominating set.", 2005, unpublished.
9) M. Mehrani, J. Shanbehzadeh, A. Sarrafzadeh, S. J. Mirabedini and C. Manford, "FEED – Fault tolerant Energy Efficient Distributed Clustering for Wireless Sensor Networks", The 12th International Conference on Advanced Communication Technology (ICACT2010), Phoenix Park, Korea, submitted for publication.
10) W. Heinzelman, A. Chandrakasan and H. Balakrishnan, "Energy-efficient communication protocol for wireless microsensor networks," Proc. the 33rd Annual Hawaii International Conference on System Sciences (HICSS), Maui, HI, Jan. 2000, pp. 3005 – 3014.
11) O. Younis and S. Fahmy, "HEED: A Hybrid, Energy-Efficient, DistributedClustering Approach for Ad-hoc Sensor Networks", sponsored in part by NSF grant ANI-0238294 (CAREER) and the Schlumberger Foundation

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An Approach For Grid Based Authentication Mechanism To Counter Cyber Frauds With Reference To Credit Card Payments

By Nayani Sateesh

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Keywords : *Cyber Frauds, Credit Cards, Online Payment, Hidden Markov Model, Debit Cards*

Classification: *GJCST Classification: D.4.6*

Strictly as per the compliance and regulations of:

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I. Introduction

With the growth of internet technologies, the entire world become a global village with resources are being connected together even though they are geographically dispersed. By a single mouse click, we can access and make use of resources and services available over the Internet. Being cheap and an efficient medium to communicate and share the services, internet is becoming more popular in the modern economy, especially with reference to e-commerce. The following table shows various online payment systems. According to Sumanjeet (2008) credit card is most popular method of payments.

Table 1.1: E-Commerce Payments

E-Commerce Payment Systems	Percentage	Rank
Credit Card	35	1
Debit Card (Smart Card)	26.5	2
Cash on Delivery	23.5	3
Bank Transfer	9	4
Money Transfer	5	5
Postal Transfer	1	6
Prepaid Card	0	0
Payment Through Convenience Store	0	0
Total	100	0

The usage of the credit cards is increasing from the consumer perspective day by day at because of its easiness in online payments and the feature "buy now pay later".

II. Treditional credit card processing

Here let us have look at the way the credit cards working mechanism

Step 1: The merchant submits a credit card transaction to the Authorize.Net Payment Gateway on behalf of a customer via secure Web site connection, retail store, MOTO center or wireless device.

Step 2: Authorize.Net receives the secure transaction information and passes it via a secure connection to the Merchant Bank's Processor.

Step 3: The Merchant Bank's Processor submits the transaction to the Credit Card Network (a system of financial entities that communicate to manage the processing, clearing, and settlement of credit card transactions).

Step 4: The Credit Card Network routes the transaction to the Customer's Credit Card Issuing Bank.

Step 5: The Customer's Credit Card Issuing Bank approves or declines the transaction based on the customer's authentication credentials and available funds and passes the transaction results back to the Credit Card Network.

Step 6: The Credit Card Network relays the transaction results to the Merchant Bank's Processor.

Step 7: The Merchant Bank's Processor relays the transaction results to Authorize.Net.

Step 8: Authorize.Net stores the transaction results and sends them to the customer and/or the merchant. This step completes the authorization process – all in about three seconds or less!

Step 9: The Customer's Credit Card Issuing Bank sends the appropriate funds for the transaction to the Credit Card Network, which passes the funds to the Merchant's Bank. The bank then deposits the funds into the merchant's bank account. This step is known as the settlement process and typically the transaction funds are deposited into your primary bank account within two to four business days.

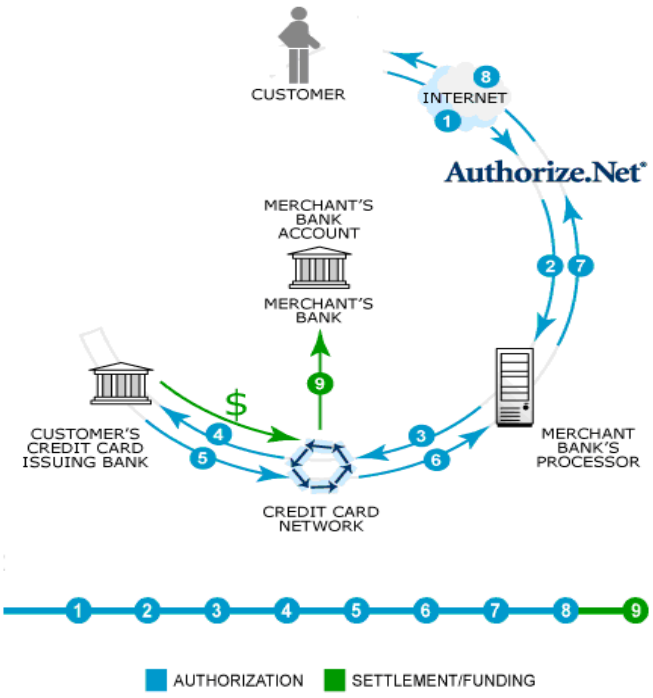

Fig: 2.1 Credit Card Process

III. Related Work

As the credit cards usage is increasing, the frauds are also taking place on the other side. Credit card frauds are detected so far using Neural Network methods, Hidden Markov Model etc. All these methods work based on the unusual patterns in payments. They are all the post methods which help to detect and then take the measures on the fraud that is occurred. But we need a system that helps in preventing the fraud at the initial stage itself such that the fraud could not take part. Here let us have a look at our proposed system in the following section.

IV. Proposed Gird Merchant Processing

Step 1: The customer submits his/her credit card credentials along with the respective Grid Characters on the grid card associated with the credit card. Grid card contains the alphabets associated with the numeric numbers printed on it. These grid codes are generated randomly by the user interface application through which the customer is connecting to the Payment Gateway via secure internet connection

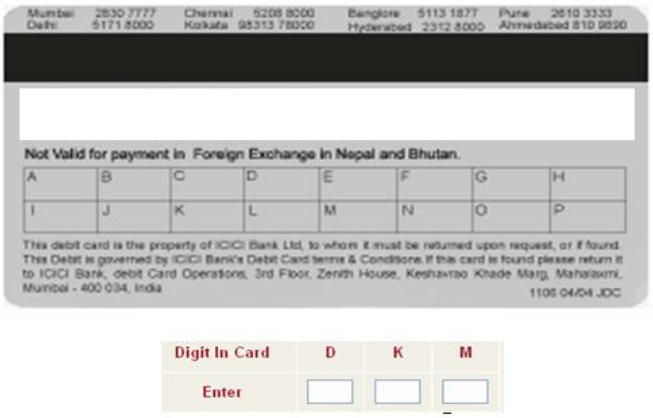

Fig: 4.1 : Grid Card

Where Grid Codes Like A = 12, B= 49, C = 89 …….

Step 2: Authorize.Net receives the secure transaction information along with the Grid codes and passes it via a secure connection to the Merchant Bank's Processor.

Step 3: The Merchant Bank's Processor submits the transaction to the Credit Card Network (a system of financial entities that communicate to manage the processing, clearing, and settlement of credit card transactions).

Step 4: The Credit Card Network routes the transaction to the Customer's Credit Card Issuing Bank.

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Step 8: Authorize.Net stores the transaction results and sends them to the customer and/or the merchant. This step completes the authorization process – all in about three seconds or less!

Step 9: *once the Customer is authenticated* The Customer's Credit Card Issuing Bank sends the appropriate funds for the transaction to the Credit Card Network, which passes the funds to the Merchant's Bank. The bank then deposits the funds into the merchant's bank account. This step is known as the settlement process and typically the transaction funds are deposited into your primary bank account within two to four business days.

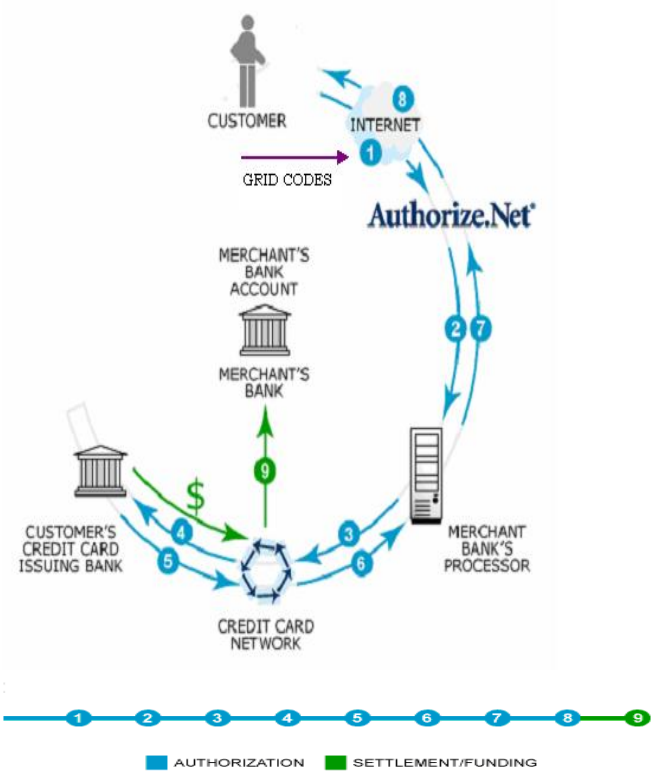

Fig: 4.2 Grid Based Credit Card Process

V. Conclusion

In Grid Based approach each credit card is associated with a Grid Card. Without the Grid Card, no one can do the online payments incase of credit card theft or lost. It helps in get ride of the credit card fraud.

VI. Limitations

Grid Based system requires the existing traditional Credit card process applications to be enhanced and revised. Every Credit card should have an associated Grid card which makes the user inconvenience at the initial stage while doing the online payments but it helps in get ride of the credit card frauds. If both the credit card and Grid card are lost then there is a chance for the credit card frauds and this process is slow

References

1) Jiawei Han , Micheline Kamber "Data Mining : Concepts and Techniques" , Second Edition , 2006 by Elsevier Inc.
2) V.Dheepa , Dr. R.Dhanapal , "Analysis of Credit Card Fraud Detection Methods" International Journal of Recent Trends in Engineering, Vol 2, No. 3, November 2009
3) Singh Sumanjeet "EMERGENCE OF PAYMENT SYSTEMS IN THE AGE OF ELECTRONIC COMMERCE: THE STATE OF ART", Global Journal of International Business Research Vol. 2. No. 2. 2009.
4) Umesh Shankar and Miriam Walker "A Survey of Security in Online Credit Card Payments" May 2001
5) Scott Schmith "Credit Card Market: Economic Benefits and Industry Trends"
6) Karnika Seth, Presentation on "Combating Cyber crimes-Law & Enforcement in India" in 'Diamond Jubilee Celebration Conference of CIRC'. , July 2008
7) FTC FACTS for Consumers - "Avoiding Credit and Charge Card Fraud" by Federal Trade Commission, Bureau of Consumer Protection, Office of Consumer and Business Education, August 1997
8) "FMCBC Recommended Practice: Acceptance of Credit Cards and Debit Cards", 2005
9) White_Paper on "Two-Factor Authentication for Banking—Building the Business Case" by Cryptomathic.
10) Manas Ratha , Prof. Jay W. Forrester "The Credit Card Model" , Massachusetts Institute of Technology , October 2001
11) Credit card payment processing – A diagrammatic illustrationhttp://www.authorize.net/resources/howitworksdiagram/111
12) Online payment processing - ICICI grid cards - www.icicibank.com

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4. Manuscript's Category,

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To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

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

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--

must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing 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 approach 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. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than 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 maintain the initial two items to no more than one ruling each.

- Reason of the study - 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 quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness 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 to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled 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 with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.

- Shape the theory/purpose 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 sound written Procedures segment allows a capable scientist to replacement 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 for the least amount of information that would permit another capable scientist to spare 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 object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text 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:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not 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 - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in 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 a 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. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise 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 in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to 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 part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a 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 implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly 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 with prospect, and let it drop at that.

- Make a decision if each premise is supported, 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 the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One 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 available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to 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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