Artificial Intelligence Techniques based modeling of Bicycle Level of Service for Urban Road Segments

VEERA LEELA MANUSHA

Department of Civil Engineering
National Institute of Technology Rourkela

Artificial Intelligence Techniques based Modeling of Bicycle Level of Service for Urban Road Segments

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Master of Technology

in

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by

Veera Leela Manusha

(Roll .No- 214CE3084)

Under the guidance of

Prof. P.K.Bhuyan

Department of Civil Engineering

National Institute of Technology Rourkela

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Department of Civil Engineering
National Institute of Technology Rourkela

May, 2016

Certificate of Examination

Roll Number: 214CE3084

Name: Veera Leela Manusha

Title of Project: Artificial Intelligence Techniques Based Modeling of Bicycle Level of Service for Urban Road Segments

This is to certify that the thesis mentioned above submitted by VEERA LEELA MANUSHA (214CE3084) in the partial fulfillment of the requirement for the degree of Master of Technology in Civil Engineering at National Institute of Technology Rourkela is a reliable work carried out by her under my supervision and guidance.

Place: NIT Rourkela

Date:

Dr. P. K. Bhuyan
Department of Civil Engineering
NIT, Rourkela

Prof. Prasanta Kumar Bhuyan

 Assistant Professor

May, 2016

Supervisor's Certificate

This is to certify that the thesis mentioned above submitted by V. Leela Manusha (214CE3084) in the partial fulfillment of the requirement for the degree of Master of Technology in Civil Engineering at National Institute of Technology Rourkela is a reliable work carried out by him under my supervision and guidance.

Place: NIT Rourkela
Date:

Prof. P.K.Bhuyan
Department of Civil Engineering
NIT, Rourkela

DECLARATION OF ORIGINALITY

I hereby declare that this submission is entirely belongs to my own work done during the course of Master's Degree and I assure to the best of my knowledge that this work does not contain any piece of work that was taken directly from the work done by any researcher in the past nor it was taken from any article that was published in the past. This work was not submitted to any other university for the award of any other degree.

VEERA LEELA MANUSHA

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Date:

Place:

<div align="right">

Veera Leela Manusha

M. Tech (Civil)

Roll No -214CE3084

Transportation Engineering

</div>

Abstract

Bicycle is one of the key methods of transportation in a creating nation like India. There is no wellbeing to bicyclists in the blended movement and rapid moving vehicles. Subsequently we ought to stress on them by considering components influencing bicyclists solace in arranging and plan stage itself. In India there is heterogeneous activity where we discover collaborations amongst bikes and vehicles. Since no systems are accessible there is a need to build up a technique that gives the see solace level of bicyclists on street sections in fair sized urban communities. In this study BLOS Model is created utilizing three systems in particular Artificial Neural Networks (ANN) and Multi Gene Genetic Programming Methods (MGGP) and Multi linear Regression (MLR). General 59 section information is utilized for investigation which is gathered from Rourkela, Bhubaneswar and Rajahmundry. Eight noteworthy information parameters are considered in the models BLOS model conditions are created for every one of the three strategies. Affectability Analysis is done to decide the vital parameters exceptionally influencing the BLOS. Exhibitions of these models have been tried as far as a few factual parameters. In present study MGGP based BLOS model has great execution contrasted with ANN and MLR strategies.

Key words: Midsized cities, Road segments, Bicycle Level of Service, Heterogeneous traffic flow, Artificial intelligence technique.

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CHAPTER 1

Introduction

1.1 General:

Since most recent five years the volume of mechanized vehicles has hugely expanded on street fragments of urban India with a yearly development rate of approximately 10.16 rate. In India, step by step states of streets are deteriorating. Since most recent five years there is a yearly development rate of 10.16 percent in the normal increment of vehicles. Because of expansion in movement there is activity blockage, increment in clamor and air contamination, and increment in mishap rates. Numerous mischances are happening in India because of blended activity and rapid moving vehicles. We need a methodology in area use arranging itself to cutoff interest for private transport. Existing street space ought to be overseen proficiently. Due consideration ought to be given to natural insurance. The method of transport which is exceptionally maintainable gives high availability furthermore portability to the street clients in an eco-accommodating way. Thus one ought to build green mode decision. Non-mechanized vehicles like people on foot and bikes must be supported. They are cost productive, eco-accommodating and reduce fuel utilization.

Henceforth there is a need to shield the bicyclists from danger elements. The offer of bike outings from general excursions has additionally declined now a days. It is because of the absence of solace being given by the geometric condition to their travel. We have to give a protected foundation to non-mechanized vehicles. Isolation of street space ought to be accomplished for both bicyclists and walkers by giving both bike paths and walkways.

1.2 Problem Statement:

Bicyclists are the appealing mode for low wage family units furthermore effectively available for short treks. Henceforth we ought to accentuate on them by considering components influencing bicyclists solace in arranging and outline stage itself. In India there is heterogeneous movement where we discover associations amongst bikes and vehicles. There are no spatial allotment or cycle tracks independently for bicyclists. Thus we can't have any significant bearing the bike level of administration models of created nations in our nation as they have homogeneous movement. Since no systems are accessible an

approach is to be created that gives the see solace level of bicyclists on street sections in moderate sized urban communities.

1.3 Objective of the study:

1. To determine the variables that effect BLOS.

2. To develop a methodology that evaluates the bicycle comfort level perceived by bicyclists using soft computing techniques like Artificial Neural Networks(ANN) and Multi Gene Genetic Programming on segments in mid-sized cities of India.

3. To evaluate statistical performance of model.

4. To test the significance of proposed models and compare it with statistical techniques.

1.4 Organization of report

The report consists of six chapters. Chapter one deals with the topic, discusses the traffic problems in India, need to promote Bicyclists, objectives and scope of present research. Chapter two deals with different literatures about the BLOS models on segments, applications of Artificial Intelligence Techniques in various fields and BLOS models based on perception. Chapter three discusses briefly on model development. Chapter four discusses about study area where data is collected. Chapter five presents results and analysis briefly where the statistical performances of all the models are compared. Chapter 6 describes summary, conclusions of present study and its future scope.

CHAPTER 2

Literature Review

2.1 General

As per HCM 2010, level of service is characterized as a subjective measure that portrays operational attributes of a driver inside an activity stream considering the view of drivers or travellers. LOS idea is initially presented in 1965. Levels speak to scope of working conditions characterized by measures of adequacy (MOE). In 1985, HCM concentrated on bike sways on mechanized vehicle limit. In 2000, HCM LOS depends on bike rate, deferral and deterrent where as in 2010, LOS depends on explorer's observation whose Score range 1-6.

2.2 Selection of variables affecting BLOS on segments

The geometric elements of roadway and movement attributes that are exceedingly affecting bicyclists are considered and different models are created. Davis (1987) managed the security of bicyclists in view of the roadway qualities. The creator created Bicycle Safety Index Rating (BSIR) model to assess BLOS. The created model comprises of two divisions. The previous is Roadway Segment Index which is a component of parameters like width of outside through path, state of asphalt, path number, area conditions and speed limits. The latter is Intersection Evaluation Index (IEI) which relies on upon signalization sort, all out number of vehicular activity and other geometric elements. Different parameters like slope, substantial vehicles rate and street markings are not considered in BSIR model. RSI Model is altered and roadway condition Index (RCI) model is proposed by Epperson (1994) which is named as Epperson-Davis Model. The model concentrated on restricted fragments having vehicles moving with fast and subsequently it altered path width by increasing it with rate limit. Later Davis (1995) made corrections to RSI display and created Bicycle reasonableness Rating (BSR). The creator finished up, the fundamental components to decide fulfilment level of bicyclists is number of vehicles and their pace. Landis (1994) dealt with methods to overcome the problem of extensive subjectivity used in assessing the variables that are used at that period and hence developed Bicycle Interaction Hazard Score (BIHS). Additional variables namely land use (LU) and curb cut frequency (CCF) are used in model. Mozer (1994) presented two variables in his model namely pedestrian volume

factor and non-motorized volume during peak hours. Jensen (2007) managed the fulfilment level of bicyclists and a model is proposed to assess LOS on sections. Taking into account six level scale, the bike clients of Denmark have given evaluations extending from 'A'(highly fulfilled) to 'F'(highly dissatisfied).The presence of bike path and its width has much effect on BLOS. In this model, nature of asphalt and states of climate are not considered. Matters and Cechvala (2014) created BLOS on urban roadways by considering the applicable strategy delineated in HCM(2010).Multimodal LOS extending is utilized by the creator to assess LOS amongst "A" and 'F'.A affectability examination was conveyed to decide the most influencing info variables. From a few information sources like aeronautical photos number of overwhelming vehicles, pace of activity, aggregate number of vehicles, and number of paths are gathered. The disadvantage of the model is there is no thought of directional segment.

2.3Application of Artificial Intelligence Techniques

Muduli and Das (2014), concentrated how to assess liquefaction of soil utilizing MGGP which is a manmade brainpower strategy by leading standard infiltration test. The creator considered an aggregate information set of 227.Also creating models utilizing MGGP, ANN, and some measurable techniques he thought about 3 models as far as factual criteria and watched that the execution is more in MGGP contrasted with different models. Muduli et al (2015) built up the models for foreseeing the limit of inspire of a suction caisson in soils like earth. The creator created model utilizing ANN.

Semeida (2012) managed components of roadway and posted rate restricts that are for the most part influencing the operational velocity on expressways. In this paper creator performed examination utilizing Regression and ANN on both desert and farming parkways. At last the creator closed in respect of R2 and RMSE, ANN gives the best execution. Semeida (2013) created limit and level of administration models on roadways of Egypt utilizing two systems in particular Artificial Neural Networks and Regression on both desert and Agricultural expressways. Information is gathered from 45 different locales to create models. The creator inferred that ANN gives best execution contrasted with relapse.

CHAPTER 3

Methodology

3.1General

In this section, different techniques to be specific Artificial Neural Networks (ANN) and Multi Gene Genetic Programming (MGGP) that are utilized to create BLOS model on portions of fair sized urban communities are examined quickly. The present study manages the choice of system structure, preparing calculation and learning rules in ANN where as in MGGP the arrangement is spoken to as tree structure which is clarified.

3.2Artificial neural network

In machine learning and subjective science, counterfeit neural systems (ANNs) are a group of models propelled by natural neural systems (the focal sensory systems of creatures, specifically the cerebrum) which are utilized to gauge or surmised capacities that can rely on upon an expansive number of inputs and are by and large obscure. A structure having 'n' inputs and 'm' neurons is a single layer network. The input space of n dimension is being mapped to output space of m dimension. The algorithm that we use for a single neuron can be applied to train the network. Linear problems mainly use this type of networks. Nonlinear data sets are not solved by single layer network. Hence for those cases multi-layer network structure should be preferred.

In multi-layer network neurons are not connected directly to output. It has some hidden layers in between them. Those layers are treated as hyper planes which increases capacity in separating a network. To train the hidden layers feed forward back propagation Algorithm is used in this study. The main principle is the data feeded to input layer, which is forwarded to all the hidden layers and the output from each hidden layer is calculated and finally output is obtained. To minimize the error obtained in the output layer, back propagation principle is applied where error is propagated back based on weights of connection to find out the change in weight. During training of each sample the above process is repeated. The above process carried in a cycle during training is called epoch. The error obtained in the output layer decides epoch number when it has to be stopped. Figure 5.1 shows the network structure of ANN used in the present study to determine BLOS.

The size of changes in weight are determined by learning coefficient (n). The learning process is slow if n value is less. Changes in weights will be more if n value is large so that desired minimum will be missed. In general n value between 0.05 and 2 is highly desirable. Adaptive learning is an extensive technique. Initially high n value helps in avoiding local minima, later on decrease in n value prevents crossing the obtained minimum. All the inputs influences momentum (a) which causes changes in weights. The range preferable is 0-1. Due to momentum for certain data training is carried out fast but some other data there is no change.
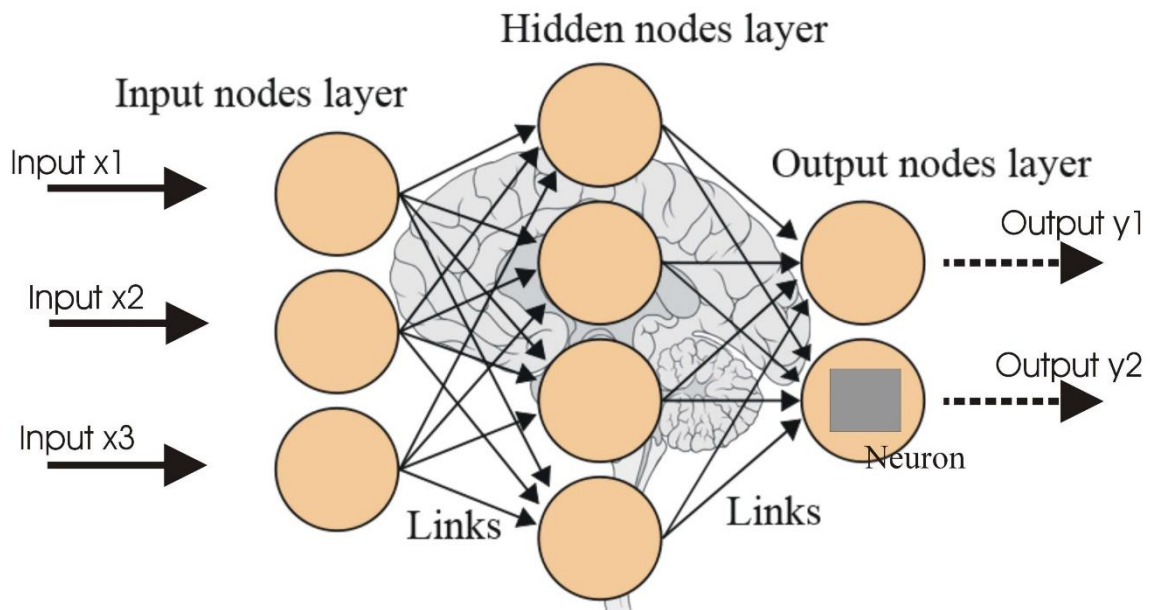

Figure 3.1 Artificial Intelligence Neural Network Nodes

3.3 Genetic Programming:

In computerized reasoning, hereditary programming (GP) is a strategy whereby PC projects are encoded as an arrangement of qualities that are then altered (advanced) utilizing a transformative calculation (regularly a hereditary calculation). The outcome is a PC program ready to perform well in a predefined errand. Frequently confounded to be a sort of hereditary calculation, GP can to be sure be seen as a use of hereditary calculations to issues where every individual is a PC program. The strategies used to encode a PC program in a manufactured chromosome and to assess its wellness as for the predefined assignment are focal in the GP system and still the subject of dynamic examination.

In 1954, spearheading chip away at what is today known as simulated life was completed by Nils Aall Barricelli utilizing the early PCs. In the 1960s and mid 1970s, developmental calculations turned out to be broadly perceived as advancement strategies. Ingo Rechenberg and his gathering could take care of complex building issues through advancement techniques as archived in his 1971 Ph.D. postulation and the subsequent 1973 book. John Holland was exceedingly persuasive amid the 1970s. The foundation of developmental calculations in mainstream researchers permitted, by then, the principal solid strides to examine the GP thought.

In 1964, Lawrence J. Fogel, one of the most punctual professionals of the GP philosophy, connected developmental calculations to the issue of finding limited state automata. Later GP-related work became out of the learning classifier framework group, which created sets of inadequate guidelines portraying ideal strategies for Markov choice procedures. In 1981Richard Forsyth developed tree guidelines to arrange coronary illness. The principal articulation of cutting edge "tree-based" hereditary programming (that is, procedural dialects sorted out in tree-construct structures and worked with respect to by reasonably characterized GA-administrators) was given by Nichael L. Cramer (1985). This work was later significantly extended by John R. Koza, a primary advocate of GP who has spearheaded the utilization of hereditary programming in different complex enhancement and hunt issues. Gianna Giavelli, an understudy of Koza's, later spearheaded the utilization of hereditary programming as a strategy to model DNA expression.

In the 1990s, GP was primarily used to take care of generally straightforward issues since it is computationally serious. As of late GP has delivered numerous novel and exceptional results in zones, for example, quantum registering, electronic configuration, diversion playing, digital terrorism counteractive action, sorting, and looking, because of upgrades in GP innovation and the exponential. These outcomes incorporate the replication or advancement of a few post-year-2000 creations. GP has been connected to equipment and PC programs.
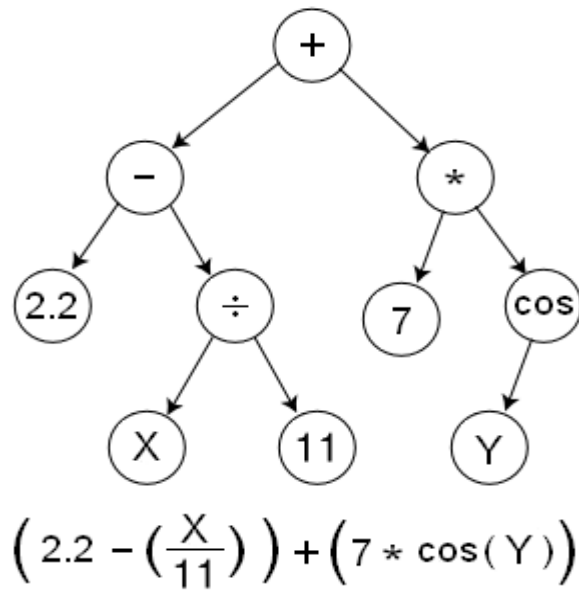
Figure 3.2 Example of a GP tree structure

CHAPTER 4

Data collection

4.1 General:

The objective of the information gathering is to make and perform an arrangement of overviews that can be reliably and dependably actualized over all modes. To accomplish the point of this concentrate all the geometric and activity related parameters (Quantitative information) influencing the level of administration of bikes are gathered. Aside from the field information, video and Questionnaire overview are conveyed to assess the apparent level of administration gave by the streets to bicyclists. In the present section, study zone and methodology to gather information is talked about in point of interest. Likewise the parameters gathered are introduced.

4.2 Study Area:

The site to be overviewed ought to be such that it ought to incorporate all the properties those are exceptionally influencing solace level of bicyclists. All the fragments giving abnormal state of administration that are brilliant and the roadways with low quality of administration are incorporated into present study. The related information required for the present examination is gathered from Bhubaneswar (29 fragments), Rourkela (19 portions) and Rajahmundry (11 sections).
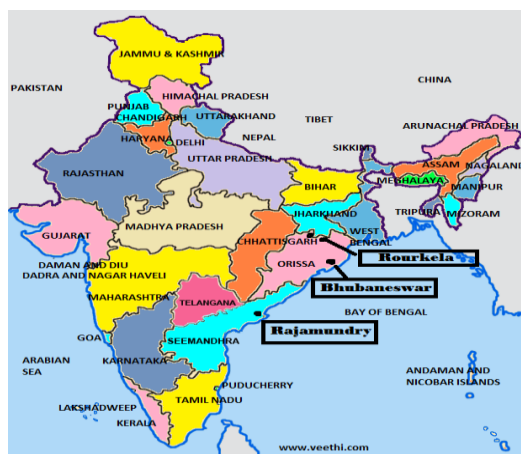

Figure 4.1: Study area showing Rourkela, Rajahmundry and Bhubaneswar

According to the task the chose zones have demographical information such that they speak to average sized urban communities in India and thus all the 59 fragments delineates the states of roadway in a well way. Some segments collected were shown in Figure3.2 (a) through (c).

(a)   (b)

(c)

Figure4.2: (a)Sector 2 to Sector 4, Rourkela City, (b)Bomikhal to Laxmisagar, Bhubaneswar City, (c)NH-16 to Ramalayam Junction, Rajahmundry city.

4.3Data collection:

4.3.1Field Data Collection:

Amid information gathering activity qualities like volume, pace are gathered. Geometric attributes of street to be specific width of street, width of outside through path by measuring tape. What's more, through perception number of vehicles being stopped for one kilometer street length ,successful number of carports for one kilometer length that are influencing level of administration, nearness of auto stand/transport stop close to section, interference to movement brought about by open travel, asphalt condition file are measured.
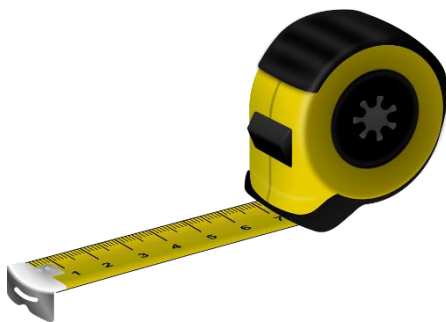
From each portion camcorders are utilized to gather the activity information by putting them along the halfway of section. Amid times of top hours, for around two hours video is gathered for each segment. Using radar firearm spot rates of vehicles are gathered crest.

(a) Tripod Stand   (b) Video Camera

(c) Radar Gun   (d) Measuring Tape

Figure 4.3 (a) Tripod Stand, (b) Video Camera, (c) Radar Gun, (d) Measuring Tape

Different geometrical estimations were completed with the assistance of measuring tapes. The asphalt states of the sections were evaluated by taking after five point rating framework. As the point of the present study is to decide the solace level offered by the roadway to bicyclists taking into account every one of the parameters of roadway, observation study is conveyed to decide the recognition rating.

To convey a discernment overview, a survey is readied. In the Questionnaire suburbanites of individual portions are requested that rate the Questions on a five point scale, the minimum quality extending from unequivocally differ to the most elevated worth being firmly concur. Through the street side meeting, rating is gathered from more than 590

respondents (i.e. no less than 10 members for 59 fragments) lastly comfort rating assessed for those portions.

CHAPTER 5

Results and Discussion

5.1 General

In the present study, BLOS models are developed using three techniques namely Artificial Neural Networks (ANN), Multi Gene Genetic Programming (MGGP) and Multiple Stepwise Regression. Performances of these models have been evaluated.

5.2 Model development

Eight significant input parameters are inputted in the Form Pearson's correlation analysis, these parameters are observed to have high influence on satisfaction levels perceived by bicyclists on Indian road segments. Hence these parameters are used for developing several prediction models in this study. Randomly selected 70% of data (i.e. 41 segments) are used for model training and remaining 30% (i.e. 18 segments) for model testing.

5.3 ANN model

In the present study, two ANN models are produced and the best model is acquired. The yield parameter having a solitary hub is BLOS. A solitary concealed layer is considered in the present study subsequent to any nonstop capacity can be approximated. The move capacity utilized as a part of the covered up and yield layer neurones is digression hyperbolic capacity (tanh).

The BLOS model created utilizing BRNN strategy is appeared as a part of condition 5.1 through 5.8. The estimations of parameters to be inputted in condition 5.1 through 5.3 are standardized in the extent [0, 1]. The denormalized estimation of anticipated BLOS score can be discovered utilizing condition 5.9.

Equations and table left blank for publication purpose.

Sensitivity Analysis is carried using Garson's algorithm and connection weight approach and results are shown in table 5.3 and 5.4.

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According to Garson's algorithm, relative importance of all eight input parameters in ANN models are shown in figure 5.3 (a) and (b).

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5.4 GP model

A BLOS model has been developed using Genetic Programming (MGGP) technique is shown in equation 5.38.

Equation left blank for publication process

Figure 5.8 shows the performance of MGGP Model.

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MGGP model had a good correlation with BLOS model compared to statistical technique. Based on error criteria, the performance of this model is good compared to ANN Models.

5.5 MLR model

MLR model is shown in equation (5.39)

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5.6 Ranges of BLOS Categories:

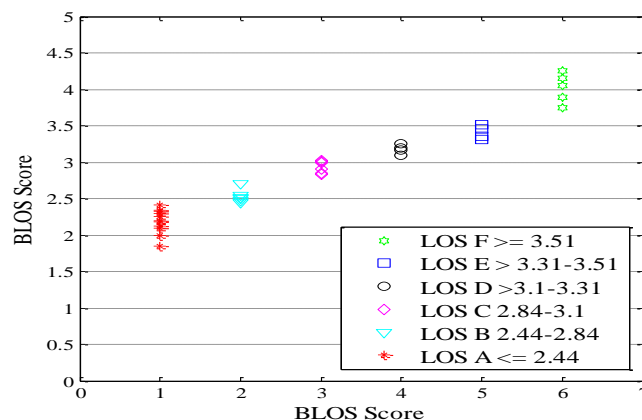Ranges of BLOS are defined using clustering technique and shown in figure 5.10.

Figure5.6: Ranging of LOS

CHAPTER-6

Summary and Conclusions

6.1 Conclusions

Soft computing Techniques namely ANN and MGGP have better performance compared to statistical technique. MLR is used to develop BLOS model in present study and also MGGP has more generalization compared to ANN.

6.2 Future Scope

i.   Comfort level of bicyclists is likewise influenced by inclination and sight separations which are not considered in present concentrate, along these lines BLOS models can be produced by considering these two parameters.

ii. Further information ought to be gathered from urban communities having high differential movement to re-enact both great to the most exceedingly terrible states of activity.

iii. BLOS models can be produced utilizing other Artificial Intelligence procedures and are thought about as far as measurable execution.

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