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Simulation Models Used for Evaluating the Effectiveness of the Interchanges and Freeways: Review

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Abstract

One of the key components of contemporary transportation systems is interchanges. As a result, this study provides a summary of the different kinds of simulation models that are frequently employed to assess the effectiveness metrics of the highways and interchanges as well as other implemented programs. It is possible to study and compare different traffic simulator software programs that applied these tactics in order to look into the various traffic simulation strategies to discuss several concepts and algorithms that can be used to simulate traffic systems in order to obtain more realistic results at the microscopic simulation level, this paper can provide a broad overview of the software packages under investigation, including their characteristics and differences like SYNCHRO 8, SIDRA INTERSECTION 5.1, (HCS) 2024, TRANSYT-7F, and multi-techninc in Spss profgramm like modular neural network (MNN), SVM, ANOVA, SARIMA, ARIMA. Choosing the model to employ in the simulation is one of the most difficult problems with traffic simulation tools. The best of these programs, according to the research findings, are those that can effectively and precisely depict the model and are more in line with reality, such as HCS 2024.

Keywords: Interchange, Traffic, Operation, Simulation, Roundabout, Freeway, Highway Capacity Manual (HCM), Transportation.

1- Introduction

The ability of intersections to handle heavy traffic volumes safely and efficiently depends on the layout available to deal with intersecting traffic movements, and generally, efficiency, safety, and minimum air pollution rates are achieved when crossed traffic is separated by grade separating the traffic lanes using a multi-level intersection, which is called the (Interchange).

The interchange is a system composed of intertwined roads grade separated at one level or more, it is the most advanced and specialized form of intersections, which makes Interchange design more sophisticated.

In addition, the traffic junctions in vehicles omits movements are eliminated by separating the levels at which the vehicles move and also the conflict points are reduced or

discarded, this study focuses mainly on traffic operations at Ramps, which are turning roadways that connect two or more legs of an interchange. [1]

2. Interchange Traffic Operations Studies

[2] explained in his study the appropriate type of interchange must be determined that suits the condition of the area designated for the study and solves the problem of traffic freeway congestion. In addition, there are several criteria that are relied upon to choose the appropriate interchange, are: choosing the number of legs and the functional level for which the highway system is prepared. There are also important secondary criteria that include systems aspects and design consistency, nearby land use, design speed, traffic volume and composition, traffic control devices, topography, property needs, and environmental considerations are other elements to consider while choosing the suitable interchange. The capacity and traffic movement are the main criterion in determining the extent of the need to create an interchange. When the level of service measure for traffic movement ranges between E and F, the engineering solution becomes the tendency to create interchange.

Whereas [3] focused on the Strategies projected for present operation and potential application at interchanges. It was found that the main element of accomplishing a unified traffic stream is controlling the ramp - providing a traffic stream by using signal controls at interchanges. Therefore, if a long vehicle line is found at the ramp, the signal time controls must be accustomed to decrease traffic streams arriving at the ramp. By using such a method, a ramp meter would stay in action for the longest time possible, which delays the beginning of vehicle lines flush and reduces the chances to face a freeway breakdown.

Furthermore, [4] recommended a beneficial procedure outline that defines the possible strong and weak points of urban interchanges, and helps control resources more proficiently. This study was built on a systematic technique that consisted of two steps, joining the grouping and regression model and the analysis of performance-importance. A travelers' behavior study was done at a selected interchange and the operational producer was practiced to the collected data.

In addition to what was mentioned before, [5] presented a set of procedures aimed at deciding where a crash can occur within an interchange, these procedures allocate a crash to a particular terminal, ramp, speed-change lane, or mainline. The selected facility is referenced to the freeway centerline using the compass direction. These procedures were tested and developed to contain a complete set of guidelines as well as a robust test for reviewers. A procedure was applied for evaluating crashes at different freeway interchange facilities, that involved diamond interchanges, partial cloverleaf interchanges, on and off ramps, also entrance and exit speed-change lanes. The long-term worth of this study was the formation of a uniform procedure so that crash reviews for freeway interchanges can be accomplished consistently.

[6] offered a safety estimation of auxiliary lanes in freeway interchange weaving areas by employing the traffic conflict method to estimate its safety influences and linked effective factors considered in the design. Simulation models were developed with (VISSIM) program by using weaving area data and present traffic characteristics. The study discussed the safety influences and associated effective factors of auxiliary lanes. The results of this study can

support making effective decisions about planning and constructing auxiliary lanes in freeway interchange weaving areas in the future.

3. Ramps Traffic & Safety Studies

[7] adopted developing enhanced techniques of the level of service and capacity analysis at interchange ramps. Data were collected at 12 interchanges in 5 different cities and included ejection headways, traffic volumes, speeds, lane consumption, data on weaving and non-weaving vehicles, downstream queue spillback, and turning radius. Adding to that, phase-related information, like phase periods, cycle length, etc. with more than 38,000 signal cycles detected and recorded during this study. [8] used Traffic simulation to evaluate exit ramp capacity in deviated areas as high-capacity exit ramps barely can be found in the selected study area, and even fewer that are occupied with traffic flows near capacity. A traffic simulation model was created that required a similar response to the one in the real world, The practical methodology involved three main sections: field study, micro-simulation model, and results analysis.

[9] discussed the features of the running velocity at an interchange ramp, and various sorts of running models of vehicles in diverse parts at an interchange ramp. Then it involved the determination of influence factors adjustment range of speed at ramp in the study area. The study investigated the running velocity of vehicles and the geometric features of ramps founded on four symbolic selected interchanges with a total of 14 ramps.

[10] presented operational evaluation at exit ramps of freeway interchange, highlighting the evaluation methods on repeated blockage sites at motorways exit ramps. This study also provided a comparison between the detected traffic operational performance indications at two locations and the expected indications using the diverge sections method of interchange weaving segments of the freeway for many different traffic conditions. The present operational situations of the selected interchange have been examined through simulation. The results specified that the projected modifications may lessen a lot of traffic congestion problems.

4. Interchange Geometric Characteristic

4.1 General

The cloverleaf interchange is considered one of the oldest types of interchanges that is capable of handling higher capacity traffic streams, it is a double-level interchange in which left turns are usually controlled by ramps. A partial cloverleaf interchange is used, where there is a moderately low traffic volume, but a road turns at the interchange, or there is a restriction that prevents the construction of ramps in one or two quadrants. The partial cloverleaf interchange has two loop ramps, which are used for the left turns ,and outer connection ramps that which are responsible for the right turns [11].

Partial cloverleaf or Parclo is an alteration that combines some features of a diamond interchange with one or more loops of a cloverleaf to remove the critical conflicts caused by turning movements. Therefore, it can be viewed as a combination of a half - cloverleaf and half-diamond interchange as shown in Figure 1. It has two intersections, normally at a distance ranging from (600 to 900) ft. It is capable of handling large traffic volumes, with only two ramps

short of a complete interchange demanding no crossing over the road. It is the most common interchange type for connecting freeways to arterials. Parclo is usually used when the intersecting roads on the secondary road will not create unpleasant amounts of risk and delay. It creates more acceleration and deceleration distance on the freeway [12].

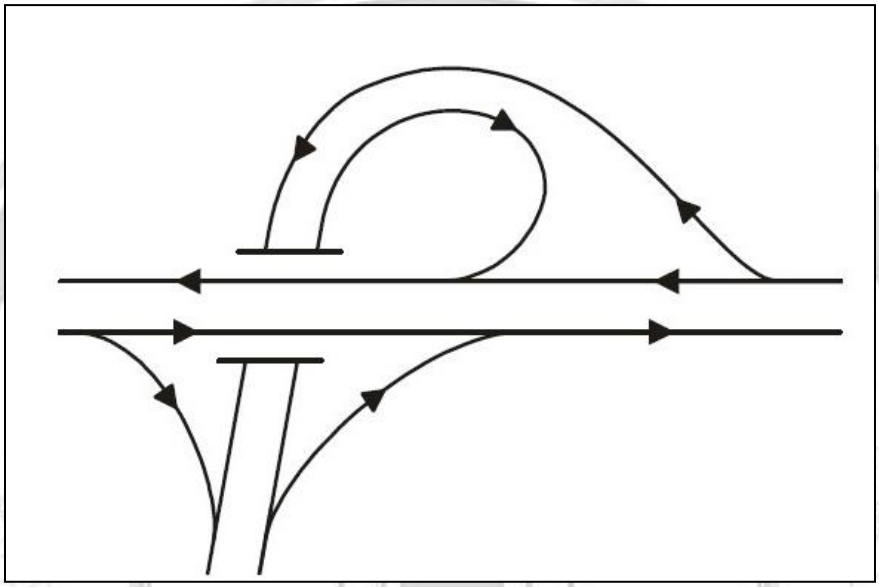

Figure 1: Partial Cloverleaf Interchange [1].

Many partial cloverleafs are constructed including one, two , or three loop ramps. In these situations, at least one of the outer connection ramps occupies a diamond ramp shape, permitting the left turn movement to take place. In some other formations, vehicles can also make left turning movements off or on the loop roads. This type of interchange has the function of the diamond interchange, except for some ramps that are curved around so they can fit better. It is called a folded diamond interchange occasionally for this reason. This interchange is also used to gain a certain space between interchanges.

The design of Cloverleaf requires a single bridge. That is why it is considered the cheapest interchange type that provides the removal of all crossing maneuvers at grade. On the other hand, in comparison with other types, it Still has the disadvantages of longer travel distances, greater operating charges, problematic merging segments, bigger zones for loops, and sight distances to exits at the other side of the bridge. Not to mention the confusion caused mainly by right- to -left turning movements and great rights-of-way induced by the radius requirements that are essential for the ramps' satisfactory speeds. [13].

4.2 Weaving

Weaving sections are highway segments where vehicles' paths cross each other, moving from one lane to another, or merging with through traffic while entering or exiting a freeway. These sections exist in interchanges. Weaving sections are integral in some interchanges type,

such as the partial cloverleaf. They are also found between ramps of consecutive interchanges. [14]

A cloverleaf interchange's loop ramps form a weaving section next to the outside through lane. Since there is a lot of turbulence inside weaving sections, interchange designs that minimize or do away with weaving from the main facility are preferred.

Weaving movements are usually acute on the full cloverleaf interchanges. When these movements are available on partial cloverleafs , the weaving segment's level of service starts to drop when the weaving vehicles volume gets near to (1000 vph). This indicates that the weaving areas should not be included in the design of partial clover leafs if such a situation exists. [15]

While interchanges without weaving segments might be more effective than those with weaving segments, interchanges with weaving are often less expensive. Designs that do away with weaving movements might need larger, more complex structures with multiple direct connections. Making a final decision between design options will be aided by the complete assessment of the interchange cost and the precise quantities that need to be regulated. It has been discovered that the partial cloverleaf with loops in opposite quadrants performs better than all other interchanges with a single separation structure, excluding weaving areas and excluding direct [16].

4.2.1 Weaving Configurations

The configuration of the weaving section has a great influence on lane changes amount necessary for weaving section vehicles in order to complete their maneuver effectively. There are three main weaving configurations:

1- Type A:

Type A configuration represents a weaving section where all weaving section vehicles make only one lane change to finish their movement successfully. The most common Type A weaving movements are shown in Figure 2.

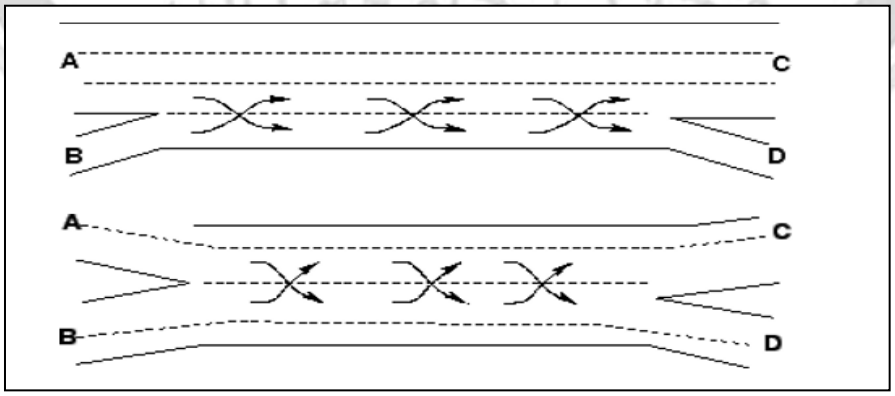

Figure 2: Type A Weaving Configuration. [17].

2- Type B:

Type B configuration represents weaving segments in which one movement can be done without any lane changing required, whilst the other movements oblige changing only one lane. Type B weaving movements are shown in Figure 3.

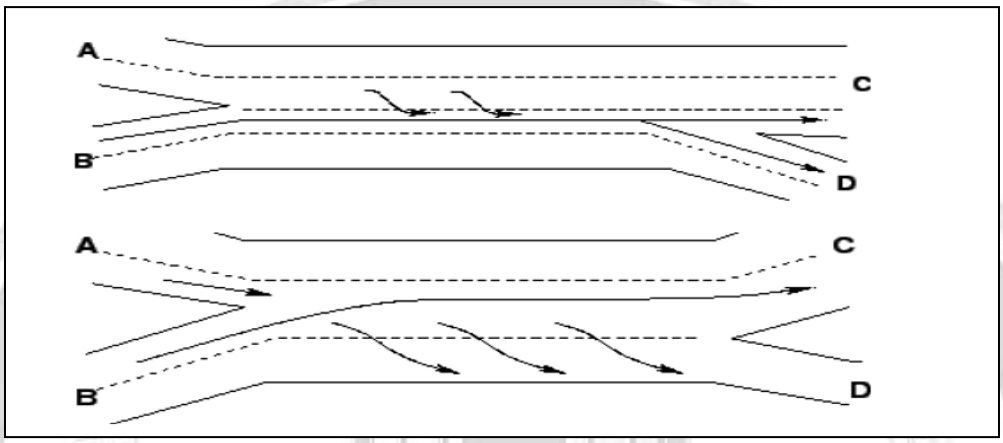

Figure 3: Type B Weaving Configuration. [17].

3- Type C:

Type C represents weaving segments that resemble Type B segments, in which one movement can be done with no changing of lanes required, whilst other movements oblige two or more changes of lanes. Type C weaving movements is (delete is &put are) shown in Figure 4.

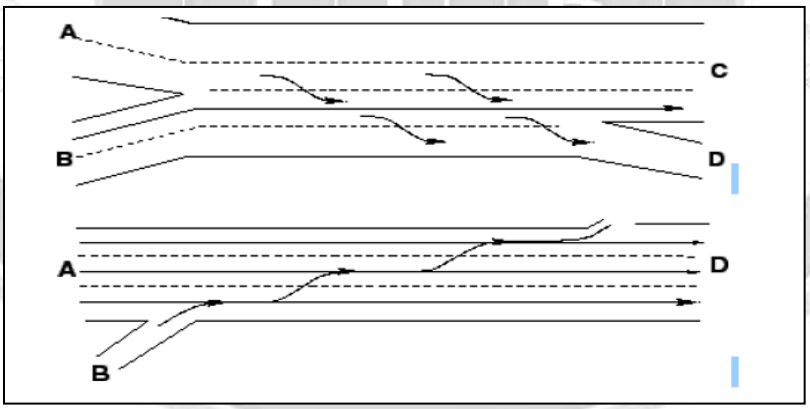

Figure 4: Type C Weaving Configuration.[17].

5. Ramps

5.1 General

The word “ramp” comprises all sizes, designs, and forms of turning roads connecting two or more interchanges legs. In general, the vertical and horizontal ramps alignment is grounded on the lower values of design speed than the design speeds for intersecting roadways; however, there are some circumstances when these values can be equal”. [17]. Well-designed ramps are

necessary for the appropriate functioning of interchanges, which are in turn a main feature of well-organized and designed access-controlled highways. An Interchange ramp is a roadway used for turning movements connecting the lower road and the upper road of an interchange [17].

An interchange ramp must provide accommodations for the numerous things that drivers should deal with at that point. A typical Ramp usually consists of three geometric components as shown in Figure 5.

1. Deceleration lane.
2. Ramp road.
3. Acceleration lane.

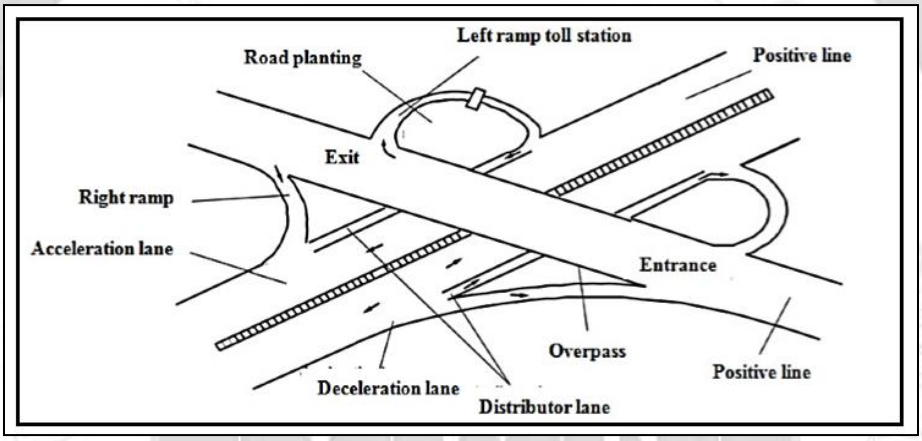

Figure 5: Geometric elements of an interchange ramp. [18].

5.2 Ramps profile

The ramp cross-section generally contains a tangent grade between the vertical curves. The tangent on ramps should be as flat as possible but may be steeper than on the through facilities. A Sufficient sight distance holds more importance than a particular gradient control and should be preferred in design.

As for the radius of curvature , the applied values of radius for loop road range from (30 to 50 m) for insignificant movements and (50 to 75 m) for major movements.

Table 1: Geometric design Standards of loop ramps of Interchanges.

Details	Loop Ramps	
	Minimum	Desirable
Ramp Curvature Radius (m)	30	60

Terminals for ramps Horizontal curves should be planned in tandem with profiles to prevent vision impairments that could negatively impact operations. A driver using a ramp on a descending grade shouldn't suddenly see a horizontal curve ahead at the ramp exit. To ensure that the driver can see the beginning and the direction of the horizontal curve in unison for safe operations, the preliminary crest vertical curve should be longer and the sight distance across it should be greater. At a ramp terminal entrance with an upward grade, the section of the ramp and its terminal projected for acceleration should be parallel closely to the through lane profile to allow the incoming drivers to have a clear view ahead, to the side, and the back on the through lane.

6. Traffic Operations Characteristic

Traffic engineers must understand not only the basic characteristics of the driver, the vehicle, and the roadway but how they interact with each other. Information achieved through traffic engineering studies helps to identify relevant characteristics and define related problems. The four main elements of highway transportation are the driver, the pedestrian, the vehicle, and the road.

To provide efficient and safe highway transportation, an understanding of the features and limits of each element of them is essential. It is also important to be aware of the mutual relations that exist among these elements to define the effects, they have on each other. [19]

It’s hard to control the traffic stream mainly because drivers do not react in the same way not to mention that vehicles usually have different sizes, weights, are operating characteristics. In addition to this, the overall environment of the

area always changes with time. Driver and vehicle characteristics for each stream differs usually, therefore there are no traffic flows can act completely the same.

7. Traffic Stream Element

Traffic flow behavior is a combination of the behavior of both the vehicle and the driver. The driver usually has a non-uniform pattern; therefore, traffic flow is non-uniform. The flow is not only subjective to the specific features of driver and vehicle but by the behavior of interactions of these elements too.

Therefore, thetraffic stream through a street of definite features differs by both time and location matching the variations of the behavior of human beings. Many variables are used to define traffic streams. The three main variables are:

1- Traffic Volume.

2- Speed.

3- Density.

8. Level of Service Concept & Evaluation

The Highway Capacity Manual Book (HCM) is the standard source that is widely used for evaluating the capacity and level of service of different highway facilities. Based on service metrics including speed and travel time, maneuverability, traffic disruptions, comfort, and

convenience, a level of service is a qualitative measure that characterizes operational conditions within a traffic stream. [19]

Six levels of service were specified aimed at every kind of facility. With letters that labels every level, starting from LOS A which represents the top operational case, ending with LOS F as the poorest level. Every level of service symbolizes a variety of operational conditions along with the driver's vision in these circumstances. These levels can be illustrated as follows:

1. Free-flow operating conditions are defined by LOS A. Free-flowing speeds are surpassed. Within the traffic stream, vehicles have almost complete unrestricted mobility. LOS A typically occurs late at night on both urban and rural routes. It is easy to internalize the effects of accidents or point breakdowns.
2. Vehicle maneuvering within the traffic stream is somewhat restricted in LOS B, which is characterized by fairly free flow, while nevertheless preserving high levels of driver comfort on both a physical and psychological level. It is quite easy to absorb the effects of interactions and point breakdowns.
3. The flow while speeds are equal or near the freeway's FFS is represented by LOS C. There is a noticeable restriction on the number of vehicles that may maneuver inside the traffic flow, and changing lanes requires the driver to exercise extra caution. The majority of seasoned drivers, however, are quite comfortable. Even while minor situations might still be handled, there will be a noticeable drop in local service quality. Any significant obstruction may result in a line of cars behind it.
4. As rates of flow and density start to rise relatively quickly, speeds start to somewhat decrease, indicating that the traffic stream is beginning to approach unstable flow (LOS D). There is less driving comfort and a noticeable restriction on maneuvering within the traffic stream. Because there isn't much room for disturbance in traffic movement, even minor occurrences might create lines.
5. LOS E explains operation at capacity with unstable flow, where speed varies rapidly due to vehicles being closely spaced with virtually no useable gaps to maneuver in the traffic stream, resulting in low driver comfort levels. Any small problem will result in long lines and significant delays.
6. Breakdown flow is represented by LOS F. After breakdown points, this level is present inside queues. At this LOS, there is constant traffic congestion on the route.

9. Simulation Program

Simulation software are numerical system for directing experiments on a digital computer. These programs are established to demonstrate an actual process with mathematical formulations. These types of systems permit the operator to detect a process without carrying out that process in the actual world by using simulation. Traffic simulation programs provide a mathematical modeling of traffic conditions on different transportation systems by using computer software.

To achieve a better analysis, and Precise detailed data about the capacity and operation performance of the transportation system and highways network of the city. These models can predict the influence of traffic control as expressed in terms of measures of effectiveness. These measures usually involve average vehicle speed, vehicle travel hours, vehicle's travel miles, vehicle stops, delays, fuel consumptions, and vehicle's pollutant productions. Which helps to provide an understanding of the effects of the practiced plan on the traffic stream. Simulation programs are considered more useful and easier to carry than real-world experiments in terms of some reasons.

The main reason for favoring simulation software over field studies, is that the required results are achieved in a short period. The interruptions of traffic operations, which frequently accompany a field experiment, are eliminated. Also, the data created by simulation involves various measures of effectiveness that are hard to obtain from field experiments alone. Not to mention that numerous patterns necessitate major physical changes to the existing facility, which cannot be done to these facilities for experimental purposes. Finally, these programs can be used for the estimation of the operational effect of future traffic demand in the study area.

The simulation soft wares that is used in estimating the measures of the effectiveness of the chosen road, along with other assisting programs are listed as follow:

9.1 Highway Capacity Software (HCS-2010)

The Highway Capacity Software (HCS 2010) executes the procedures specified in the Highway Capacity Manual (HCM 2010) for evaluating capacity and calculating levels of service for Arterials, Un-signalized and Signalized Intersections and, Freeway sections, Weaving segments, Ramps and junctions, Two-Lane Highways and Multilane Highways.

The Highway Capacity Manual (HCM) Model is widely used for the operational analysis of traffic conditions in various transportation facilities as many traffic analysis software tools use the HCM delay model.

Numerous studies were conducted to assess and quantify the necessity of using modeling software or finite element programs in undergraduate education. The advantages of teaching finite element analysis in undergraduate courses were investigated by [20]. According to their research, companies find it to be beneficial, and students find it fulfilling. Additionally, they discovered that this addition improved the learning experience, which was confirmed by the input from the students. According to a study by [21] on teaching object-oriented software in undergraduate engineering education, students had a fruitful learning experience because the tool helped them comprehend the overall goals of their internships and ace their job interviews. [22] explain the software, its current features, and how it might be used as a teaching aid in a traffic engineering undergraduate course. This study is among the first to examine the application of HCS+ in an undergraduate traffic engineering course. The poll was designed to quantify the success rate of this development. Ten questions in the survey compared students' learning experiences in a classroom and a computer lab, assessed how engaging the computer software was, assessed whether there was any chance that the material would be better understood by the students, and asked if the software aids in the retention of key ideas.

By using SIDRA and SYNCHRO programs for performance analysis and evaluation of three signalized intersections and four roundabouts, The enhancement of traffic flow on arterials, signalized, and un-signalized crossings was examined by [23]. For the estimation of roundabout delay, three statistical models were created: polynomial, linear with 50% confidence level, and linear with 95% confidence level. To address the present and upcoming issues, two options were suggested. Samawa Downtown Transportation Network's Flow Improvements were examined by [24]. Ten crossings make up the research area: four roundabouts, five signalized intersections, and one un-signalized, intersection. Both signalized and unsignalized junctions were evaluated and analyzed using software from SYNCHRO 8, SIDRA INTERSECTION 5.1, (HCS) 2010. The evaluation's findings demonstrated that the majority of street segments and crossings "operate with the level of service (LOS F). [25] investigated the degree of service improvement at a congested crossroads in Fallujah's central business district. The traffic analysis procedure made use of the HCS program. The assessment of traffic performance at specific zones within a roadway network is the focus of [26]. It was accomplished by evaluating the performance of urban streets and intersections at a chosen network in addition to a set of recommendations for various enhancements, ranging from geometric enhancement to a total redesign of the intersection type. The alternative criterion of the suburban two-lane highway performance index was examined by [27]. Two performance metrics average travel speed and tracking-time percentage are used to assess the service quality of two-way two-lane roads.

As a result of the network's growth and improvement [28] forecasted traffic for a pre-construction route, analyzed and estimated capacity, and forecasted future demand. They also prevented the development of issues brought on by rising demand and a lack of facilities, which could have problems. The country's roadways are reduced by the current network.

[29] employed (HCS) 2010 software to assess the time distance distribution of cars under heavy traffic flow during the day and at night. as well as [30], who carried out researched to assess the quality of service on a Calcutta, India, class 1 arterial route, to do this, LOS requirements were applied using field data gathered from a city's urban hexagonal arterial. The goal of B.R. [31] was to categorize the level of service for a variety of urban traffic situations. The analysis of simulation data demonstrates the model's ability to accurately represent a variety of urban traffic flow circumstances. To determine the degree of traffic flow service on Finland's two-lane highways, [32] carried out a study. The findings are in line with conventional statistics from the USA about the capacity of two-lane highways and the flatness and linearity of flow-speed curves. On Finnish highways, slowing seems to occur more quickly in HCM than in real traffic.

9.2 Traffic Network Study Tool (TRANSYT-7F)

TRANSYT-7F is a deterministic traffic simulation software that involves a phasing sequence, cycle length genetic algorithm optimization, offsets , and splits. Numerous measures of effectiveness can be obtained by the use of this software, these measures are used for of operational evaluation, which includes the travel time, average delay, fuel consumption, and performance index. This software also provides a macroscopic simulation model. Which includes the simulation of platoon dispersion, queue spillback and actuated control.

Different simulation packages included different graphical representations of the running simulation, one of the packages [33]. A non-graphical simulation that merely generates output files and data to assess and ascertain what has occurred within the trace network is also offered for evaluation. Even though every simulation program had a graphical representation of the simulation, there were still significant variations in the representations' quality. The primary difference was whether the graphics were two- or three-dimensional. Only two-dimensional representation was available in three [33, 35, 38] of the packages under evaluation; the remaining three programs additionally offered the option of a three-dimensional simulation. Regarding the simulation packages' two-dimensional preview, we discovered that it was a standard aerial image of a traffic network, with quite simple identification of the different vehicles. The three-dimensional representations of the software packages that featured this functionality did differ in a few ways, though [34, 36, 37].

For intrusion detection, [38] suggested using SVM in conjunction with Rough Set Theory (RST). They reduced the dimensionality of a DARPA database by applying rough set theory. Additionally, rough set theory is used to choose the features. To detect intrusion, [39] suggested RST and incremental SVM techniques. The KDD Cup dataset was used in the authors' experiments. The RST method is used to identify important attributes from the network traffic data set, and the SVM approach is then used for training and testing. Rough set theory and support vector machines were established by [40] to reduce the dimensionality of intrusion detection. They used the KDD Cup data set for their experiments. [41] used Principal Component Analysis and Support Vector Machines to assess an intrusion detection system. They used the NSL-KDD data set to test their suggested model. The PCA technique is used to reduce the amount of characteristics to make the system less complex.

A modular neural network (MNN) for intrusion detection was introduced by [42]. The KDD Cup data set, which has 41 attributes, is where the authors gathered their data. Using the PCA method, they were able to extract the most important characteristics from the complete collection of network traffic data. The principle component analysis neural network technique (PCANNA) was proposed by [43] to detect any new assaults. The PCA method lowers the data set's dimensionality to increase accuracy. Two stream mining algorithms, Data Stream based traffic (DSTC) and Very Fast Decision Tree (VFDT), were proposed by [44] for the classification of online network traffic. [45] identified outliers in a network traffic data set using the unsupervised random forest approach. The goal of outlier detection is to detect network intrusions. The KDD cup dataset was used in the authors' experiments.

To examine intrusion detection, [46] suggested decision tree data mining methodologies. The authors gathered a dataset of several assault types from DARPA. To enhance internet traffic throughput, [47] suggested four data mining techniques: J48, Random Tree, Random Forest, and Boosting. The NLANR data collection was used in the authors' experiments.

9.3 SPSS Program

SPSS is a widely used software for managing data and computing a wide variety of statistics. It can carry out not only statistical analysis but also graphical presentation of data. This software can perform many types of statistical analysis, like descriptive statistics that includes Frequencies, charts, lists, diagrams, cross formulations, and descriptive ratio statistics. It can also

carry out bivariate statistics that include Analysis of variance (ANOVA) and Numeral outcome prediction. Furthermore, it can perform linear regression Predictions. As well as other analysis types such as cluster analysis that includes two-step, graded ,and factor analysis. Surveying statistical methods used by researchers to analyze network traffic is one example. [48].

Several of classification data mining approaches, including Naive Bayes, J48, OneR, projective adaptive resonance theory (PART), and the RBF network algorithm for intrusion detection, were proposed by [49]. [50] analyze the relative effectiveness of four distinct data mining techniques for intrusion detection: J48, BayesNet, OnerR, and NB. They concluded that the J48 classifier produced better results, with a high detection rate and low costs and false positives. For intrusion detection, [51] suggested the supervised learning algorithms Bayes Net and Naive Bayes. They obtained the data set from the KDD Cup. They contrasted their findings with those of RC [52]. They disclosed that their findings outperformed those of the RC Staudemeyer research article. A comparison between Bayes Net and NB is shown.

For intrusion detection, [53] introduced the Naive Bayes classifier using Principal Component Analysis (PCA) techniques. The linear discriminate analysis approach was proposed by [54] to extract features for intrusion detection, while the Back Propagation algorithm is utilized to classify attacks. The ARMA time series model was presented by [55] to forecast network traffic with high file transfers. File transfer protocol (FTP) data sets were used in the authors' experiments.

A time series model using an ARMA technique was suggested by [56] to forecast the network traffic pattern of bit torrent applications. Using Wireshark software, they gathered six sets of actual data from Bit Torrent P2PN (point- to- point networks) throughout six days to assess the ARMA approach. To anticipate multi-scale high-speed network traffic .[57] suggested a time series model using the K-factor ARMA model. To forecast mobile network traffic , [58] suggested using a time series model in conjunction with an accumulative prediction model (APM).

The ARIMA linear time series model was proposed by [59] to predict network traffic. Whereas the Heilongjiang chain's mobile network was tested by the authors at various points in time.While the linear ARIMA model for modeling and forecasting wireless network traffic was presented by [60]. Also, the authors used actual GSM wireless mobile data from China Mobile in Tianjin over a range of periods. To estimate network traffic [61] introduced the SARIMA linear time series model with data mining model (k-means algorithm).

To lessen the noise that exists in network traffic, [62] suggested the SARIMA technique, which is based on wavelet filters. By breaking down the original signal, they used Daubechie's db4 wavelet filter approach to eliminate noise from traffic data. In addition to model networks and forecast long-range dependent internet traffic, [63] developed a new model called Adjusted Autoregressive Integrated Moving Average (ARIMA). Furthermore to forecast network traffic, [64] explained the engineering prediction time series (EPTS) technique.

10. Conclusions

The main concern in researching traffic operations at interchange ramps was to explore common traveling problems, as interchange use has become more dynamic in big cities to handle congestion. The level of service on freeways idea was cleared. As many different researchers discussed the traffic operations on interchanges generally and at ramps specifically, with the help of simulation models that will be used in evaluating of the measures of effectiveness, which is linked to the evaluation of the level of service indication. Also, different method was discussed to improve safety at the critical points of these facilities. Many reasearched aimed researches that aimed to improve existing techniques while some others tried to create new procedures by developing models. In the light of the highway capacity manual (HCM) as the main guide. An overview of various types of simulation models that are commonly used for evaluating the measures of the effectiveness of the interchanges and freeways along with other adopted programs.

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نماذج المحاكاة المستخدمة في تقييم فعالية التقاطعات والطرق السريعة: مراجعة

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الخلاصة

تعد التقاطعات من أهم الوسائل في أنظمة النقل الحديثة. تهدف الدراسة إلى تقليل أو القضاء على نقاط التعارض التي تسببها مسارات المركبات وتقليل حركات الانعطاف إلى اليسار المتقاطعة على الطرق السريعة والمواقع الأخرى حيث لا يمكن التحكم في حركة المرور بكفاءة من خلال التقاطعات على مستوى الأرض. لذلك، يتضمن هذا البحث تفصيل بعض الخصائص الهندسية للتقاطعات والمنحدرات. يتبع هذا العرض نظرة عامة على أنواع مختلفة من نماذج المحاكاة المستخدمة عادة لتقييم مقاييس فعالية التقاطعات. من الممكن دراسة ومقارنة برامج محاكاة حركة المرور المختلفة التي طبقت هذه التقنيات من أجل النظر في استراتيجيات محاكاة المرور المختلفة لمناقشة العديد من المفاهيم والخوارزميات التي يمكن استخدامها لمحاكاة أنظمة المرور من أجل الحصول على نتائج أكثر واقعية على مستوى المحاكاة المجهرية، يمكن لهذه الدراسة تقديم نظرة عامة واسعة على مجموعة البرامج قيد التحقيق، بما في ذلك خصائصها واختلافاتها مثل SYNCHRO 8 و SIDRA INTERSECTION 5.1 و (HCS) 2024 و TRANSYT-7F والتقنيات المتعددة في برنامج Spss مثل الشبكة العصبية المعيارية (MNN) و SVM و ANOVA و SARIMA و ARIMA. يعد اختيار النموذج الذي سيتم استخدامه في المحاكاة أحد أصعب المشكلات التي تواجه أدوات محاكاة المرور. أفضل هذه البرامج، وفقًا لنتائج البحث، هي تلك التي يمكنها تصوير النموذج بشكل فعال ودقيق وتكون أكثر انسجامًا مع الواقع، مثل HCS 2024

الكلمات الدالة: التقاطعات، عمليات المرور، محاكاة، الاستدارة، الطريق السريع، دليل سعة الطريق السريع، النقل.