Fuzzy Traffic Light Control Using Cellular Automata for Urban Traffic

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ABSTRACT

Vehicular travel which demands on the concurrent operations and parallel activities is increasing throughout the world, particularly in large urban areas. Most of the models introduced in the recent years are formulated using the language of cellular automata (CA). In this paper, to control urban traffic, we study the simulation and optimization of traffic light controllers in a city and present an adaptive fuzzy algorithm based on cellular automata properties. We have used CA for simulating transition function of density of vehicles. Although in the existent system environmental factors like priority of streets of intersection and width and length of streets are assumed equal and have no role in making decision for changing the status of traffic light, in real situations parameters like time during the entire day, density of the vehicles of the street, number of shopping centers, offices, malls that have plenty of clients, have determinant effects on amount of traffic of streets. To overcome these limitations we proposed a novel three leveled fuzzy system; at the first level priority of each street is computed momently based on fuzzy rules and regarding to environmental factors. At the second level real velocity of vehicles of every street is calculated at specific moment and at the third level by taking into account two parameters, priority of the street and amount of density behind the traffic light, decision for changing status of traffic light is done. Simulation results of our method underline efficiency and robustness of our approach in comparisons with best available global and adaptive strategies of traffic light control.

Keywords: traffic light control, urban traffic, cellular automata model, fuzzy control

1 INTRODUCTION

In the recent years there were strong attempts to develop a theoretical framework of traffic science among the physics community. Consequentially, a nearly completed description of highway traffic [7, 11], e.g., the “Three Phase Traffic” theory, was developed. This describes the different traffic states occurring on highways as well as the transitions among them. Also the concepts for modeling vehicular traffic are well developed. Most of the models introduced in the recent years are formulated using the language of cellular automata (CA) [4]. Unfortunately, no comparable framework for the description of traffic states in city networks is present. In contrast to the highway networks, where individual highway segments can be treated separated, the structure elements of city networks exert an immense influence onto the traffic dynamics [7].

In existent urban traffic systems priority of intersection streets and width and length of streets are assumed equal and therefore they have no role in making decision for changing the status of traffic light. To overcome these limitations, we proposed a novel fuzzy system that momently computes priority of the street based on fuzzy rules and regarding to environmental factors, also length of streets are not considered the same. Subsequently a cellular automata is employed for modeling density transmission and also type of movement of vehicles.

1.1 Cellular Automata

It‟s too years that computational model of cellular automata has been proposed to study different fields natural phenomena [1]. CA has been shown capable of yielding discrete approximations to the solutions of systems of differential equations, in terms of which much of the macroscopic physics of our world can be expressed. CA models have been applied to fluid dynamics, plasma physics, chemical systems, growth of dendritic crystals, economics, two-directional traffic flow, image processing and pattern recognition, parallel processing, random number generation, and have even been used as a model for the evolution of spiral galaxies[13].

Cellular automata is a mathematical discrete time and space model. Time is considered as specific constant intervals and space is demonstrated as one more dimensional networks of cells. Dimensions of networks are related to dimensions of cellular automata. Each cell has time-variant properties, variable values of each cell in each interval, describes status of that cell and overall system state is recognized by considering status of all cell in a specific interval [1].

CA is a class of discrete dynamical systems, consisting of an array of nodes (cells) of some dimension, n. Each cell can be in one of k different states at a given tick of the clock. At each discrete tick of the clock, each cell may change its state, in a way determined by the transition rules of the particular CA. The transition rules describe precisely how a given cell should change states, depending on its current state and the states of its neighbors. Let n be the dimension of the lattice, k the number of states, T the transition rule function, $C_t (i_1 , \ldots , i_n)$ the state of the cell at position $(i_1 , \ldots , i_n)$ at time t, $N_t (i_1 , \ldots , i_n)$ the values (given in a specific order) of the neighboring cells to this location at time t. Then the dynamics of the CA is completely specified by the initial states of all the cells, C_0 , along with the recursion rule (Equation 1).

$$C_{t+1}(i_1,\cdots,i_n) = T (N_t(i_1,\cdots,i_n)) \quad (1)$$

CA provides a useful mathematical model of massively parallel multi-processor systems. Each cell can be considered a processor, with the cell states corresponding to the finite possible states of the processor. The processors in the neighborhood of a given processor, P, are the processors directly connected to P. The above could also be describing a neural net, with „neuron" in place of „processor". How to get such a system to perform useful computational tasks, making optimal use of all that parallel computing power, is a central problem in computer science. CA experiments have provided much needed insight into how simple local interactive dynamics can give rise to complex emergent global behavior [13].

2 RELATED WORKS

Traffic dynamics bare resemblance with, for example, the dynamics of fluids and those of sand in a pipe. Different approaches to modeling traffic flow can be used to explain phenomena specific to traffic, like the spontaneous formation of traffic jams. There are two common approaches for modeling traffic [6]; macroscopic and microscopic models.

- **Macroscopic Traffic Models:** Macroscopic traffic models are based on gas-kinetic models and use equations relating traffic density to velocity. These equations can be extended with terms for build-up and relaxation of pressure to account for phenomena like stop-and-go traffic and spontaneous congestions.
- **Microscopic Traffic Models:** In contrast to macroscopic models, microscopic traffic models offer a way of simulating various driver behaviors. A microscopic model consists of an infrastructure that is occupied by a set of vehicles. Each vehicle interacts with its environment according to its own rules. Depending on these rules, different kinds of behavior emerge when groups of vehicles interact.

Existent traffic prevention approaches can be categorized as follows [10]:

- **Global Strategies:** The considered global strategies are a "synchronized strategy", a "green wave strategy" and a "random strategy". In the case of the synchronized strategy all traffic lights switch synchronously to green (red) for the east (north) bound vehicles and vice versa. In the case of a green wave strategy, i.e., adjacent traffic lights switch with a defined offset. Additionally, an appropriate offset has to be determined for the green wave strategy; this is equal to the free flow travel time for the depicted case. A further investigated candidate among the global strategies is the random strategy, i.e., adjacent traffic lights switch with a random offset. Also here a quite good result is achieved [7, 8].

- **Adaptive Strategies:** In the following three different adaptive strategies are presented. The first investigated adaptive strategy is the "switching based on the queue length". Here a traffic signal switches if the length of a vehicle queue in front of a red light trespasses a certain value. Further investigated adaptive strategies are the "switching based on waiting time" and the "switching in analogy to a neural network". In the first case a traffic light switches to red if the green phase is not used by a vehicle for a certain time. In the case of switching in analogy to a neural network the traffic lights act like integrate-and-fire neurons. More precisely the number of passed vehicles is integrated and determines the cycle time (potential) of a traffic light. After the switching process (fire) the potential is reset to zero again. The switching in analogy to a neural network strategy leads to similar results like the switching based on the waiting time [7, 8].

3 THREE LEVELD FUZZY PROPOSED METHOD

In the proposed models that employ adjusting traffic light for urban traffic control, priority of streets of intersection and width and length of streets have been assumed equal. whereas in urban traffic parameters like time during the entire day, density of the vehicles of the street, number of shopping centers, offices, malls that have plenty of clients, have determinant effects on amount of traffic of streets and priority of each street is defined by considering these environmental factors. Taking into account these parameters we proposed a fuzzy system that priority of each street is computed at each moment, also this system doesn‟t set any constraint on width and length of streets. The proposed system has three levels; at the first level priority of each street is computed momently based on fuzzy rules regarding to environmental factors and features of the street. At the second level real velocity of vehicles of every street is calculated at specific moments based on factors like priority, density and standard velocity (maximum allowed velocity that‟s defined for each street) of the street. Then cellular automata model is applied to specify density transmission and also type of movement of vehicles in cellular spaces of each street. And finally at the third level by considering two parameters, priority of the street and amount of density behind the traffic light decision is done for changing status of traffic light and also the specific moment that status of traffic light is changed.

3.1 First Level of the Proposed System

In this paper, pausing coefficient is used as a significant factor to determine priority of each street. Streets with larger quantity of stopped or paused vehicles have more priority. Pausing coefficient is classified in three main categories:

- **Health and Commercial Centers:**

In these centers, density of clients is computed momently. Since number of clients directly affects on number of paused or stopped vehicles in the street, priority of street is dependant to amount of density of clients with a linear function. So fuzzy sets of health and commercial centers are defined as follows (Figure 1):

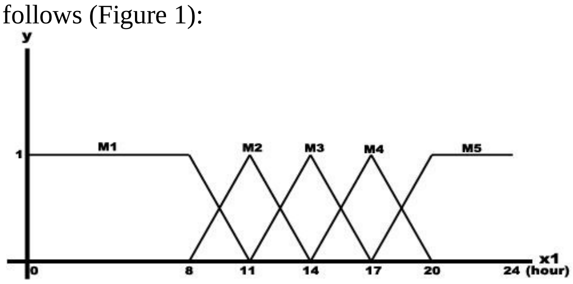

Figure 1: Fuzzy Sets of Density of Clients of Health and Commercial Centers

In figure.1; M1, M2, M3, M4, M5 fuzzy sets are respectively related to low, high, medium, high and low densities.

- **Official Centers:**

In these centers density of clients in each moment could affect directly on priority of the street. Fuzzy sets of official centers are determined as follows (Figure 2):

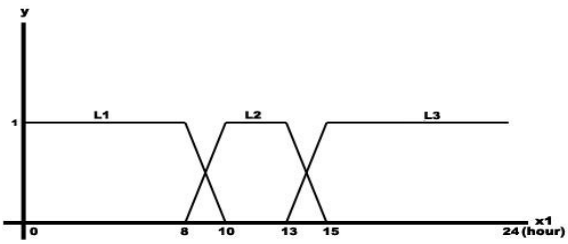

Figure 2: Fuzzy Sets of Density of Clients of Official Centers

In figure 2; L1, L2, L3 fuzzy sets are respectively related to low, high and low densities.

- **Shopping Centers:**

Like two previous centers amount of clients of these centers, has an important effect on priority of the street, fuzzy sets of these centers can be considered as figure 3:

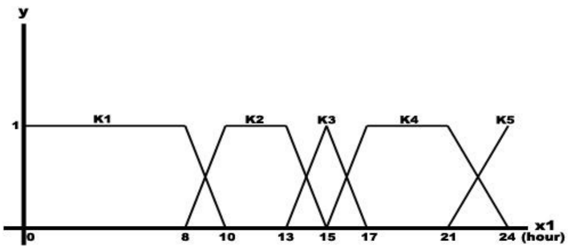

Figure 3: Fuzzy Sets of Density of Clients of Shopping Centers

In figure 3; K1, K2, K3, K4, K5 fuzzy sets are respectively related to low, high, medium, high and low densities.

3.1.1 Fuzzy Rules

In the proposed system, 24 fuzzy are regarded as follows:

IF (x_1 is M_1) and (x_1 is L_1) and (x_1 is K_1) then
$F_1=[A_1*(1-y_{11})]*[A_2*(1-y_{21})]*[A_3*(1-y_{31})]$ (2)

IF (x_1 is M_1) and (x_1 is L_1) and (x_1 is K_2) then
$F_2=[A_1*(1-y_{11})]*[A_2*(1-y_{21})]*[A_3*y_{32}]$ (3)

IF (x_1 is M_1) and (x_1 is L_2) and (x_1 is K_1) then
$F_3=[A_1*(1-y_{11})]*[A_2*y_{22}]*[A_3*(1-y_{31})]$ (4)

IF (x_1 is M_1) and (x_1 is L_2) and (x_1 is K_2) then
$F_4=[A_1*(1-y_{11})]*[A_2*y_{22}]*[A_3*y_{32}]$ (5)

IF (x_1 is M_2) and (x_1 is L_1) and (x_1 is K_1) then
$F_5=[A_1*y_{12}]*[A_2*(1-y_{21})]*[A_3*(1-y_{31})]$ (6)

IF (x_1 is M_2) and (x_1 is L_1) and (x_1 is K_2) then
$F_6=[A_1*y_{12}]*[A_2*(1-y_{21})]*[A_3*y_{32}]$ (7)

IF (x_1 is M_2) and (x_1 is L_1) and (x_1 is K_3) then
$F_7=[A_1*y_{12}]*[A_2*(1-y_{21})]*[A_3*(1-|1-y_{33}|)/2]$ (8)

IF (x_1 is M_2) and (x_1 is L_2) and (x_1 is K_1) then
$F_8=[A_1*y_{12}]*[A_2*y_{22}]*[A_3*(1-y_{31})]$ (9)

IF (x_1 is M_2) and (x_1 is L_2) and (x_1 is K_2) then
$F_9=[A_1*y_{12}]*[A_2*y_{22}]*[A_3*y_{32}]$ (10)

IF (x_1 is M_2) and (x_1 is L_2) and (x_1 is K_3) then
$F_{10}=[A_1*y_{12}]*[A_2*y_{22}]*[A_3*(1-|1-y_{33}|)/2]$ (11)

IF (x_1 is M_3) and (x_1 is L_2) and (x_1 is K_2) then
$F_{11}=[A_1*(1-|1-y_{13}|)/2]*[A_2*y_{22}]*[A_3*y_{32}]$ (12)

IF (x_1 is M_3) and (x_1 is L_2) and (x_1 is K_3) then
$F_{12}=[A_1*(1-|1-y_{13}|)/2]*[A_2*y_{22}]*[A_3*(1-|1-y_{33}|)/2]$ (13)

IF (x_1 is M_3) and (x_1 is L_2) and (x_1 is K_4) then
$F_{13}=[A_1*(1-|1-y_{13}|)/2]*[A_2*y_{22}]*[A_3*y_{34}]$ (14)

IF (x_1 is M_3) and (x_1 is L_3) and (x_1 is K_2) then
$F_{14}=[A_1*(1-|1-y_{13}|)/2]*[A_2*(1-y_{23})]*[A_3*y_{32}]$ (15)

IF (x_1 is M_3) and (x_1 is L_3) and (x_1 is K_3) then
$F_{15}=[A_1*(1-|1-y_{13}|)/2]*[A_2*(1-y_{23})]*[A_3*(1-|1-y_{33}|)/2]$ (16)

IF (x_1 is M_3) and (x_1 is L_3) and (x_1 is K_4) then
$F_{16}=[A_1*(1-|1-y_{13}|)/2]* [A_2*(1-y_{23})]*[A_3*y_{34}]$ (17)

IF (x_1 is M_4) and (x_1 is L_2) and (x_1 is K_2) then
$F_{17}=[A_1*y_{14}]*[A_2*y_{22}]*[A_3*y_{32}]$ (18)

IF (x_1 is M_4) and (x_1 is L_2) and (x_1 is K_3) then
$F_{18}=[A_1*y_{14}]*[A_2*y_{22}]*[A_3*(1-|1-y_{33}|)/2]$ (19)

IF (x_1 is M_4) and (x_1 is L_2) and (x_1 is K_4) then
$F_{19}=[A_1*y_{14}]*[A_2*y_{22}]*[A_3*y_{34}]$ (20)

IF (x_1 is M_4) and (x_1 is L_3) and (x_1 is K_2) then
$F_{20}=[A_1*y_{14}]*[A_2*(1-y_{23})]*[A_3*y_{32}]$ (21)

IF (x_1 is M_4) and (x_1 is L_3) and (x_1 is K_3) then
$F_{21}=[A_1*y_{14}]*[A_2*(1-y_{23})]*[A_3*(1-|1-y_{33}|)/2]$ (22)

IF (x_1 is M_4) and (x_1 is L_3) and (x_1 is K_4) then
$F_{22}=[A_1*y_{14}]*[A_2*(1-y_{23})]*[A_3*y_{34}]$ (23)

IF (x_1 is M_5) and (x_1 is L_3) and (x_1 is K_4) then
$F_{23}=[A_1*(1-y_{15})]*[A_2*(1-y_{23})]*[A_3*y_{34}]$ (24)

IF (x_1 is M_5) and (x_1 is L_3) and (x_1 is K_5) then
$F_{24}=[A_1*(1-y_{15})]*[A_2*(1-y_{23})]*[A_3*(1-y_{35})]$ (25)

In the above rules y_{1j},y_{2j} and y_{3j} respectively demonstrate membership functions of M_j,L_j and K_j fuzzy sets.

3.1.2 Defuzzification

In this system defuzzification is performed by using equation (26). Output of defuzzifier is considered as output of first level of system and shows priority of the street.

$$F = \frac{\sum_{i=1}^{24} Fi}{n} \qquad (26)$$

In the above equation, Fi is output of ith rule (i=1...24), n is number of rules that have nonzero output and F is defuzzifier output (output of first level of system). F uses as one of the inputs of second level of the system.

3.2 Second Level of the Proposed System

In this step real velocity of vehicles of every street is calculated at specific moments and then type of transmission of density of vehicles is evaluated. Real velocity of vehicles is obtained by regarding three factors:

- **Priority of Street:** That"s calculated dynamically at specific moments, based on fuzzy rules at the first level.
- **Density of Vehicles:** Since low-priority streets have low pausing coefficients, most of vehicles would be paused behind intersections. So if adjustment of the traffic light is done only based on priority of the street, vehicles may pause for a long duration behind intersections. To prevent this problem, number of existent vehicles in the street is also regarded as one of the inputs.
- **Standard Velocity of Vehicles of Street:** Since number of vehicles behind intersections, is a determinant factor for specifying distance between pausing location and traffic light, we have used cellular automata for segmentation of street from intersection to end of street. So type of movement of vehicles from entrance time till pausing time behind intersection is achieved by using transition rules of cellular automata. standard velocity of vehicles (standard velocity is constant for all vehicles of each street and computed based on width and length of street) must be specific while applying transitions rules so it"s considered as third factor

Based on these three inputs, velocity of each vehicle is computed as follows:

$$V=(1-\gamma)(1-\alpha)*V_N+\varepsilon \quad (27)$$

γ is priority of the street (output of first level of fuzzy system), V_N is standard velocity of street, ε is a constant value for movement of vehicles (5km/h in this paper) and α is density of the street that‟s obtained from equation 28 :

$$\alpha = \frac{N}{W*L*A} \quad (28)$$

W and L are respectively width and length of the street, A is the average occupied area by each vehicle (15 m2 in this paper), N is number of available vehicles in the street (N is calculated as follows: W*L is multiplied by summation of densities of cellular spaces). Regarding equation 28 more density or more priority of street, leads in less velocity of vehicles. Based in this velocity, transition rules of cellular automata are determined.

3.2.1 Cellular Automat Rules

Since velocity and displacement have a linear dependency (x=v*t), we used a linear transition function. Because of extra computations, discrete time method is applied instead of continuous time approach and system is updated at specific seconds. In this paper, velocities of vehicles are divided in intervals of length 5 and length of each cell is considered as 10 meters. So at every 7.2" time interval, the vehicle moves 10 meters (equal to one cell) in a fixed 5km length. (Updating progress is done every 7.2 seconds). Based on these comments, we used following transition function for obtaining cellular rules of density transmission in the street:

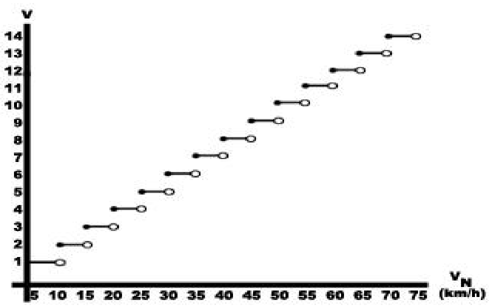

Figure 4: Density Transmission Function Based on CA Model

In the proposed cellular automata model width of cell is regarded as width of the street and length of cell is set to a constant number (10). Notice that transmission of density of vehicles means transmission of vehicles from one cell to another one, type of this transmission is specified as figure 4.

Example: if initial velocity of vehicle is 45 km/h, equation 28 is used for transmission of density:

$$C(j+9)=C(j+9)+C(j) \quad (29)$$

Where C(j+9) is 9th neighbor of C(j) in the direction of movement.

Maximum density of each cell is one and related to number of available vehicles at each cell. Maximum number of vehicles of each cell is computed as follows:

$$N = \frac{w*10}{15} \quad (30)$$

W is width of the street, 10 is length of the street and 15 shows estimated area allocated for a vehicle (this area includes the space between two vehicles).
If number of available vehicles of each cell exceeds the maximum value (calculated from equation 30) surplus is transferred to previous cell. Notice that in this paper all of the streets are bidirectional and cellular space of streets is as follows:

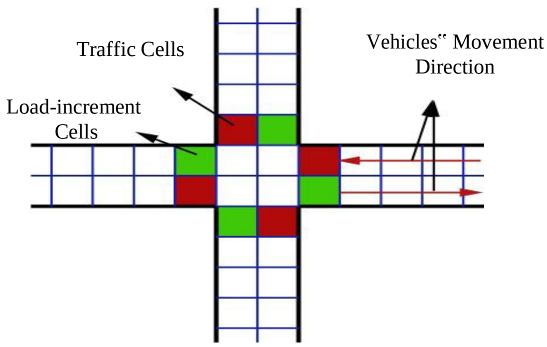

Figure 5: Cellular Space of Streets and Corresponding Traffic and Load-increment Cells

Traffic cells that illustrated in figure 5 have different affects, when the traffic light is red or yellow these cells cause to increment of cell density, whereas they cause to decrement of cell density when the traffic light is green. Load-increment cells always cause to transmission of density from one street to another one.

In this paper transmission of density from traffic cells to load increment cells is done equally and steady. Traffic cells of the street momently dispread the density equally among load-increment cells of three other streets. Dispreading of density also can be done regarding to type of the street.

3.3 Third Level of the Proposed System

In this paper two factors are considered for adjusting traffic light. Priority of the street and number of complete traffic cells are inputs of third level of the proposed system. Since density and traffic in high-priority streets have more undesirable effects, priority is considered for adjusting traffic light. Furthermore number of paused vehicles behind intersections is the main factor to determining time for changing status of traffic light. This factor is illustrated by traffic cells and regarded as input of system.

In this proposed system two conversion functions are used for priority and number of traffic cells to determine time duration that green light is active.

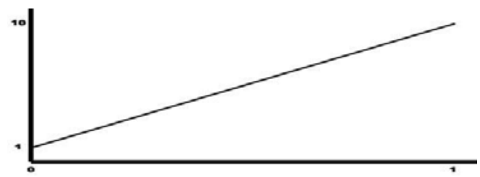

Figure 6: Conversion Function (Priority to Time)

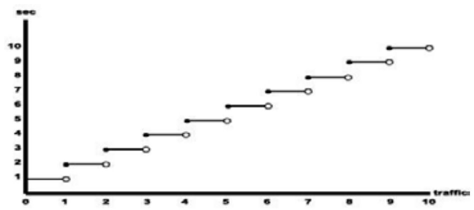

Figure 7: Conversion Function (Number of Traffic Cells to Time)

Multiplication of outputs of two functions represents time duration that traffic light is green for each street:

$$G=Tc*\gamma \tag{31}$$

G shows the time interval that green light is active, Tc is number of traffic cells and γ is priority of the street. G is computed for all of streets of intersection. These calculations are done concurrently and independently and finally street with the highest G actives green light and uses G seconds from the green light. Like section 3-2-1 the system is updated every 7.2 seconds. To prevent consecutive variations of traffic light status equation 32 is employed:

If ***G_max >= 2*G_green_light*** THEN (32)
Change ***Traffic light***

G_max is maximum value of G in every updating progress (among streets of an intersection) and G_green_light is updated value of G for the street with green light. *Change Traffic Light* instruction actives green light for the street that has G_max. In the proposed approach traffic every moment light green is active only for one of the streets.

4 SIMULATION RESULTS

The proposed method was simulated with specific inputs and more desirable results were obtained in comparison with based adaptive method.

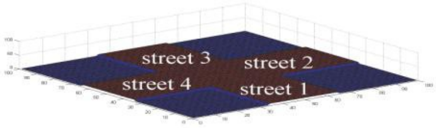

Figure 8: Cellular Representation of Initial State of Intersection without Regarding Priority of Street in the Absence of Density of Vehicles

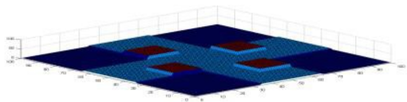

Figure 9: Result of Fuzzy Proposed Approach for Representing Complete Traffic Cells by Considering Equal Priority and Steady Density for Streets of Intersection

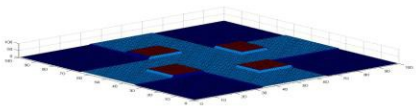

Figure 10: Result of NN-based Approach for Representing Complete Traffic Cells by Considering Equal Priority and Steady Density for Streets of Intersection

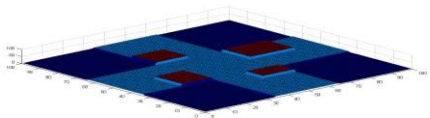

Figure 11: Result of Fuzzy Proposed Approach for Representing Complete Traffic Cells by Considering 1st Street as High-priority and 2nd Street as Low-priority Street

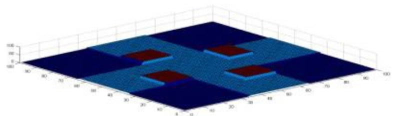

Figure 12: Result of NN-based Approach for Representing Complete Traffic Cells by Considering 1st Street as High-priority and 2nd Street as Low-priority Street

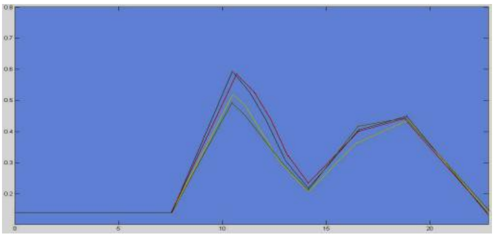

Figure 13: Density of Streets of Intersection of Figure 11 Obtained from Fuzzy Proposed Approach (Blue Shows High-priority and Green Show Low-priority Street)

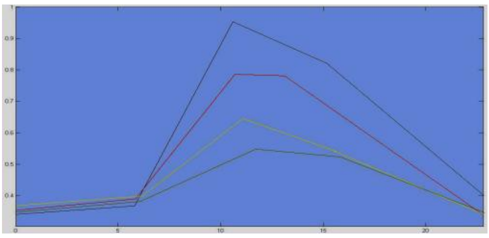

Figure 14: Density of Streets of Intersection of Figure 12 Obtained from NN-based Approach (Blue Shows High-priority and Green Show Low-priority Street)

When priorities of streets are considered almost equal and factors like average velocity of street and density are disregarded, three level fuzzy and NN-based approaches almost have same responses.

When priorities of streets are different from each other and density of vehicles of streets of intersection streets is not the same results of NN-based method doesn‟t change at all, because this method doesn‟t consider priority of streets, so density of high-priority streets would increase that this matter leads to traffic increment of that street. Whereas in the proposed three level fuzzy approach changing priority of streets and density of each street causes to significant changes in traffic light scheduling and traffic cells. This change results in only street with more density and higher priority adjust traffic light. Finally traffic load and street density will be balanced.

Figure 13 indicates two main notes, First; the proposed system controls density of intersecting streets in a way that traffic load would be balanced and equal and second; higher priority of streets leads to more density at intersections.

For better understanding we review an example: we consider intersection‟s streets have these main centers:

- 1st street: 5 Health and Commercial Centers, 4 Official Centers, 1 Shopping Center
- 2nd street: 4 Health and Commercial Centers, 5 Official Centers, 1 Shopping Center
- 3rd street: 2 Health and Commercial Centers, 3 Official Centers, 1 Shopping Center
- 4th street: 1 Health and Commercial Centers, 1 Official Centers, 2 Shopping Center

Note that priorities of streets would be as follows (based on fuzzy relationships):

- 1st street: 0.8333
- 2nd street: 0.8333
- 3rd street: 0.25
- 4th street: 0.0833

It‟s assumed that standard velocity of all streets are the same and equal to 50 km/h, also width and length of streets are considered as 10m and 2km. so real velocity would be:

- 1st street: 13.3194
- 2nd street: 13.3194
- 3rd street: 42.4375
- 4th street: 50.5769

At third level of the system density and number of traffic cells at 12 o‟clock are computed as follows:

- 1st street: Density: 0.5834, Number of Traffic Cells: 2
- 2nd street: Density: 0.5741, Number of Traffic Cells: 2
- 3rd street: Density: 0.5208, Number of Traffic Cells: 3
- 4th street: Density: 0.4917, Number of Traffic Cells: 4

Whereas by regarding NN-based method density and number of traffic cells would be as:

- 1st street: Density: 0.9571, Number of Traffic Cells: 2
- 2nd street: Density: 0.7840, Number of Traffic Cells: 2
- 3rd street: Density: 0.6425, Number of Traffic Cells: 3
- 4th street: Density: 0.5403, Number of Traffic Cells: 4

Notice that although inconsiderable density has been added to 4th street, density decrement is completely sensible in 1st,2nd and 3rd streets.

While existent systems only consider specific limited segment behind the intersection for adjusting traffic light, our proposed system can control density of vehicles and traffic load throughout the street and prevent heavy traffics.

5 CONCLUSIONS

In this paper a three level fuzzy system was proposed for urban traffic control by adjusting traffic light. Using this approach results in traffic decrement and also steady traffic dispreading all over the city. In the proposed system priority and length of streets are considered variable. Also real velocity of vehicles is computed based on fuzzy rules in different hours during the day. Considering this factor leads to traffic load balancing throughout the city. Another dominant note in this paper is that priority of streets and max allowed velocity of the street are obtained by fuzzy sets with regard to urbanism principals. This matter also reduces traffic significantly.

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