1.0 Introduction

- Demands of the traffic flows in the urban cities usually are covered by a complicated traffic network.
  - Traffic lights system starts to failed to meet the demands of the increasing traffic flows.
  - Traffic congestions occur.

- An intelligent traffic control system is required to solve the problem.
  - Ability to learn from the environment.

2.0 Objective

- To explore the learning capability of Genetic algorithm in traffic signal timing plan management .

3.0 Methodology

- Genetic algorithm
  - an algorithm for locating the best optimal solution throughout the evolutionary process of the possible solutions.
  - modelled as an imitated biological environment
  - all the possible solutions are treated as individual chromosomes in a population.
  - compete and survive through the evolution

3.0 Methodology

- Chromosomes
  - possible solutions
  - encode the entire information of a solution
  - Contains intersections' signal timing parameters such as
    - cycle time, *C*,
    - green split, *S*
    - phase sequence, *o*
    - and offset, *F*

Offset, *F*	Cycle Time, *C*	Phase Sequence, *o*	Green Signal Split, *S*

Figure 1. Chromosome structure.

3.0 Methodology

- Fitness Function
- Evaluates based on traffic delay and fluency.
  - Profit = Destination reach, distance travelled.
  - Cost = time

- Total Fitness = Profit - Cost

4.0 Simulations

- 2 four-way intersections network.
- Two case study are analyzed.
  - CS-1 : Undersaturated Traffic network
  - CS-2 : Oversaturated Traffic network

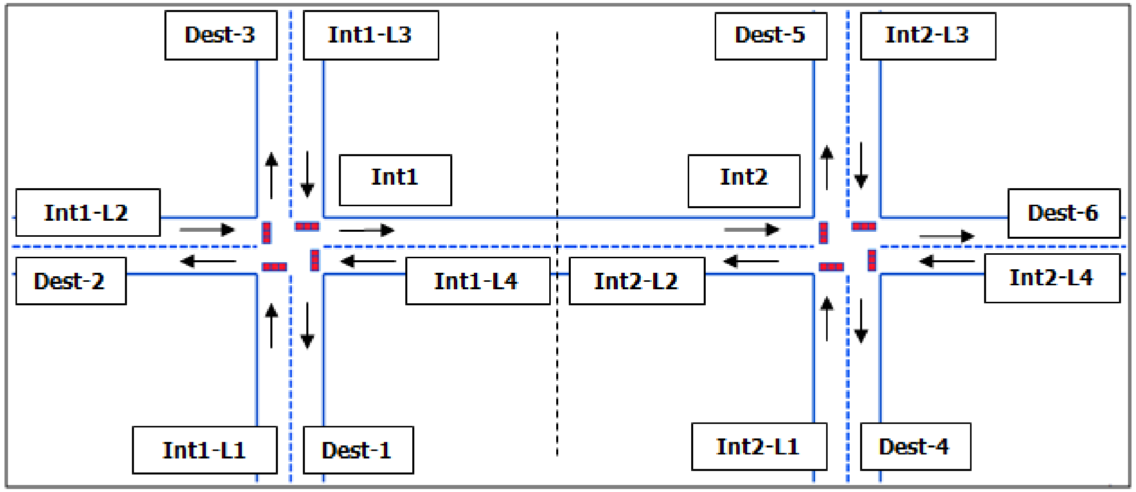
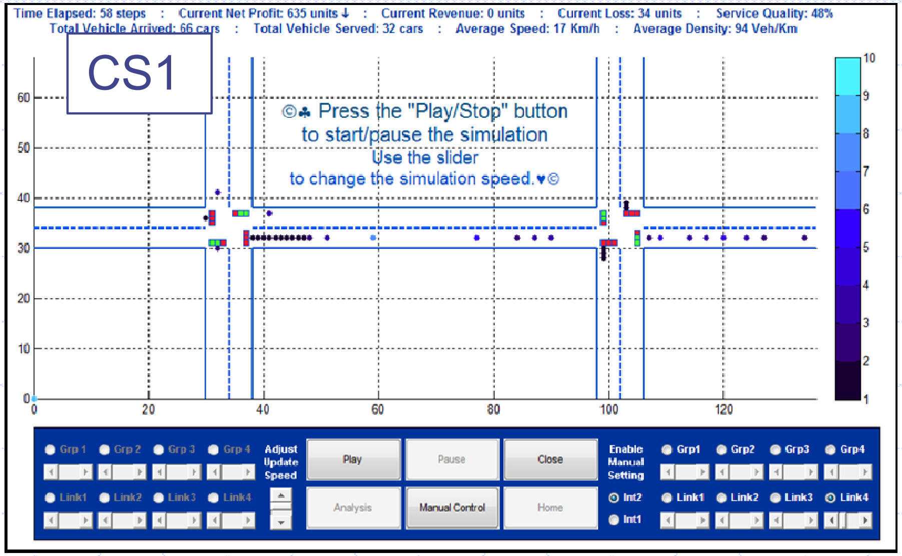


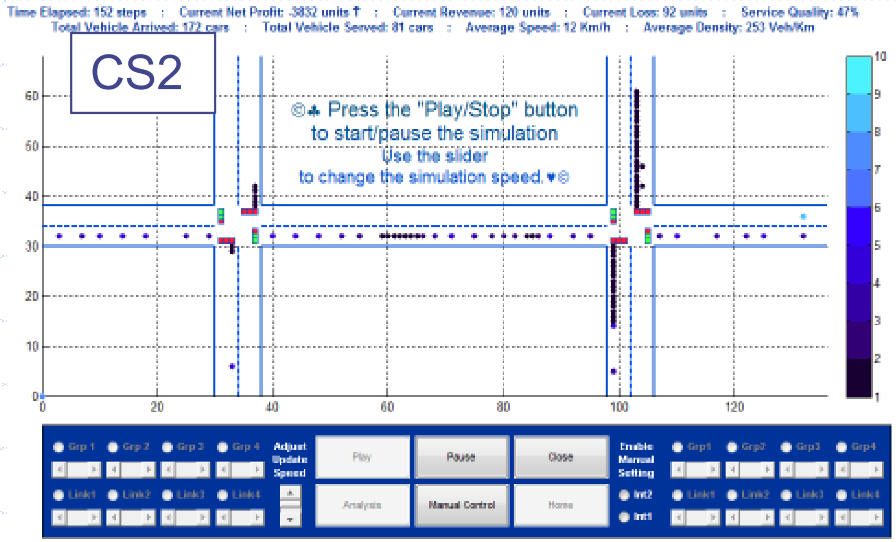
Figure 2 – Virtualization of a 4-way intersection network.

5.0 Results

- **CS-1**
- investigate the control strategy of GATSTM system
- only 1 of the intersection high traffic demand.

- **CS-2**
- traffic demands increase rapidly (oversaturated)
- Most traffic demand flow toward Int1-L2





5.0 Results

Optimized Signal Timing	
Offset	$\mathcal{F}^2 = 7$
Cycle Time	$\mathcal{C}^1 = 75, \mathcal{C}^2 = 14$
Green Split (%)	$\mathcal{S}^1{}_1 = 86, \mathcal{S}^1{}_2 = 10$ $\mathcal{S}^1{}_3 = 0, \mathcal{S}^1{}_4 = 4$ $\mathcal{S}^2{}_1 = 80, \mathcal{S}^2{}_2 = 2$ $\mathcal{S}^2{}_3 = 0, \mathcal{S}^2{}_4 = 18$
Phase Sequence	$\sigma^1{}_1 = 4, \sigma^1{}_2 = 2$ $\sigma^1{}_3 = 3, \sigma^1{}_4 = 1$ $\sigma^2{}_1 = 3, \sigma^2{}_2 = 4$ $\sigma^2{}_3 = 2, \sigma^2{}_4 = 1$
Profit	5445
Average Speed (km/h)	31.06
Average Density (veh/m)	82
Average Flow rate (veh/(m * lane))	2538
Total Served Vehicle (veh)	101
Total Vehicle Arrived (veh)	122

- **CS-1**
- The control strategy is successful.
- Dominant signal group is assigned with a higher green signal
- GATSTM system recognizes the dominant link and assigning longer green period.

5.0 Results

Optimized Signal Timing	
Offset	$\mathcal{F}^2 = 11$
Cycle Time	$\mathcal{C}^1 = 55, \mathcal{C}^2 = 96$
Green Split (%)	$\mathcal{S}^1{}_1 = 88, \mathcal{S}^1{}_2 = 0$ $\mathcal{S}^1{}_3 = 0, \mathcal{S}^1{}_4 = 11$ $\mathcal{S}^2{}_1 = 54, \mathcal{S}^2{}_2 = 8$ $\mathcal{S}^2{}_3 = 1, \mathcal{S}^2{}_4 = 20$
Phase Sequence	$\sigma^1{}_1 = 1, \sigma^1{}_2 = 4$ $\sigma^1{}_3 = 3, \sigma^1{}_4 = 2$ $\sigma^2{}_1 = 1, \sigma^2{}_2 = 3$ $\sigma^2{}_3 = 4, \sigma^2{}_4 = 2$
Profit	-4468
Average Speed (km/h)	12.97
Average Density (veh/m)	211
Average Flow rate (veh/(m * lane))	2738
Total Served Vehicle (veh)	97
Total Vehicle Arrived (veh)	190

- **CS-2**
- GATSTM releases the link with lowest demand (Int2-L1) first.
- Let other link form queue.
- Fully utilized maximum saturation flow rate with longer queue.
- Spillback is the congested situation when vehicles start to form queue on the intersection.
- Change the signal phase to release longer queue at other link.
- Prevent Spillback.

6.0 Discussion

- In CS-1, GATSTM able to prioritize the dominant signal group.
- release total of 101 vehicles out of the 122 arriving vehicles.
- In CS-2, GATSTM system to manage queue spillback during the oversaturated conditions.
- GATSTM prioritize the movements and control the directions of queue build-up to avoid spillback.

7.0 Conclusion

- Genetic algorithms' ability to evolve itself in the dynamic traffic flows has shown a good performance in the GATSTM.
- A suitable method or technique to be further implemented into the traffic flow control and optimization of urban traffic network system.