PROJECT REPORT

UNDERSTANDING CONGESTED TRAFFIC IN URBAN AREAS:

Aim:To suggest routes for the users, which reduces congestion for the system.

During these days congestion of traffic is increasing rapidly,the cause for the congestion is rapid urbanisation and increasing demand for transportation

Level of congestion:It is the interplay
between the number of vehicles and available road capacities.
The possible limits of congestion allivation by only modifing route capacities have notbeen studied systematically.

Challenges:
1.To know about the user equilibrium which is based on wardrops first principle.
2.To know about the system optimal which is based on wardrops second principle.
3.Introducing the social good (λ).
4.Differentiating between user equilibrium
and system optimal.

User equilibrium :

- Users choose the route that minimizes their own travel time

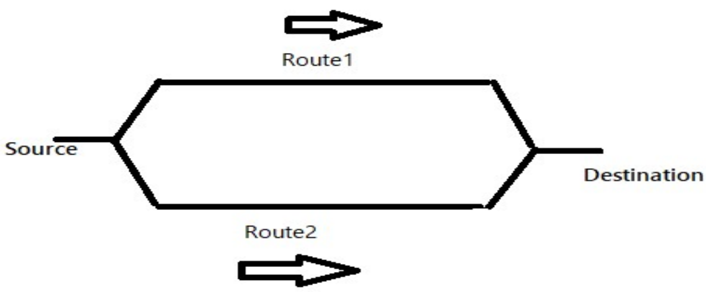
- Travellers cannot improve their travel times by unilaterally changing routes.
    - Travel time between two zones on all used routes will be equal.
- When determining travel route choice, two assumptions are usually made:
    - Travellers will select a route on basis of travel times.
    - Travellers know the travel times that would be encountered on all available routes.

Explaining using an example:

Example:

Vehicle flow is 4500 V/hr , travel time in the routes are $T_1 = 6 + 4x_1$ and $T_2 = 4 + x_2^2$ where x_1 and x_2 are the flows in the respective routes.

Time is taken in min and flow is expressed as 1000s of vehicle/hour



- As $T_1 = T_2$

  $6 + 4x_1 = 4 + x_2^2$
- From the flow conservation, $x_1 + x_2 = 4.5$

- Solving we get x_1= 1.601,x_2 = 2.899.
  And travel time in any of the route is
  $T_1 = T_2 = 12.4$min
- Total system travel time is
- $S(x)=x_1t(x_1)+x_2t(x_2)$
  =1601veh (12.4 min)+2899 veh(12.4 min)
  =930 veh-hr

System Optimal:

- Users distribute themselves on the network in such a way that the average travel time for all users is minimized.
- Solving the previous problem

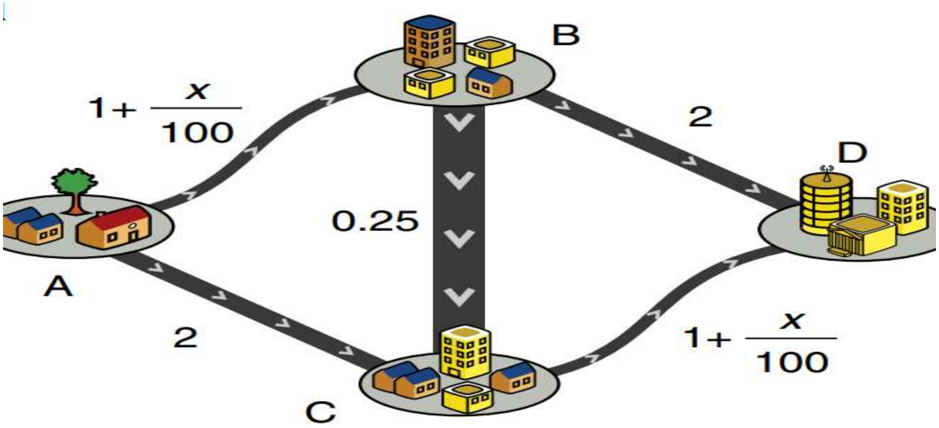
  $S(x) = x_1(6+4x_1)+x_2 (4+x_2^2)$
  $S(x) = 6x_1+4x_1^2 +4x_2+x_2^3$
- From flow conservation,$x_1=4.5-x_2$
  $S(x)=x_2^3+4x_2^2-38x_2+108$
  $dS(x)/dx_2 = 3x_2^2+8x_2-38=0$
  Which gives x_2= 2.467
  x_1= 4.5-2.467=2.033.
- System Optimal Travel Time is
  $T_1 =6+4(2.033) = 14.13$min
  $T_2 = 4+(2.467)^2 = 10.08$min

Total travel time is

$S(x) = x_1T_1(x_1) + x_2T_2(x_2)$
=2033(14.13min) + 2467(10.08min)
=893.2 veh-hr.

Hence System Optimal results in System wide travel savings of 36.8 veh-hr

Another example by considering social good (λ)

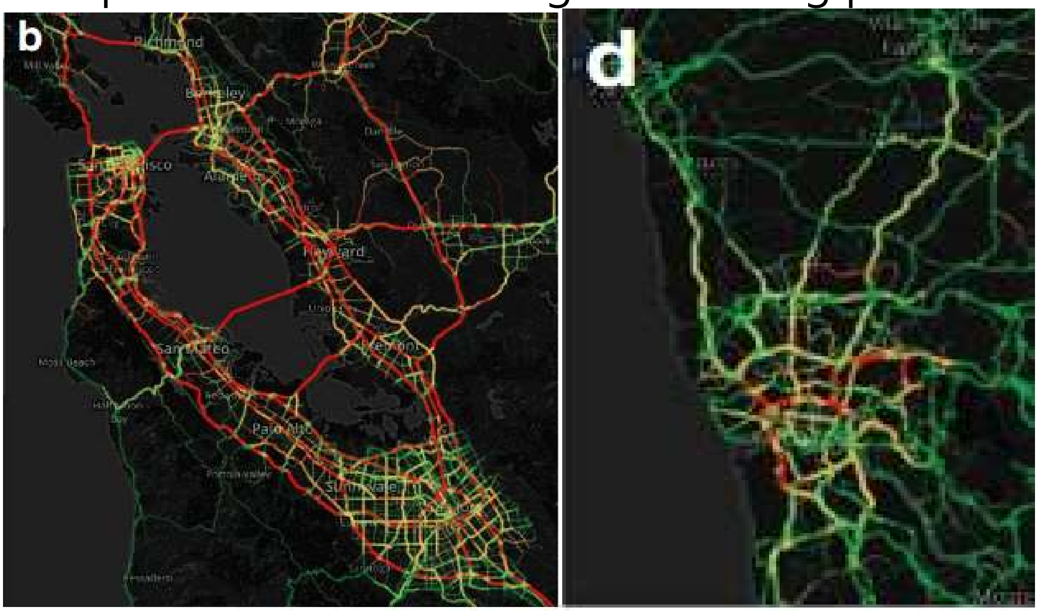


In this example 100 users are travelling from A to D

User equilibrium allocates the flows between paths as (ABD)=(ACD)=25,(ABCD)=50, average travel time is 3.75 min for all drivers.

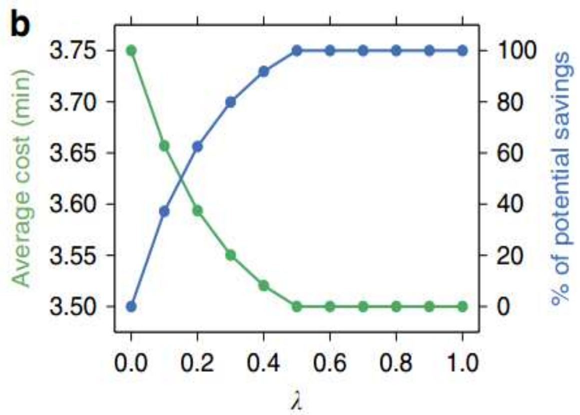
System optimum allocates flows between paths as (ABD)=(ACD)=50,decreasing the travel time to 3.50 and making the path BC unused.

Comparision of cost findings in morning peak areas



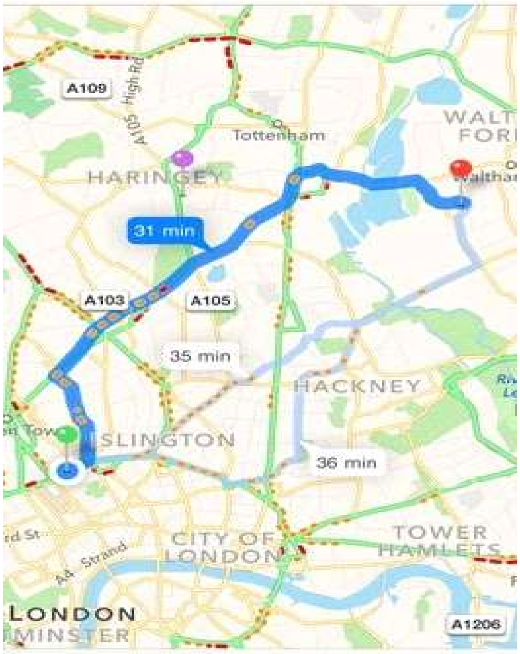
San Fansisco,USA Porto,Portugal

UserEquilibrium :	33.6	19.3
Social Optimal :	31.0	18.2
Benefit :	2.6	1.1



Potential savings increases with increasing values of weight of social good (λ).

Limitations in the existing maps:
Only provide the approximate travel time based on
• Maps provide travel time by taking the previous travel time records in to consideration.
• They also provide average time by taking motion of users i.e. by GPS



A depiction of three route alternatives with corresponding travel times for
λ=0,
λ=0.2,
λ=1.

Proposed Solution:
Set of users have a particular route which has high λ (weight of social good).

Number of users	user equilibrium	System Optimal
100	375	360
120	468	458
130	516.75	503.8
150	618.75	612.5

Table showing the travel times of whole system in veh-hrs.

Implementation in Java:
Showing the available routes ,users,travel time in respective routes.

```
1 2 4
1 2 3 4
1 3 4

Enter the number of users
100

Cost of route_1:-3.6666666666666665

Cost of route_2:-3.583333333333333

Cost of route_3:-3.6666666666666665

Users from 1.0 to 33.0 prefer the path 1 to achieve system optimal

Users from 34.0 to 66.0 prefer the path 2 to achieve system optimal

Users from 67.0 to 100.0 prefer the path 3 to achieve system optimal


Total System travel time in veh-time is : 360.25
```

For particular set users have a set of λ values with one route having λ=1.
and remaining routes having lesser λ values i.e 0.1,0.2... depending on the routes.

Conclusion:
Hence the individual may get benefitted or may not get benefitted but the system gets benefitted by reducing the system travel time, there by reducing the congestion.

REFERENCES:
Sedar Colak,Antonio Lima & Marta C.Gonalez,"Understanding congested travel in urban areas",2016.
Tom V. Mathew and K V Krishna Rao," TRAFFIC ASSIGNMENT",2007.

-S.Naren.Ritvik
1501053.