Technische Universität München - Lehrstuhl für Verkehrstechnik

Master thesis Topic: Adaptive Traffic Signal Control with Connected Vehicle Data

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Motivation:

- 100 billion Euros loss due to congestion
- 2.9 billion gallons fuel, 4.2 billion hours time costing $78 billion
- 50% increased grid locks costing $4.4 Trillion by 2030.
- Indiect losses- Mental health, premature deaths.
- Inefficient and uneconomical detecting methods
- Scope for using wireless & compuational technologies

Objectives:

- To develop an Adaptive Traffic Signal Control.
- Use CV data instead of conventional loop detectors.
- Control algorithm based on Dynamic Programming called Adaptive Traffic Signal Control with Connected-Vehicle Data (ATSCC).
- Evaluation against Conventional Adaptive method.

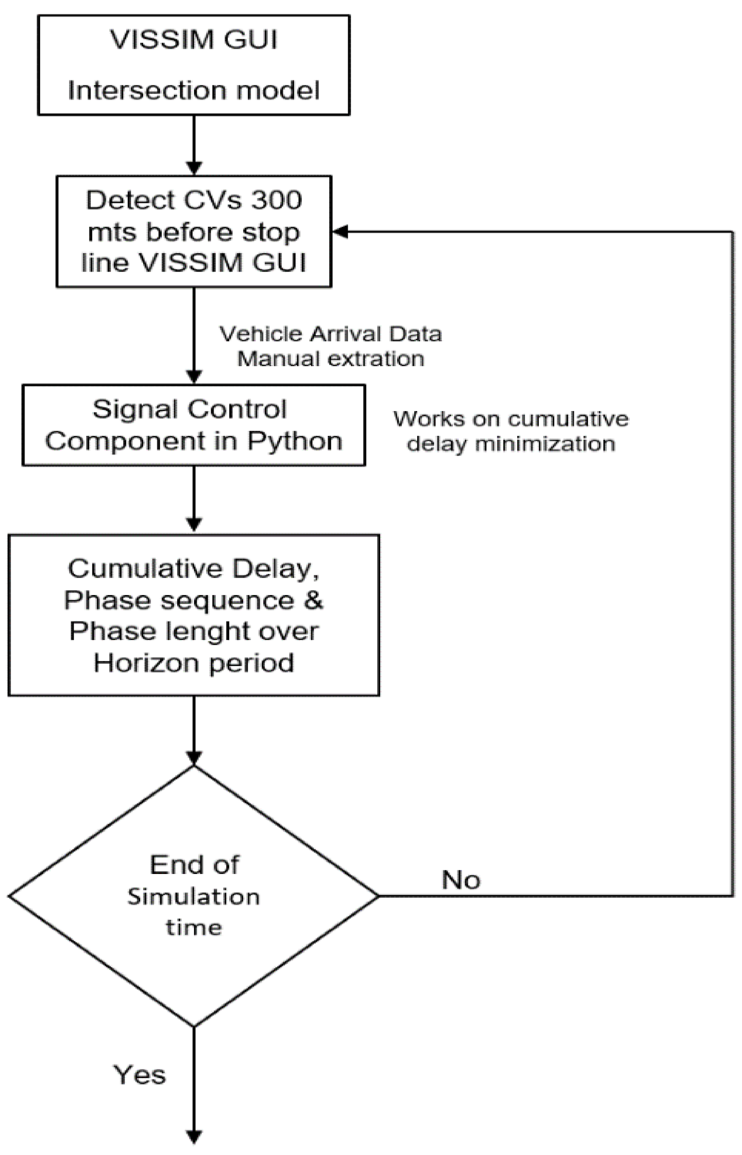
Computer Intelligence based Control Methodologies:

- Fuzzy Logic
- Neural Network
- Reinforcement Learning (RL)
- Dynamic Programming (DP)

Methodology:

Control System Architecture
ATSCC Algorithm Description

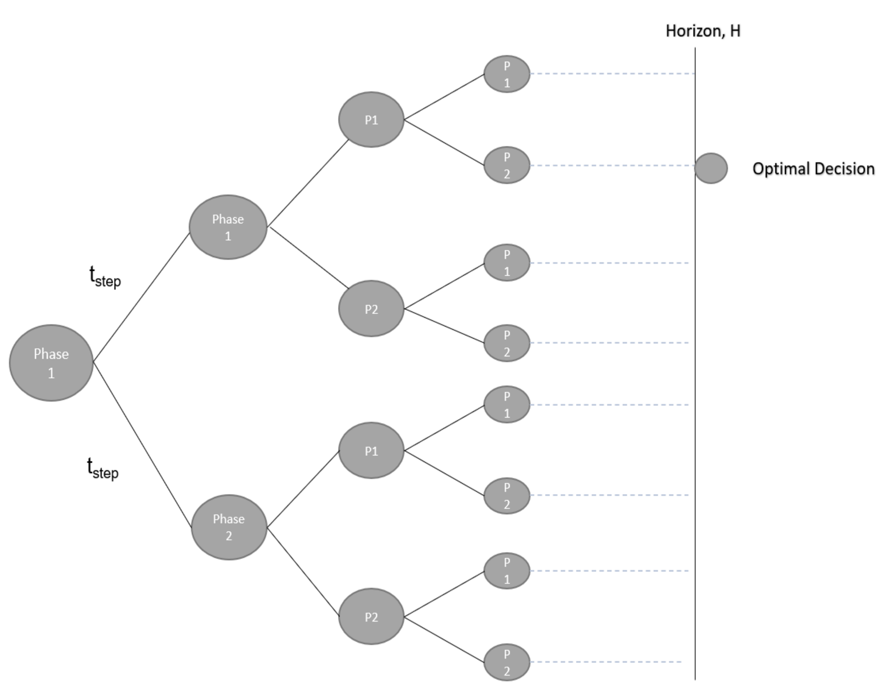
- Noncyclic approach for Isolated intersection
- Cumulative Delay minimization
- Calculating optimized signal plan
- Using Dynamic Programming for the algorithm



Dynamic Programming:

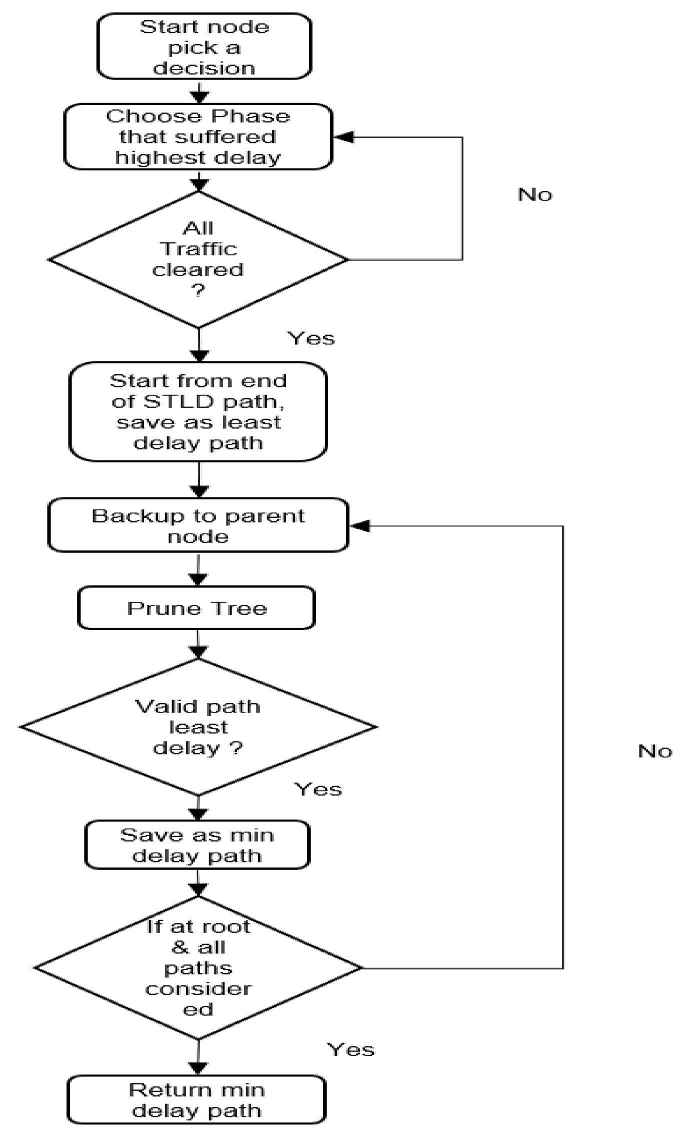
Decision Tree

- Node – represent the state of the system
- Link – represent the time step for two different decisions



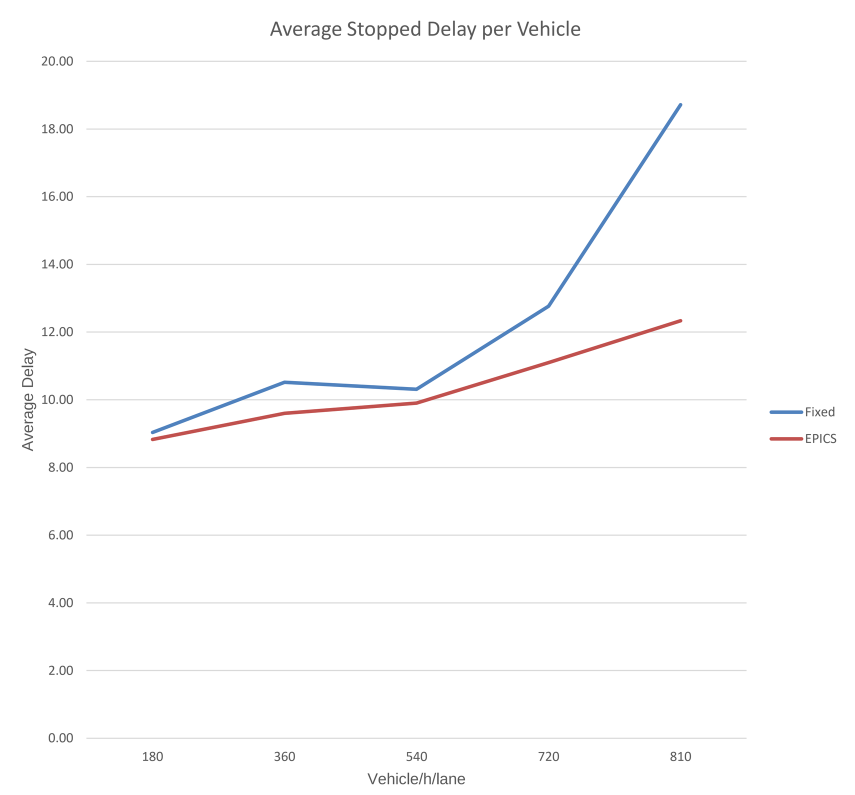
Algorithm Description:

- Two step search algorithm
- Branch & Bound Technique (B&B)
- Steps
- 1 – Depth-first for initial path
- 2 – Backtracking based on 'serve the largest cost'



Results & Discussion:

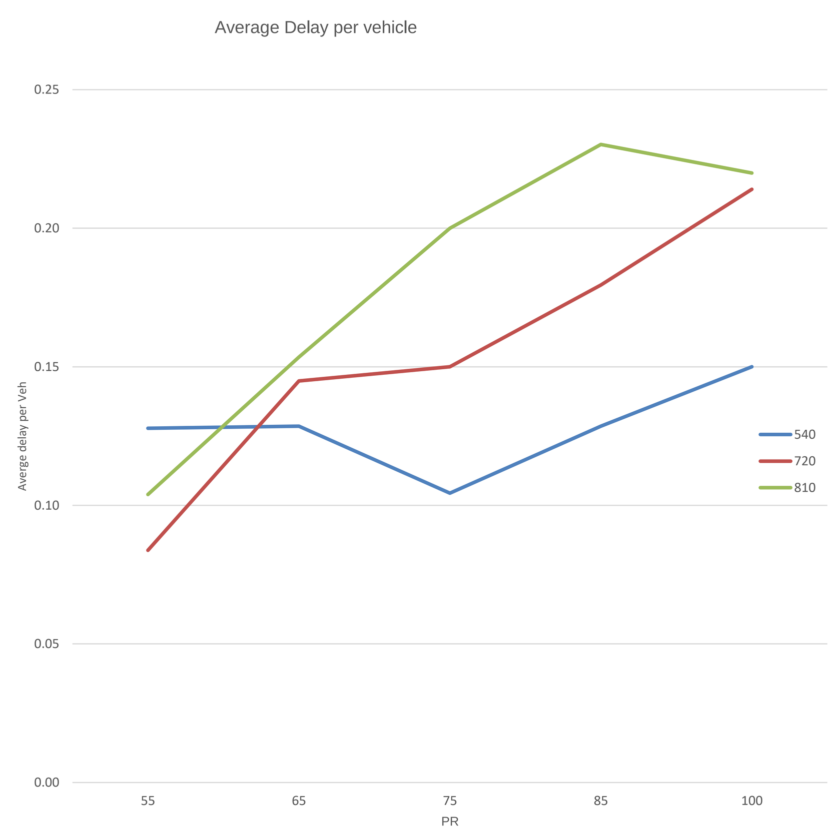
Stopped Delay by Fixed-time and EPICS Control



- Fixed-time control performance worsens with demand.
- EPICS's performance is consistent.
- Average delay per vehicle in EPICS is always lower than that of fixed-time control.
- EPICS performs better with increase in demand

Delays by ATSCC Algorithm in IDE:

- Average delay by ATSCC increases with increase in vehicles.
- Algorithm performs well at higher vehicle detections.
- The trend of delay for various vehicles categories is inconsistent, which could also be due to smaller number of vehicles in the model.



Conclusions:

- Present Adaptive control systems rely on inefficient & ineffective detectors.
- CV Data can be used effiectively for signal planning.
- CV data gives elaborate information, better representation of the system.
- ATSCC algorithm uses CV Data effectively to propose an optimized signal plan.
- Cumulative delay is kept minimum.
- ATSCC algorithm has to be run in a traffic simulation environment so that its performance can be assessed