**Motivation**

Estimation and prediction of travel time has significant impact on traffic planning, management, and control:
- As the primary measure of the level of service in an urban arterial
- To determine design traffic volumes on roadway in urban transportation planning model
- To adaptively control signal timing and detect incidents

**State-of-the-Art**

Stochastic modeling with the following assumptions:
- No vehicles entering and existing the roadway between detectors
- The probability distribution of travel time is invariant between detectors
- Short-term estimates and predictions is made for 5-15 minutes

Simulation modeling and analysis:
- Need to predetermine all distributions and parameters for traffic flow, vehicle volumes, driver behaviors, etc.
- No guideline for validation of simulation results
- Hard to implemented in real time traffic control

**Objectives & new features**

To develop an effective model and statistical analysis techniques for travel time estimation for urban arterial traffic with the following new features:
- Travel time estimation is performed based on real time loop-detector data with the resolution of one second
- The effects of vehicle volume and the location of entrances and exists are modeled explicitly by using varying probability distributions of travel time between detectors
- The effect of trip generation factors is integrated in the traffic flow model

**Proposed approaches**

![Traffic Flow Diagram](attachment:image.png)

**Accomplishments**

**Model formulation**

\[
\begin{align*}
\tilde{V}_1(t) &= \sum_{i=0}^{n} f_i(t) \cdot V_X(t) \\
\tilde{V}_2(t) &= \sum_{i=0}^{n} f_i(t) \cdot [V_i(t) + U_i(t)] \\
\tilde{V}_Y(t) &= \sum_{i=0}^{n} f_i(t) \cdot [V_2(t) - U_0(t)]
\end{align*}
\]

- Different travel time distribution through entrances/ exits
- Effect of travel time on travel speed

**Impact of Work**

Provide short-term travel time estimation for real time traffic control and early incident detection.

**Reference**