Smart Personalized Routing in Car Navigation System
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Electrical Engineering/Control Systems

Smart Routing Characteristics
- Estimate real-time flow for all links (traffic data not available for all links)
- Incident detection
- Predict link flows in case of events
- Driver style
- Driver preferences

Structure of the System

Driver Style

Events
On-Road events:
- Accident
- Road closure
- Construction

Off-Road events:
- Sport events
- Concerts

Extreme events:
- Natural disasters
- Terrorist Attack

Driver Style has impact on the travel time estimation and classified into three categories:
- Fast
- Normal
- Slow

Flow Generation Methodology

Initial Estimation
Four-Stage model

Trip Generation
Production of zone i
\[ p(i) = \sum_{j=1}^{n} \beta_j p_j v_j \]
Attraction of zone j
\[ A_j = \sum_{i} v_i A_i \]

Trip Distribution
\[ v_{ij} = a(i,j)p(i)A_j(A_i) \]

Modal Split
- Car
- Bus
- Truck

Traffic Assignment
- Incremental assignment

Off-Line Estimation
Off-Line estimation is based on the historical data as well as the results from initial estimation.

minimize \( f(v) = \alpha_1 \sum_{i=1}^{n} (\theta_i - \theta'_i)^2 + \alpha_2 \sum_{r=1}^{m} c_{r,i} v_{r,i} \)
subject to \( \theta_i \geq 0 \)

\( \theta_i \): Average link flow
\( \theta'_i \): Volume of route i connecting OD
\( c_{r,i} \): Cost of route r connecting OD
\( \alpha_1, \alpha_2 \): Decision variable
\( 0 \leq \alpha_2 \leq \alpha_1 \)

On-Line Estimation
On-Line estimation is based on the off-line estimation and real-time flow.

minimize \( f(v) = \beta_1 \sum_{i=1}^{n} (v_{r,i} - \theta_i)^2 + \beta_2 \sum_{i=1}^{n} (v_{r,i} - \theta'_i)^2 \)

\( v_{r,i} \): Real-time volume of link i
\( v_{r,i} \): Historical volume of link i
\( \theta_i \): Estimated link flow
\( 0 \leq \beta_2 \leq \beta_1 \)

Interfaces

Web-Based

Car Interface

Smart Phone Apps

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