

**Using Dynamic Traffic Assignment Models to
Represent Day-to-day Variability**

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Order of Events

- Brief CV / Plea for briefcase!
- Designing network programmes for 2006, not 1976
- Role of equilibrium solutions
- Impact and modelling of day-to-day variability
- Conclusions

Who am I? A brief CV

- Born in Montreal
- Van Vliet Bros.
- Maths and Physics at McGill
- Physics PhD etc. 1963 to 1970; UK
- Greater London Council 1971 – 1974
- Institute for Transport Studies, University of Leeds 1974 – 2001/2006
- SATURN Assignment Suite: 1976 to date

A new Generation of Dynamic Traffic Models: Two Issues

- Equilibrium or not?
- Variability or not?

Previous Related Papers

- “What happens when it rains?” – MSc dissertation 1980’s
- “Effect of variability in travel demand and supply on urban network evaluation” Willy Mutale, PhD Leeds (1992)
- DRACULA Project, ITS 1992-95 (Dave Watling and Ronghui Liu)

Equilibrium Model Assumptions:

- T_{ij} (or T_{ij}^t) fixed and independent of the day
- Costs uniquely determined by flows and do not vary between days
- All drivers have same rational objectives
- Perfect information
- Same optimum driver decisions every day
- No influence of previous network
- No en-route diversions

Equilibrium (Static) Network Assumptions

- Link travel costs are separable
- Loading is “simultaneous”
- Queuing between time slices ignored
- Time-sliced costs are “instantaneous”
- Link data (capacities etc.) are taken during “neutral” months (October?)

2 Basic Equilibrium Problems:

1. Over-estimate driver abilities to choose “optimum” routes
2. Under-estimate the complexity of traffic conditions

Therefore they give an over-optimistic estimate of network conditions

Conclusions for Dynamic Assignment Models in 2006

- Deterministic “single point solution” equilibrium is less than perfect starting point
- Need to model a **distribution** of possible states, not a single predicted average state

Day-to-day Variability

- Traffic conditions vary from day to day – a lot! Why?
- Differences in O-D demand patterns
- Differences in departure time and/or route choice
- Day of the week
- Holidays
- Seasonal effects (e.g., daylight)
- Weather
- Road works / Incidents
- Information systems

Willy Mutale's PhD

- Run a network assignment using SATURN to equilibrium using “average/neutral” inputs
- Simulate repeated “daily” trials with random selections of:
 - (1) The O-D trip matrix
 - (2) Route choice proportions
 - (3) Link saturation flows etc. both globally (e.g. weather) and locally (incidents)
- Record the distribution of pcu-hrs etc. etc.

Willy Mutale's Results

- Highly skewed distributions of, e.g., total pcu-hrs
- “True” average therefore greater than the mode or median
- A “real-life” study of North Leeds showed an increase of 14% in total travel time.

DRACULA

- Based on a micro-simulation approach to both “demand” and “supply”
- The system evolves “day to day”
- Daily individual driver demands based on previously experienced O-D costs
- Individual daily route and departure time choice based on previous network experience
- Daily network conditions subject to random fluctuations
- Incremental time simulation of all trips

DRACULA Conclusions

- Day-to-day simulations are feasible on “not too big” networks
- Converges to give stable distributions
- Results broadly similar to Mutale’s
- Provides a handle on reliability
- But calibration is a major issue (e.g., car following, lane changing, give ways, etc. etc.)
- An idea ahead of its time?

How to Model Day-to-day Variability using “Simpler” Dynamic Models

- Run the system to “normal” convergence
- Initiate a series of “day-to-day” runs with:
 - (i) T_{ij} chosen from $\text{Nor}(T_{ij}, aT_{ij})$
 - (ii) Route p from multinomial distribution P_{pij}
 - (iii) Global + individual multipliers for link speeds and capacities
 - (iv) Random incidents

Conclusions

- Variability is highly significant
- It may lead to biases in comparing schemes based on different modes
- Modelling using existing dynamic micro-simulation models (e.g., DYNAMEQ) should not be difficult.
- Give it a go!