Dynamic Highway Modelling

A Perspective

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Dynamic Modelling – Position in the Modelling Spectrum

- Conventional ‘Static’ assignment – summed up as:
  - ‘Instantaneous’ loading of trips across the network
  - All-or-Nothing, volume averaging, equilibrium methods
  - Incorporates junction modelling
  - Outputs:
    - (Cost) skim matrices
    - Select link, sub-area cordon analysis
- But:
  - Does not capture the time dependent dynamics in the network
  - Cannot model traffic congestion ‘generators’ satisfactorily
  - Not ‘fit’ for some purposes
### Dynamic Modelling – Position in the Modelling Spectrum

- **Micro-simulation models**
  - Detailed modelling of individual vehicles moving through the network
  - Time dependent dynamics and traffic congestion generators are modelled

- **But:**
  - Linkage with the static model is tenuous/difficult due to different network data requirements
  - Static/Simulation models tend to be viewed as alternatives rather than complementary

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<td>Emme/3; Cube Avenue</td>
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OmniTRANS – Macroscopic Dynamic Assignment

- Data Requirements:
  - Same network structure as used by Static Modelling
    Additional network data requirements limited to:
    - Definition of number of lanes per link (match junction definition)
    - Saturation flows per lane
    - Link free flow and capacity speeds
    - Classification of ‘urban’ and ‘non-urban’ link types
  - Uses same demand matrices as used by Static Modelling
    Some notion of time profiling is required:
    - Either ‘hourly’ matrix is given a flow profile, or
    - Series of matrices by time slice are provided
  - Uses the routing determined by the Static Assignment
    - Is fixed for the modelling period

MaDAM - Features

- Model based on principles of Fluid Mechanics
  - This models the flow of traffic through the network in terms of speed, flow and density
  - Models the conditions on (small) link segments in the network – essentially the density of traffic
- Supports the modelling of:
  - the time dependent dynamics in the network
    - blocking back at junctions
    - propagation of queues along links
    - variable rates of traffic demand
  - the effects of (dynamic) traffic management measures
    - Lane merges and land ‘drops’
    - Ramp metering
    - Speed limit changes
    - Rush hour lanes
MaDAM - Principles

- Number of lanes
- Free-flow speed
- Speed at capacity
- Saturation flow

Speed - flow curve

0 20 40 60 80 100 120

Flow (car-equivalants /h)

0 500 1000 1500 2000 2500

Speed (km/h)

Density - flow curve

0 20 40 60 80 100 120

Density (car-equivalants /km)

Speed (Flow, Density): recalculated every n seconds (where n is typically 1)

MaDAM - Principles

‘Non Urban’ Links

Lane Merges

Lane Drops

Extra term added to the speed equation
MaDAM - Principles

Urban Links

MaDAM – The Ins and Outs of Time

inputs

time

modelling time

output time units (mins)

Calculations are done per modelling time unit, typically 1 second, per link segment.

Outputs are aggregated into user defined time blocks for analysis.

network loads
network costs
network skims
link densities
link ‘service quality’

Analysis by time slice
An Example – St Helier Jersey
Summary

• Relatively easy to progress from the ‘static’ to ‘dynamic’ world
• Provides a more detailed understanding of what is happening in a network
• Gives more accurate network costs
• Considerably cheaper than building a micro-simulation model
• Of more use for ‘operational’ investigations?
• How does it fit into our analytical mindset?
  – Can the more detailed outputs can be used in the ‘conventional’ static analytical environment?