Workshop on Integrating Demand and Supply Travel Models

Overview

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TRB Workshop 168, Washington, D.C.
01-21-2007

Background

- Methodological advances (meso, micro, simulation)
  - demand models (activity, travel choice)
  - supply models (network loading, flow propagation)

Integration ignored or at best cursory!

- typically, “ad hoc” approach using input-output linkage across models (implicit, opaque)
- lacks true integration (interactions and emergent effects masked, consistency issues arise)

There is an increasing realization that:

- there is a disconnect between theory and reality
- adequately addressing recent application domains necessitates explicit integration
- the full capabilities of modeling sophistication cannot be harnessed unless formal integration

Background (contd.)

- Application domains
  - land-use planning (long-term)
  - route guidance (near-term)
  - toll pricing (near-term)
  - airline operations (near- to medium-term)

Integration essential for fidelity!

Context to Illustrate Issues/Aspects

- Real-time integrated corridor management under information provision to drivers

Issues/Aspects

- Interactions
- Timescales
- System State
- Stochasticity
- Data
- Methods

Interactions

- “Routing” network models typically focus on modeling traffic flow dynamics robustly and determining assignment strategies; restrictive behavior assumptions
- Stand-alone “route choice” models do not consider network interactions and dynamics; travel time primary linkage
- “Loosely coupled” integrated models view integration mostly as an “input-output” relationship
- In reality, parametric dependency exists; added complexity due to multiple timescales

Timescales

- Multiple timescales exist for demand (behavior) and supply (network)
  - Demand: short-term (within day) and long-term (day-to-day; emergent behavior)
  - Supply: short-term (ambient conditions) and long-term (systems effects)
- Timescales may be different; pose challenges for coupling while modeling
  - Traffic flow (different granularity levels)
  - Network (different timescales)
  - Behavior (different timescales)
  - Field deployment (objective; framework)

Timescales (contd.)

- Order of magnitude of difference in timescales
  - Timescales across demand and supply are close
  - Timescales across demand and supply are significantly different

System State

- A key consequence of explicit integration is that the notion of “equilibrium” may not be as meaningful under some timescales
- May need to focus on “transience”

  - heterogeneity in driver response behavior to information (under explicit integration) leads to disequilibrium states

  - traditional DTA models (that ignore this integration) focus on equilibrium solutions irrespective of whether they represent reality

Stochasticity

- Several potential sources of randomness
  - Demand: prediction, path prediction (behavior), driver characteristics, driver behavior characteristics, noise
  - Supply: incidents, path prediction (time-dependent network conditions), parameters (traffic, system), noise
- Intertwined
- Difficult to separate effects: issues of observability

Data

- Significant needs
  - Vacuum or limited availability
  - Need data tracked over time
- Technology
  - Science not a significant barrier
  - Deployment issues (cost, network-wide sensors, individual vehicle sensors, support infrastructure, systems integration)
  - Other issues (privacy, legal)

Methods

- Type
  - Analytical (limited scope efforts)
  - Simulation (more flexibility and applicability)
  - Hybrid (simulation + analytical components)

- Desirable characteristics
  - Modular
  - Seamless across timescales
  - Sensitive to data availability
  - Robust under available data

- Context
  - Real-time deployment (consistency-checking, update parameters across different timescales)
  - Planning (update parameters across different timescales)