Introduction

Limitations of static network equilibrium models have led to a number of research efforts in the prediction of temporal and spatial traffic conditions of road networks

- Dynamic nature of traffic can be depicted through Dynamic User Optimal (DUO): each driver determines their best route based on prevailing traffic conditions.
- This work focuses on extending DUO to DUO with recourse (DUOR) where a user can also alter their journey en route depending on the traffic conditions.

Motivation: depicting more realistic behaviour in traffic modelling...

- A road user’s route choice is adaptive and dependent on the traffic state of the current route and the perceived states of the alternative routes available between an origin and destination.
- Sources of information affect the decision making of a user.

Traditional network models cannot account for all these aspects of users’ behaviour dynamically.

Dynamic User Optimal with Recourse

Assumptions

- Based on concepts of User Equilibrium with Recourse (UER) (Unnikrishnan and Waller, 2009).
- Networks experience multiple states ($S_\alpha$) portraying different traffic conditions/costs ($C(S_\alpha)$) experienced by each individual.
- Information sources reveal the state of the network.
- Each state has a known probability of occurring ($Pr(S_\alpha)$)
- For every state of a network, each individual will have a specific path. An individual will construct a routing policy of paths to traverse the network for all states considered.

Each user has an expected cost of travel:

$$E (C) = \sum_{i=1}^{n} Pr(S_\alpha) C(S_\alpha)$$

Objective

Minimise: $E (C) = \sum_{i=1}^{n} Pr(S_\alpha) C(S_\alpha)$

When a user is unable to switch to an alternative policy to reduce their expected travel cost, equilibrium is achieved.

Results and Discussion

The DUOR modelling framework was demonstrated using a hypothetical two path network.

- In state 2, B suffers a disruption/restricting capacity.
- Users gain information of the state of the network at node 2.

DUOR-CTM Framework

- CTM provides travel costs for each vehicle in every state.
- Iterative Simulation Approach: Simulate feasible policy combinations and check for equilibrium conditions.

- “With information” and “No Information” (expected DUO solution with no ability to re-route) scenarios tested.
- Multiple DUOR solutions present for each scenario tested, path based user optimal approach results in non-uniqueness which is not uncommon (He et al., 2010).
- Expected Total System Travel Time (ETSTT) reduces with the presence of information.

Conclusions and Future Work

- This study proposes a modelling framework, Dynamic User Optimal with Recourse using a Cell Transmission Model (DUOR-CTM). Determines a path-based dynamic user optimal with recourse (DUOR) solution for a single origin destination pair.
- Demonstration of the model indicates the presence of multiple DUOR solutions and information provision improves the ETSTT under lower levels of congestion.
- Implications arise for the decision to implement ITS systems.
- Future work will involve reducing computational burden and larger scale application of the model.

References
