NOVEL DYNAMIC USER EQUILIBRIUM MODELS: ANALYTICAL FORMULATIONS, MULTI-DIMENSIONAL CHOICE, AND AN EFFICIENT ALGORITHM

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ABSTRACT

Traffic assignment is a core problem in transportation modeling. Given a transportation network and origin-destination trip demands, the traffic assignment problem requires determining link flows, and in some cases path flows. The traffic assignment problem considering time varying flows is referred to as Dynamic traffic assignment (DTA) problem peet01, peet94. Existing DTA models a) do not universally solve general networks, b) are characterized by ill-behaved system properties particularly arising from the need to model traffic flow and individual behavior realistically, or c) lack theoretical guarantee of properties such as existence, uniqueness, and stability.

The overall goal of the dissertation is toward addressing two critical issues in dynamic user equilibrium literature. First is to develop analytical models that provide strong mathematical properties without compromising on traffic flow dynamics realism. Second is to develop an efficient solution algorithm for DUE problem considering multiple choice dimensions.

Specifically, in this dissertation:

- Analytical dynamic traffic equilibrium formulations with point-queue models allowing for general heterogeneity assumptions are developed; solution uniqueness is proved and insights obtained from specific numerical examples.

- The analytical formulation is extended to a more realistic traffic flow model - the cell-transmission model - and its theoretical properties are studied.

- An operational framework, referred to as Activity-Travel Networks, that allows multi-dimensional choice making within a network equilibrium framework is developed.

- A novel dynamic traffic assignment algorithm, referred to as Algorithm B-Dynamic, that efficiently solves for DUE considering multi-dimensional choice in Activity-Travel networks is constructed.